2014 GROUNDWATER AND SURFACE WATER CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY

Prepared for:

Montana Environmental Trust Group, LLC
Trustee of the Montana Environmental Custodial Trust
P.O. Box 1230
East Helena, MT 59635

Prepared by:

Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, MT 59601

July 2014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF EXHIBITS

2014 GROUNDWATER AND SURFACE WATER CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY

1.0 INTRODUCTION

This Corrective Action Monitoring Plan (CAMP) summarizes the groundwater and surface water monitoring activities to be conducted in 2014 at the East Helena Facility (the Facility). The CAMP represents an update to the most recent water resources monitoring plan, the 2013 Field Sampling and Analysis Plan (FSAP) (Hydrometrics, 2013). The overall objective of the 2014 CAMP is to provide for collection of adequate and appropriate groundwater and surface water monitoring data to support Corrective Measures Study remedy evaluations and allow ongoing evaluation of the effectiveness of groundwater remedies (Interim Measures or IMs) implemented to date at the Facility. The IMs have been developed to reduce offsite migration of groundwater contaminants (primarily arsenic and selenium). The 2014 CAMP also provides for continued monitoring of residential/water supply wells within the City of East Helena, near Lamping Field, and north of the Facility near Canyon Ferry Road, in order to ensure protection of groundwater users (nearby residents) and to support planning for a proposed Controlled Groundwater Area (CGWA).

The 2014 data collection program has been developed to support the following project activities:

- Completion of Corrective Measures Study (CMS) remedy evaluations, including the assessment of additional IMs and/or other final corrective measures (CMs);
- Refinement of the Facility numerical groundwater flow model and development of a contaminant fate and transport model;
- Planning and design of additional IMs and/or CMs;

- Assessment of ongoing groundwater responses to all IMs performed to date, including installation of slurry walls in the former acid plant sediment drying (APSD) area and the Speiss-Dross area; and
- Periodic updates to the groundwater conceptual site model (CSM) for the Facility.

The 2014 CAMP is a streamlined document intended as a practical guide to conducting Facility-related groundwater and surface water monitoring activities; therefore, it identifies monitoring objectives and describes the number, type, and location of samples to be collected as well as the sampling and analytical methodologies to be employed. The monitoring activities described in this plan are focused on providing comprehensive synoptic groundwater and surface water quality data, groundwater and surface water elevation measurements, and streamflow data targeting specific project objectives (see Section 1.2).

As analysis and implementation of IMs and other potential remedial actions continues at the East Helena Facility in 2014, it is likely that monitoring needs will change, and supplemental modifications to this CAMP may be necessary. Modifications describing additional monitoring to be conducted at the Facility will be documented in focused work plans issued as addenda to this CAMP.

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, 2011a), and the Data Management Plan (DMP) for Environmental Data Collection Activities (Hydrometrics, 2011b). 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.

The 2014 groundwater and surface water CAMP is structured as follows:

- Section 1.0 – Introduction;
- Section 2.0 – Sampling Locations and Frequency;

- Section 3.0 – Sampling Methodologies;
- Section 4.0 – Sample Handling and Documentation;
- Section 5.0 – Laboratory Analytical Procedures and Reporting;
- Section 6.0 – Interim and Corrective Measure Effectiveness Evaluation; and
- Section 7.0 – References.

1.1 PROJECT BACKGROUND

The East Helena Facility is identified in the First Modification as all former ASARCO properties, and includes the former smelter site. The former smelter site covers approximately 142 acres, is located primarily on the Prickly Pear Creek alluvial plain, and is bounded to the south by Upper Lake and Lower Lake, to the east and northeast by Prickly Pear Creek, and to the west and southwest by uplands or foothills comprised of tertiary-age sediments. The former smelter site is bordered on the north by State Highway 12 and the American Chemet plant (a manufacturer and marketer of metals-based chemicals), with the business district and residential areas in the City of East Helena located a short distance to the north (Figure 1-1).

The East Helena Facility was added to the National Priorities List in September 1984, pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in order to address contamination due to releases of hazardous constituents to environmental media from more than a century of lead smelting and associated activities. The U.S. Environmental Protection Agency (EPA) initiated a transfer of responsibility for ongoing remedial activities at the Facility from its CERCLA program to its Corrective Action program under the Resource Conservation and Recovery Act (RCRA) in 1997. In May 1998, Asarco and EPA entered into a Consent Decree (CD) to further the objectives of RCRA and the Clean Water Act (CWA) (U.S. District Court, 1998).

The Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust (Custodial Trust) was established on December 9, 2009, as part of the larger Asarco bankruptcy settlement agreement approved by the Bankruptcy Court and U.S. Federal District Court. The Custodial Trust is performing RCRA Corrective Actions at the Facility, pursuant to the First Modification to the 1998 Resource Conservation and Recovery Act (RCRA) Consent Decree (First Modification, 2012) under the oversight of the US Environmental Protection Agency (EPA).

1.2 2014 MONITORING PROGRAM OBJECTIVES

The 2014 East Helena groundwater and surface water monitoring program has been developed to address the primary objective of obtaining the information necessary to evaluate the groundwater response to and effectiveness of interim and other remedial measures implemented at the Facility. Recently published EPA guidance on groundwater remediation completion strategies (EPA, 2014) includes a discussion of recommended remedy evaluation (i.e., effectiveness monitoring) questions that should be addressed by a site monitoring program. Among the applicable questions regarding the performance of IMs implemented to date by the East Helena cleanup project, as well as the adequacy of the conceptual site model (CSM), are the following:

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

Information and evaluations used address these questions will include trend analysis (visual and/or quantitative statistical analysis), along with estimates of the rates of reduction of contaminant volumes and/or mass (EPA, 2014). For inorganic contaminants such as arsenic and selenium that do not degrade, rates of reduction in volume/mass will also be quantified as reductions in contaminant flux and/or reductions in the lateral and vertical extent of contaminant plume water quality standard exceedances.

Therefore, to support remedy (IM) effectiveness monitoring at the East Helena Facility, the following specific objectives have been established:

1. Document and track contaminant plume extent, groundwater chemistry, and groundwater flow responses to IMs implemented to date:
   a. in historic and current source areas, at locations within and adjacent to areas of historic impacts or releases;
   b. in downgradient areas, at locations in the City of East Helena, Lamping Field, and further north along the verified extent of the downgradient plumes;
2. Continue monitoring overall arsenic and selenium plume stability, in terms of the overall geographic extent of water quality standard exceedances as well as the extent and magnitude of the areas of highest concentration (source areas);
3. Provide ongoing data on residential/public water supply well water quality in the area of former smelter site impacts, to provide protection of water users and to aid in the planning and development of a Controlled Groundwater Area (the East Valley CGWA);
4. Monitor groundwater quality in the Phase I and II CAMU area; and
5. Assess general groundwater chemistry and arsenic concentrations in the "West Arsenic Area" to further refine understanding of water quality standard exceedances in this area, in support of the East Valley CGWA petition and implementation process.

As noted above, the 2014 CAMP data will also support additional project activities, including development of a groundwater contaminant fate and transport model, planning and design of additional IMs and/or corrective measures (CMs), assessment of ongoing groundwater responses to past remedial actions, and periodic updates to the groundwater conceptual site model (CSM) for the Facility.

2.0 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. Details on sampling methodologies, sample handling, and analytical requirements are presented in Sections 3, 4, and 5, respectively. The 2014 CAMP will be implemented in accordance with the QAPP and DMP prepared for the East Helena Facility (Hydrometrics, 2011a and 2011b).

The 2014 groundwater monitoring well network includes a subset of monitoring wells installed on the former smelter site (also referred to as “on-site”), as well as monitoring and residential, private, and water supply wells in areas upgradient and downgradient of the former smelter (also referred to as “off-site”). On-site sampling locations include selected wells located near identified contaminant sources (i.e., where plant activities were historically conducted) and along historically identified plume migration routes. Off-site sampling locations include monitoring wells located in East Helena, in Lamping Field (west of East Helena), and on Burnham and Helena Sand and Gravel property northwest of East Helena, along with selected private wells located south, west, and north of the Facility.

Monitoring well locations were selected to spatially represent various groundwater concentrations and flow directions (e.g., downgradient, cross-gradient) adjacent to features of interest (e.g., CAMU, slurry walls), to monitor groundwater conditions in specific areas within and downgradient of the Facility (e.g., west and east selenium “hot spots,” historic and potential current source areas, selenium plume axis, leading edges of groundwater arsenic and selenium plumes). The selected 2014 monitoring well locations are shown on Exhibit 1. Residential and water supply well locations selected for monitoring in 2014 are shown on Exhibit 2. Monitoring and private wells selected to address specific project objectives are discussed in Section 2.1.

Surface water monitoring locations were selected to represent Lower Lake, Prickly Pear Creek, gravel pit ponds near Prickly Pear Creek, and drainage through the former area of

Upper Lake and from the Upper Lake marsh. Surface water monitoring locations selected for 2014 are shown on Figure 2-1. Surface water monitoring locations selected to address specific project objectives are discussed in Section 2.2.

Similar to the FSAP monitoring programs implemented in previous years, the selected 2014 sampling locations and monitoring schedule are intended to provide data to evaluate groundwater and surface water flow and water quality characteristics under dynamic conditions (including high spring surface water runoff, seasonally high groundwater levels, etc.) and during dry weather conditions (i.e., low streamflow, potential high evapotranspiration, seasonally low groundwater levels). While the overall monitoring objectives for the 2014 program noted in Section 1.2 above are somewhat different from those outlined in the 2011, 2012, and 2013 FSAP monitoring programs, with a current emphasis on obtaining data to support remedy identification and performance evaluation, the overall scope of monitoring remains similar: seasonal monitoring at an extensive set of groundwater and surface water locations with sufficient spatial distribution to comprehensively evaluate groundwater quality trends and plume geometry changes.

An overall summary schedule for the 2014 East Helena Facility groundwater and surface water monitoring is shown in Table 2-1. Table 2-1 presents the monthly schedule for various groundwater and surface water monitoring activities, along with the monitoring objectives (see Section 1.2) addressed by each activity. As outlined in Table 2-1, groundwater quality sampling for 2014 at selected monitoring wells has been separated into monthly monitoring events (at a small number of wells), an early season monitoring event in April 2014 (at a larger number of wells), and semiannual monitoring events (involving the largest number of wells). Residential and public water supply well monitoring in 2014 will consist of semiannual monitoring at selected wells. Sitewide groundwater level monitoring will be conducted on a monthly basis from March through November, supplemented by surface water elevation measurements from June through November, to allow assessment of potential groundwater/surface water interactions at various points along the seasonal hydrograph. Streamflow measurements and surface water quality sampling will be conducted on a semiannual basis during high flow (June) and low flow (September or October) conditions.

Specific sites selected for monitoring in 2014 are discussed in the following sections for groundwater (Section 2.1) and surface water (Section 2.2), along with established monitoring frequencies and reference to the monitoring objectives (Section 1.2) addressed by each monitoring task.

2.1 GROUNDWATER MONITORING

Specific wells selected for the 2014 groundwater monitoring program for the East Helena Facility, and the monitoring frequencies assigned to each well, are summarized in Tables 2-2 (monitoring wells) and 2-3 (residential and water supply wells). For the monitoring wells scheduled for groundwater quality sampling, Table 2-2 also presents a well-by-well summary of the primary purpose for including each well in the monitoring program, although the majority of the wells sampled will address more than one monitoring objective. The schedule table indicates the total number of wells addressing each of the monitoring program objectives outlined in Section 1.2; as shown in Table 2-2, the number of wells selected to primarily address each of the program objectives includes:

- Source Area Effectiveness Monitoring (IM Response): 48 wells;
- Downgradient Effectiveness Monitoring (IM Response): 44 wells;
- Plume Stability (Arsenic and Selenium Plumes): 30 wells;
- CAMU Area Groundwater Quality: 8 wells; and
- West Arsenic Area Groundwater Quality: 16 wells.

Note that the residential/private well monitoring program (Section 2.1.5 below) will address Objective (4) in Section 1.2, protection of local groundwater users and support for planning and implementation of a Controlled Groundwater Area.

2.1.1 Monthly Monitoring Well Sampling

Based on continued elevated selenium and arsenic concentrations in groundwater in certain portions of the former smelter site and in downgradient areas, thirteen wells have been selected for monthly sampling events in 2014 (Table 2-2). Events are scheduled to occur in June, July, August, September or October, and November 2014, with the June and

September/October events coinciding with the semiannual monitoring events discussed in Section 2.1.3. The monthly sampling is intended to closely track water quality responses in source areas and the near downgradient area, in order to evaluate the effectiveness of recent and 2014 planned IMs through assessment of water quality trends and changes in plume geometry (Objectives 1a, 1b, and 2 in Section 1.2 and Table 2-1). The monthly monitoring data will also be used to evaluate additional IMs and/or CMs in key source areas, if necessary.

The wells selected for monthly monitoring are listed in Table 2-2 and shown on Exhibit 1. Groundwater quality sampling will be performed in accordance with applicable SOPs summarized in Sections 3 and 4 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, dissolved metals, and selenium speciation as described in Section 5. Groundwater sampling and water level measurement activities will be performed in the shortest time period practical to provide a synoptic snapshot of hydrogeologic conditions.

2.1.2 Early Season Monitoring Well Sampling

Early season monitoring will be done to monitor stability of both the arsenic and selenium plumes (Objective 2 in Section 1.2 and Table 2-1), and to evaluate sitewide and downgradient responses to recent IMs (Objectives 1a and 1b); and to further investigate potential arsenic loading sources in the "West Arsenic Area" located west of the former smelter site (Objective 5).

Wells selected for early season monitoring in 2014 at the East Helena Facility include:

- Recently installed wells with relatively limited existing data sets, selected to expand the groundwater quality database, to determine seasonal variability, and to allow for evaluation of temporal trends;
- Selected wells along the selenium plume axis and boundaries from the plant site to Canyon Ferry Road;

- Plant site wells in key areas that define arsenic and selenium source areas and migration paths;
- Selected wells that have shown water level and water quality responses to current IMs;
- Selected wells located within and adjacent to the APSD and Speiss-Dross areas; and
- Wells to the west of the former smelter that have previously shown elevated arsenic concentrations, at least partly due to sources other than impacts from the plant site.

The wells selected for early season (April 2014) monitoring are summarized in Table 2-2 and shown on Exhibit 1. A total of 80 wells are included in the April 2014 groundwater monitoring event.

Groundwater quality sampling will be performed in accordance with applicable SOPs summarized in Sections 3 and 4. Field parameters and static water levels will be recorded when water samples are collected. Samples will be analyzed for common ions and dissolved metals as described in Section 5. Groundwater sampling and water level measurement activities will be performed in the shortest time period practical to provide a synoptic snapshot of hydrogeologic conditions.

2.1.3 Semiannual Monitoring Well Sampling

In addition to the wells sampled during the early season April 2014 monitoring event and those scheduled for monthly monitoring, a comprehensive set of monitoring wells has been scheduled for semiannual sampling in 2014. The objectives of the semiannual monitoring are outlined in Section 1.2 and in Table 2-1; in general, the semiannual monitoring is intended provide information to monitor IM effectiveness in source areas and downgradient, evaluate water quality trends and plume stability, provide protection of groundwater users, monitor CAMU area groundwater quality, and continue the evaluation of West Arsenic Area groundwater chemistry. The wells that have been identified for sampling only during the semiannual event are generally those for which: (1) extensive datasets have already been obtained through historic monitoring, and/or; (2) well locations are further away from key areas (plume sources, axes, or boundaries). For these wells, semiannual monitoring has been deemed sufficient to achieve the stated objectives when combined with the monthly and early season monitoring programs.

The wells selected for semiannual monitoring in 2014 are listed in Table 2-2 and shown on Exhibit 1. A total of 142 wells are scheduled for semiannual monitoring in June and September/October 2014. Groundwater quality sampling will be performed in accordance with applicable SOPs summarized in Sections 3 and 4. Field parameters and static water levels will be recorded when water samples are collected. Samples will be analyzed for common ions and dissolved metals as described in Section 5. Groundwater sampling and water level measurement activities will be performed in the shortest time period practical to provide a synoptic snapshot of hydrogeologic conditions.

2.1.4 Sitewide Water Level Monitoring

An extensive suite of monitoring wells and piezometers (217) has been selected for measurement of groundwater levels in 2014 (Table 2-2). Measurement locations are shown on Exhibit 1. Water level data from these wells will be used in combination with surface water flow and elevation data to further evaluate groundwater/surface water interactions on a seasonal basis, to provide additional data to support development of the groundwater flow and transport model, and to assess the potential impact of seasonal variability in flow direction and surface water gain/loss on contaminant plume geometry. 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 2.1.5.

Water level monitoring will be performed monthly between March and November 2014 (Table 2-2), to capture the effects of potentially dynamic conditions (e.g., spring melt, wet season, and initiation of flow in irrigation ditches and canals). Manual measurements will be obtained at all locations. Transducers may be installed in selected locations to obtain continuous water level measurements.

Water level measurements will be obtained in accordance with applicable SOPs summarized in Sections 3 and 4. During those months when comprehensive groundwater quality sampling is scheduled (April, June, September/October 2014), a complete round of water level measurements will be obtained prior to initiation of the sampling event. To the extent feasible, sitewide water level monitoring events will be conducted in coordination with the surface water elevation and flow measurement monitoring events described in Section 2.2, in order to provide a complete representation of groundwater and surface water elevations across the project area.

2.1.5 Semiannual Private Well Monitoring

Residential and public water supply wells were selected for the 2014 groundwater monitoring program to ensure protection of groundwater users (i.e., nearby residents) and to support the planning and implementation of a Controlled Groundwater Area (see Section 1.2 and Table 2-1).

The residential water supply locations selected for 2014 semiannual water quality sampling are listed in Table 2-3, and shown on Exhibit 2. Monitoring will be performed at 19 wells on a semiannual basis (June and September/October 2014), and at 18 additional wells (37 wells total) in September/October 2014 (see Table 2-3). The 18 additional wells scheduled for sampling in September/October 2014 were not sampled in 2013, and although many of these wells have been sampled in the past, their current condition is unknown. These 18 wells are being added to the 2014 CAMP monitoring program in support of the Controlled Groundwater Area petition and implementation effort, and to further ensure protection of groundwater users. Since the current condition of the wells is not known, the actual number of wells sampled may be lower than planned, subject to the results of well owner interviews, as some wells may be inactive, abandoned, or otherwise unavailable for sampling. Groundwater sampling and water level measurement activities will be performed in the shortest time period practical to provide a synoptic snapshot of hydrogeologic conditions.

Residential and public water supply well sampling will be performed in accordance with the standard operating procedures (SOPs) summarized in Sections 3 and 4. Field parameters (pH, specific conductance, temperature, dissolved oxygen, turbidity, and oxidation/reduction potential [ORP]) and static water levels (if access permits) will be recorded when water samples are collected. Samples for analytical testing will be submitted to the laboratory for analysis of physical parameters, common ions, and total and dissolved metals as described in Section 5.

2.2 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 2-4 and shown on Figure 2-1.

The 2014 surface water monitoring program has been designed to achieve the following objectives (see Section 1.3 and Table 2-1):

- Evaluate flow and surface water quality responses to recent (2011-2013) and 2013 IMs; and
- Assess whether recharge from surface water features affects the direction or rate of groundwater plume migration.

2.2.1 Elevation Monitoring

Surface water elevation measurements will be collected concurrently with sitewide groundwater level monitoring, from June through November 2014 (Table 2-4). Monthly monitoring is intended capture potentially dynamic conditions (e.g., spring melt, wet season, initiation of flow in irrigation ditches and canals). Water elevation measurements at stream, ditch, and pond locations will be obtained using a survey-grade global positioning system (GPS) instrument. Sites selected for elevation monitoring (20 sites) are listed in Table 2-4 and shown on Figure 2-1.

2.2.2 Surface Water Flow and Water Quality Sampling

Surface water flow measurements and water quality monitoring for 2014 at the East Helena Facility will be conducted during high flow (June) and near baseflow (September/October) conditions. Locations selected for flow measurement (11 sites) and water quality sampling (11 sites) are listed in Table 2-4 and shown on Figure 2-1. The timing of the surface water quality monitoring events will be coordinated 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 3.2.1. Surface water quality sampling on flowing water bodies with more than one sampling location (Prickly Pear Creek) will be conducted in a synoptic fashion. Sites will be sampled and streamflows measured from downstream to upstream in a single day, to provide information on streamflow gains and losses and in-stream parameter loading trends across various stream reaches, while minimizing the possibility of temporal variability. Samples from ponds and flowing water bodies with only one sampling location may be collected in any order.

The surface water quality sampling and flow measurements will be performed in accordance with applicable SOPs summarized in Sections 3 and 4. 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 5.

3.0 SAMPLING METHODOLOGIES

Groundwater and surface water sampling activities described in the 2014 CAMP will be conducted in accordance with the procedures described in the 2011, 2012, and 2013 FSAPs (METG, 2011; Hydrometrics, 2012 and 2013), and consistent with the East Helena Facility QAPP (Hydrometrics, 2011a). Standard Operating Procedures (SOPs) for planned and anticipated field activities are listed in Table 3-1. The sampling methodologies outlined below for groundwater (Section 3.1) and surface water (Section 3.2) are based on the 2013 FSAP methodologies, which were derived from the SOPs and the QAPP. Collection of field quality control (QC) samples for groundwater and surface water is discussed in Section 3.3.

3.1 GROUNDWATER MONITORING

Groundwater samples will be collected from both monitoring wells and private (residential or water supply) wells in 2014. Procedures for collection of samples at these two types of wells differ, since private wells typically have dedicated pumps installed, and are pumped frequently in comparison to monitoring wells. Collection of samples from monitoring wells (Section 3.1.1) and private wells (Section 3.1.2) are discussed separately below.

3.1.1 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.

3.1.1.1 <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).

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

In general, groundwater sampling will proceed in order from "clean" wells (with lower concentrations of constituents of concern), to "dirty" wells 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 most monitoring wells, and a 12-volt submersible pump will be used to purge and sample these monitoring wells. For some deeper wells, a non-dedicated submersible pump and tubing system capable of greater pumping depths (e.g., 2-inch Grundfos pump) will be utilized. 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 should 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 should 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. All purge water will be containerized and routed to the Facility water treatment system for 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.

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 1999). 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 2014 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 will be filtered through a 0.45-micrometer (µm) filter before preservation. Samples for common constituent analyses 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 approximately 4±2°C during transport. Water quality sample container and preservation requirements are specified in the project QAPP (Hydrometrics, 2011a) and in Table 3-2.

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, 12-volt sampling pump and short piece of discharge line used to connect to the dedicated well tubing, Grundfos 2-inch 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 3.3, the East Helena Facility QAPP, and SOPs.

3.1.3 Private Well Samples

Collection of water samples from private 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/private well monitoring was developed for 2011 FSAP monitoring (METG, 2011). This document (METG-SOP-001) is included in Table 3-1 and in Appendix A, and should be consulted as the guide for conducting private well sampling as part of this 2014 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 private 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 3-2. Following sample collection, samples will be preserved as appropriate, and stored on ice in coolers at approximately 4±2°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, and a completed "Private Well Water Sampling Notice" will be left at the door or other convenient location (see METG-SOP-001).

3.2 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.

3.2.1 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 feet) and elevations in feet above mean sea level (AMSL).

3.2.2 Streamflow Measurement

Surface water flow measurements at flowing water sites will be collected using a Marsh-McBirney current meter and wading rod (area-velocity method) or equivalent equipment following the appropriate project SOPs (see Table 3-1). If measurement conditions are unsafe because of high flows, the field sampling team will estimate the flow. Stage measurements (water surface elevations) also will be recorded at sites equipped with staff gages, or by measurement from established survey points.

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 six-tenths of the total subsection depth, or at two-tenths and eight-tenths if the water depth exceeds 2.5 feet. 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.

3.2.3 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. Water quality sample container and preservation requirements for surface water sites are specified in the project QAPP (Hydrometrics, 2011a) and in Table 3-2.

Samples will be preserved as appropriate for the intended analysis (e.g., place samples for metals analysis in precleaned and prepreserved laboratory supplied containers containing nitric acid to acidify the sample to a pH < 2), and stored on ice in coolers at approximately 4±2°C for transport. Note that surface water samples will be analyzed for total recoverable metals concentrations (unfiltered samples).

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.

3.3 FIELD QUALITY CONTROL SAMPLES

Field QC samples will be collected and analyzed as part of the 2014 groundwater and surface water monitoring programs and in accordance with the project quality assurance program. Details for collection and submittal of quality assurance and quality control samples are also discussed in the QAPP (Hydrometrics, 2011a).

Required field QC sample types and frequencies for the 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 private wells).

- Field duplicate samples (groundwater and surface water sampling, including both monitoring and private wells).

3.3.1 Field Blanks (Rinsate Blanks and DI Blanks)

Equipment rinsate blanks consist of 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 surface water samples will be collected at a frequency of one per twenty samples (1/20) or one per day, whichever is greater. DI blanks for private/residential well groundwater samples will be collected at a frequency of one per twenty samples (1/20) over the course of the complete private well 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, 2011a).

3.3.2 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 samples 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 groundwater samples and surface water samples will be collected at a minimum frequency of one per twenty (1/20) or one per day, whichever is greater. Field duplicates for private/residential well groundwater samples will be collected at a frequency of one per twenty samples (1/20) over the course of the complete private well 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, 2011a).

4.0 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 approximately 4±2°C. The SOPs for sample labeling, documentation, and chain-of-custody procedures are listed in Table 3-1, and discussed further in the project QAPP (Hydrometrics, 2011a).

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., 1406 for June 2014), and XXX is a three-digit code that is incremented sequentially for each successive sample.

5.0 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 3 above, and in the applicable SOPs (see Table 3-1). All laboratory analysis will be fully documented and conducted in accordance with EPA-approved and/or industry standard analytical methods.

5.1 GROUNDWATER ANALYSES

Required parameters, analytical methods, and project-required detection limits (PRDLs) for 2014 groundwater quality samples collected at the Facility are shown in Table 5-1. 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 suite of wells selected for monthly monitoring will also be analyzed for arsenic and selenium speciation.

The PRDLs for individual parameters have been set at concentrations normally achievable by routine analytical testing in the absence of unusual matrix interference (laboratory's practical quantitation limit). These limits will support project objectives for contaminant plume characterization, comparison with regulatory standards, and risk assessment. 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.

5.2 SURFACE WATER ANALYSES

Required parameters, analytical methods, and project-required detection limits for surface water quality samples collected at the Facility are shown in Table 5-2. 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 (laboratory's practical quantitation limit). These limits will support project objectives for ongoing trend analysis, evaluation of groundwater/surface water interactions, comparison with regulatory standards, and risk assessment; 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.

5.3 DATA REVIEW AND REPORTING

Procedures for data review, validation, and reporting are presented and discussed in the Site QAPP (Hydrometrics, 2011a) and in the DMP (Hydrometrics, 2011b), 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, 2011b). Both of these checklists will be completed for each monitoring event conducted during 2014.

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 FSAP and the project QAPP (Hydrometrics, 2011a). 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, 2011b).

6.0 REFERENCES

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

EPA, 2014. 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.

Hydrometrics, Inc., 2011a. Quality Assurance Project Plan for Environmental Data Collection Activities, East Helena Facility (Draft). Prepared for Montana Environmental Trust Group, LLC. Revised August 2011.

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

Hydrometrics, Inc., 2012. 2012 Groundwater and Surface Water Field Sampling and Analysis Plan, East Helena Facility – Draft. Prepared for Montana Environmental Trust Group, LLC. April 2012.

Hydrometrics, Inc., 2013. 2013 Groundwater and Surface Water Field Sampling and Analysis Plan, East Helena Facility – Draft. Prepared for Montana Environmental Trust Group, LLC. April 2012.

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

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/.)

US District Court, 1998. RCRA Consent Decree, Civil Action No. CV 98-3-H-CCL. United States District Court for the District of Montana. Lodged version: January 23, 1998.

USGS, 1999. Techniques of Water Resources Investigations, Book 9 – Handbook for Water Resources Investigations, National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples. September 1999.

TABLES

Table 2-1. East Helena Facility 2014 Water Resources Monitoring Schedule and Objectives

<table>
<tr><th colspan="2"></th><th colspan="5">Groundwater Monitoring Activity</th><th colspan="3">Surface Water Monitoring Activity</th></tr>
<tr><th colspan="2">Month</th><th>Semiannual Private Well Monitoring</th><th>Early Season Monitoring Well Sampling Event</th><th>Monthly Monitoring Well Sampling Event</th><th>Semiannual Monitoring Well Sampling Event</th><th>Sitewide Water Level Monitoring</th><th>Elevation Monitoring</th><th>Flow Monitoring</th><th>Surface Water Quality Monitoring</th></tr>
<tr><td colspan="2">March</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">April</td><td></td><td>X</td><td>X</td><td></td><td>X</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">May</td><td></td><td></td><td>X</td><td></td><td>X</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">June</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">July</td><td></td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td colspan="2">August</td><td></td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td colspan="2">September</td><td rowspan="2">X(1)</td><td></td><td>X</td><td rowspan="2">X(1)</td><td>X</td><td>X</td><td rowspan="2">X(1)</td><td rowspan="2">X(1)</td></tr>
<tr><td colspan="2">October</td><td></td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">November</td><td></td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td rowspan="8">Monitoring Objectives Addressed (see CAMP Section 1.2)</td><td>1. Document/Track Water Chemistry/Flow Response to IMs</td><td colspan="8"></td></tr>
<tr><td>1(a). Source Area Response/Effectiveness</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>1(b). Downgradient Response/Effectiveness</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>2. Monitor Plume Stability</td><td></td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>3. Ensure Protection of Groundwater Users/Support CGWA</td><td>X</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4. Monitor CAMU Area Water Quality</td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>5. Investigate West As Area Loading Sources</td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td></tr>
</table>

(1) 2014 low flow seasonal groundwater and surface water quality monitoring will be conducted within the September/October timeframe, depending on flow conditions.

Table 2-2. 2014 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Early Season Monitoring	Monthly Monitoring	Semiannual Monitoring	Primary Monitoring Objective Addressed				
				March-November 2014	**April 2014**	**July, August, November 2014**	**June and September/October 2014**	*Source Area IM Response*	*DG IM Response*	*Plume Stability*	*CAMU*	*West As Area Monitoring*
APSD-2	859190.51	1360429.95	3927.99	X			X	***				
APSD-7	859330.03	1361317.85	3924.04	X			X	***				
APSD-8	859082.86	1361339.82	3923.93	X			X	***				
APSD-9	858912.40	1360815.30	3927.12	X			X	***				
APSD-10	858974.64	1360468.59	3926.57	X	X		X	***				
APSD-11	859033.66	1361045.57	3926.84	X	X		X	***				
APSD-12	859200.40	1360715.77	3924.24	X			X	***				
APSD-16	859280.93	1360323.88	3922.05	X			X	***				
DH-1	861171.53	1359021.49	3910.89	X			X		***			
DH-10A	861456.81	1360608.82	3886.97	X	X		X		***			
DH-11	859948.68	1361576.86	3912.36	X			X			As		
DH-12	860548.24	1359804.81	3910.16	X			X	***				
DH-13	860561.05	1359795.41	3909.66	X			X	***				
DH-14	859527.88	1361225.11	3916.06	X			X	***				
DH-15	861541.06	1360257.00	3889.82	X	X		X	***				
DH-16	861008.82	1359678.88	3905.77	X			X	***				
DH-17	860997.41	1359668.63	3904.84	X			X	***				
DH-18	860535.29	1359814.83	3910.21	X			X	***				
DH-19R	859443.14	1360086.52	3919.67	X	X		X	***				
DH-2	859910.43	1358532.44	3936.91	X			X					***
DH-20	858989.37	1360128.45	3930.89	X	X		X	***				
DH-21	860286.89	1359997.44	3916.94	X			X	***				
DH-24	861412.63	1359442.01	3899.59	X			X		***			
DH-3	858002.57	1359985.22	3947.48	X			X			Background		
DH-30	859935.19	1360099.56	3914.23	X	X		X	***				
DH-33	860349.34	1359900.91	3918.73	X			X	***				
DH-36	860631.50	1359936.34	3907.98	X	X		X	***				
DH-4	859526.82	1361217.20	3917.26	X			X	***				
DH-42	859587.20	1359938.80	3931.61	X			X	***				
DH-47	859460.02	1360402.02	3922.33	X		X	X	***				
DH-49	861441.36	1359297.07	3904.07	X			X		***			
DH-5	859641.38	1360792.82	3921.18	X			X	***				
DH-51	861330.25	1359700.33	3904.34	X			X		***			

Table 2-2. 2014 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Early Season Monitoring	Monthly Monitoring	Semiannual Monitoring	Primary Monitoring Objective Addressed				
				March-November 2014	**April 2014**	**July, August, November 2014**	**June and September/October 2014**	*Source Area IM Response*	*DG IM Response*	*Plume Stability*	*CAMU*	*West As Area Monitoring*
DH-52	861372.14	1360876.16	3889.18	X			X		***			
DH-53	861343.68	1361117.67	3892.87	X			X		***			
DH-55	860568.82	1360945.56	3972.76	X			X	***				
DH-56	861098.43	1360350.74	3958.17	X	X	X	X	***				
DH-57	860328.95	1360256.39	3915.26	X			X	***				
DH-58	860620.35	1360149.80	3899.64	X			X	***				
DH-59	859632.08	1360058.60	3917.74	X	X		X	***				
DH-6	861527.08	1360252.42	3889.85	X	X	X	X	***				
DH-61	860401.86	1359292.93	3919.62	X			X	***				
DH-62	860406.74	1359291.47	3919.40	X	X		X	***				
DH-64	861382.75	1359476.26	3904.02	X	X	X	X		***			
DH-66	861005.14	1359333.41	3913.43	X	X	X	X	***				
DH-67	861657.64	1359095.51	3899.77	X	X	X	X		***			
DH-69	859899.60	1360783.89	3934.40	X			X		***			
DH-7	861281.52	1361580.68	3898.66	X			X			As		
DH-70	859738.60	1360346.81	3918.94	X			X	***				
DH-71	859876.69	1359640.54	3925.12	X	X		X	***				
DH-72	859627.55	1360069.20	3918.51	X	X		X	***				
DH-73	860573.78	1360394.40	3899.82	X	X		X	***				
DH-74	860942.46	1360679.47	4001.49	X	X		X	***				
DH-75	860942.10	1360685.11	4001.55	X	X		X	***				
DH-76	860173.63	1360887.06	3994.28	X	X		X		***			
DH-8	860693.17	1359404.72	3916.83	X	X	X	X	***				
DH-9	860570.68	1360370.61	3896.56	X			X	***				
EH-100	862197.19	1358800.89	3889.83	X	X	X	X		***			
EH-101	862185.06	1359841.73	3879.95	X	X		X		***			
EH-102	862174.53	1360751.10	3880.45	X	X		X		***			
EH-103	862095.33	1359303.12	3890.54	X			X		***			
EH-104	862312.66	1358282.52	3887.83	X	X	X	X		***			
EH-106	862709.93	1358337.12	3882.07	X	X		X		***			
EH-107	862700.49	1358801.99	3880.15	X	X	X	X		***			
EH-109	862428.79	1358738.30	3885.67	X	X		X		***			
EH-110	862408.94	1359199.73	3884.05	X			X		***			

Table 2-2. 2014 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Early Season Monitoring	Monthly Monitoring	Semiannual Monitoring	Primary Monitoring Objective Addressed				
				March-November 2014	April 2014	July, August, November 2014	June and September/October 2014	*Source Area IM Response*	*DG IM Response*	*Plume Stability*	*CAMU*	*West As Area Monitoring*
EH-111	863063.82	1358121.67	3876.50	X	X	X	X		***			
EH-113	863390.21	1357972.37	3871.34	X	X		X			As		
EH-114	863127.75	1357769.76	3878.07	X	X		X			As		
EH-115	862717.81	1357963.04	3883.29	X			X			As		
EH-116	863344.59	1357810.98	3874.52	X	X		X			As		
EH-117	863491.19	1357815.10	3871.33	X	X		X			As		
EH-118	863059.91	1357370.97	3879.95	X	X		X		***			
EH-119	863617.62	1357263.09	3873.75	X			X		***			
EH-120	864330.24	1357409.93	3865.78	X	X		X		***			
EH-121	864410.14	1358127.82	3869.49	X			X			Se		
EH-123	863027.35	1356631.31	3885.71	X	X		X		***			
EH-124	863928.39	1356666.49	3874.46	X	X		X		***			
EH-125	864978.44	1357089.97	3863.22	X	X		X		***			
EH-126	865515.80	1356002.80	3870.00	X	X		X		***			
EH-127	865361.56	1357810.28	3860.75	X			X			Se		
EH-128	863371.55	1355903.64	3892.17	X	X		X					
EH-129	865649.69	1355425.09	3870.21	X	X		X		***			
EH-130	866018.01	1356641.21	3858.55	X	X		X			Se		
EH-131	867032.64	1356912.02	3834.44	X			X			Se		
EH-132	864040.35	1355360.41	3893.90	X	X		X					***
EH-134	865643.48	1355425.55	3870.21	X	X		X		***			
EH-135	865688.59	1357384.98	3852.25	X			X			Se		
EH-138	867179.05	1355646.47	3839.70	X	X		X			Se		
EH-139	867197.45	1354635.30	3839.78	X	X		X			Se		
EH-140	867962.26	1356224.79	3812.08	X	X		X			Se		
EH-141	868713.30	1354782.70	3813.32	X	X		X			Se		
EH-142	870077.47	1353868.60	3804.68	X	X		X			Se		
EH-143	870683.75	1354372.76	3803.37	X	X		X			Se		
EH-144S	874170.36	1354091.18	3778.70	X	X		X			Se		
EH-144M	874170.21	1354096.29	3778.95	X	X		X			Se		
EH-144D	874170.14	1354086.12	3778.86	X	X		X			Se		
EH-202	861250.68	1357113.74	3930.56	X			X					***
EH-203	860233.86	1356623.21	4003.92	X			X					***

Table 2-2. 2014 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Early Season Monitoring	Monthly Monitoring	Semiannual Monitoring	Primary Monitoring Objective Addressed				
				March-November 2014	April 2014	July, August, November 2014	June and September/October 2014	*Source Area IM Response*	*DG IM Response*	*Plume Stability*	*CAMU*	*West As Area Monitoring*
EH-204	860660.99	1358703.60	3925.69	X	X		X		***			
EH-205	861652.52	1358687.06	3900.66	X	X		X		***			
EH-206	862969.40	1356012.78	3898.10	X	X		X					***
EH-210	861653.60	1358674.68	3901.19	X	X		X		***			
EH-211	862223.94	1356747.92	3905.75	X	X		X					***
EH-212	862222.63	1356753.36	3905.90	X	X		X					***
EH-50	862195.69	1358818.00	3889.39	X	X	X	X		***			
EH-51	862186.98	1359828.42	3880.09	X	X		X		***			
EH-52	862191.66	1360752.34	3880.50	X	X		X		***			
EH-53	863387.47	1358268.83	3872.82	X	X		X			As		
EH-54	863345.39	1359822.33	3869.66	X	X		X			As		
EH-57A	862625.90	1357731.04	3885.45	X	X		X		***			
EH-58	861985.39	1361553.20	3888.15	X			X			As		
EH-59	862766.01	1361023.24	3876.57	X	X		X			As		
EH-60	862093.37	1359295.78	3888.46	X			X		***			
EH-61	862095.86	1359282.10	3889.77	X			X		***			
EH-62	863373.62	1358812.98	3875.07	X	X		X			As/Se		
EH-63	862682.49	1359427.43	3878.32	X			X			As		
EH-65	862702.98	1358789.93	3879.96	X	X	X	X		***			
EH-66	864406.90	1358105.33	3869.48	X			X			Se		
EH-69	863791.12	1360852.61	3869.10	X	X		X			As		
EH-70	864971.91	1357077.78	3863.48	X	X		X		***			
MW-1	858771.65	1358766.76	3953.05	X			X				***	
MW-10	858554.20	1359549.27	3946.28	X			X				***	
MW-11	857959.47	1358516.75	3973.33	X	X		X				***	
MW-2	859191.64	1358745.84	3945.97	X	X		X		***			
MW-3	859196.82	1359132.39	3940.95	X	X		X		***			
MW-4	858802.48	1359150.01	3947.06	X			X				***	
MW-5	858414.70	1358930.24	3956.18	X			X				***	
MW-6	858876.27	1359556.47	3938.14	X	X		X		***			
MW-7	858777.00	1358177.77	3963.67	X			X				***	
MW-8	857962.24	1359400.93	3958.65	X			X				***	
MW-9	857977.44	1358978.98	3965.36	X			X				***	

Table 2-2. 2014 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Early Season Monitoring	Monthly Monitoring	Semiannual Monitoring	Primary Monitoring Objective Addressed				
				March-November 2014	April 2014	July, August, November 2014	June and September/October 2014	*Source Area IM Response*	*DG IM Response*	*Plume Stability*	*CAMU*	*West As Area Monitoring*
SDMW-1	860514.59	1359962.88	3914.28	X			X	***				
SDMW-2	860448.26	1359851.23	3914.17	X			X	***				
SDMW-3	860203.94	1359859.36	3918.07	X			X	***				
SDMW-4	860218.12	1360144.94	3917.66	X			X	***				
SDMW-5	860446.70	1359750.31	3921.29	X	X		X	***				
WDPZ-1D	863319.38	1355737.85	3900.92	X			X					***
WDPZ-1S	863315.13	1355738.81	3900.98	X			X					***
WDPZ-2D	863037.38	1355829.96	3901.82	X			X					***
WDPZ-2S	863015.25	1355829.66	3902.12	X			X					***
WDPZ-3	864056.82	1355272.24	3895.90	X			X					***
			Total Sites Per Monitoring Event	**217**	**80**	**13**	**142**					
							# of Wells Addressing Primary Objective	**48**	**44**	**30**	**8**	**16**

Table 2-3. 2014 Residential/Water Supply Well Sampling Schedule -- East Helena Facility

Map Key (Exhibit 2)	Site ID	Northing	Easting	Semiannual Monitoring (Jun/Sep or Oct)
1	EHC-1	872558.37	1356681.06	X
2	2843 Canyon Ferry	872346.42	1354330.00	X
3	2853 Canyon Ferry	872391.53	1354773.24	X
4	2865 Canyon Ferry	872086.41	1355030.70	X
5	EHPW-3	868437.60	1356673.10	X
6	2540 Wylie	866156.57	1356934.48	X
7	2489 Wylie Dr	864206.53	1358674.56	++
8	3885 US HWY 12	862259.92	1355055.07	X
9	802 Manlove	861781.59	1356290.54	X
10	800 Manlove	861925.29	1356400.09	X
11	701 Manlove	861784.41	1356574.41	X
12	409 Gail Street	863278.12	1357979.20	++
13	405 Gail Street	863264.10	1358105.44	++
14	401 Gail Street - S	863255.39	1358240.44	X
15	317 Gail Street	863250.07	1358456.08	++
16	305 Gail Street	863257.08	1358568.29	++
17	203 Gail Street	863263.27	1359031.01	X
18	201 Gail Street	863250.07	1359185.43	++
19	109 Gail Street	863266.68	1359337.84	X
20	108/110 Gail Street	863425.39	1359501.01	++
21	105 Gail Street	863270.75	1359501.67	X
22	24 W Groschell	863109.81	1359725.42	++
23	9 Gail Street	863256.45	1359757.14	X
24	7 Gail Street	863233.58	1359840.14	++
25	3 Gail Street	863256.45	1359904.15	X
26	1 Gail Street	863237.91	1360019.06	X
27	202 W Main	862450.60	1359157.38	++
28	126 East Clinton-I	863327.86	1360948.64	++
29	126 East Clinton-H	863296.03	1360955.74	X
30	303 Thurman	863069.96	1361069.38	++
31	210 E Groschell	863053.71	1361184.11	++
32	107 E Groschell	862873.52	1360767.10	++
33	111 E Groschell	862864.36	1360861.52	++
34	316 N. Montana	863376.30	1361815.27	++
35	212 E Pacific	861861.51	1361212.16	++
36	224 E Pacific	861854.50	1361415.54	++
37	690 Smelter Rd Yard	855347.37	1359909.48	X

Total Measurements - June 2014	**19**
Total Measurements - September/October 2014	**37**
Total Measurements for 2014	**56**

NOTE: ++ = location not monitored in 2013 (added in 2014); these locations will be added to the monitoring program for the September/October 2014 monitoring event as the petition process for the East Valley Controlled Groundwater Area proceeds.

Table 2-4. 2014 Surface Water Monitoring Schedule -- East Helena Facility

Site ID	Northing	Easting	Water Elevation Measurements (GPS Survey)	Instantaneous Flow Measurements	Water Quality Monitoring
			(Jun/Jul/Aug/Sep/Oct/Nov)	(Jun/Sep or Oct)	(Jun/Sep or Oct)
PPC-3A	856283.87	1361694.37	X	X	X
PPCB-1	859218.73	1361864.62	X	X	X
Trib-1	858008.43	1360249.85	X	X	X
SG-05	858797.46	1361263.58	X	X	X
Lower Lake	859613.71	1360690.93	X		X
Former PPC-BD	859466.51	1361434.66	X	X	X
PPC-5	859954.78	1361478.38	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	865772.47	1357760.10	X		
PPC-10	867712.58	1356117.83	X	X	X
SG-16	872677.17	1350559.96	X	X	X
HVIC-1	870433.13	1354118.75	X		
GP-1	869382.84	1355642.76	X		
GP-2	870307.35	1354223.32	X		
GP-3	872295.33	1352636.82	X		
GP-4	869942.71	1352286.21	X		
GP-5	868811.08	1355741.50	X	X	
GP-5A	867206.54	1357125.85	X		

Total Measurements Per Monitoring Event	**20**	**11**	**11**
Total Monitoring Events	**6**	**2**	**2**
Total Measurements for 2014	**120**	**22**	**22**

Table 3-1. 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-80	Water Level Monitoring With The Stevens Multilogger 9200
HF-SOP-81	Operation of The Stevens Type A/F Multilogger
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; 2011a).

(2) SOP was prepared by METG and is presented in Appendix A.

Table 3-2. Sample Container and Preservation Requirements

Matrix	Parameters	Sample Container	Preservative
Groundwater	Field Parameters	None	None
	Common Constituents	1000 mL HDPE	Cool to 4°C
	Dissolved Metals[(1)]	250 mL HDPE	Filter samples (0.45 µm) HNO3 to pH <2 Cool to 4°C
	Total Metals [(2)]	250 mL HDPE	Unfiltered samples HNO3 to pH <2 Cool to 4°C
	As Speciation [(3)]	250 mL HDPE	Filter samples (0.45 µm) HCl to pH<2, Cool to 4°C
	Se Speciation [(3)]	500 mL HDPE	Filter samples (0.45 µm) Cool to 4°C
Surface Water	Field Parameters	None	None
	Common Constituents	1000 mL HDPE	Cool to 4°C
	Total Recoverable Metals	250 mL HDPE	Unfiltered samples HNO3 to pH <2 Cool to 4°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.

(3) As and Se speciation will be analyzed on the suite of monthly monitoring well samples only.

Table 5-1. 2014 Groundwater 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	1
Chloride	300.0/SM 4500CL-B	1
Calcium	215.1/200.7	5
Magnesium	242.1/200.7	5
Sodium	273.1/200.7	5
Potassium	258.1/200.7	5
Trace Constituents (Total and/or Dissolved) (2)(3)		
Antimony (Sb)	200.7/200.8	0.003
Arsenic (As)	200.8/SM 3114B	0.002
Beryllium (Be)	200.7/200.8	0.001
Cadmium (Cd)	200.7/200.8	0.001
Chromium (Cr)	200.7/200.8	0.001
Copper (Cu)	200.7/200.8	0.001
Iron (Fe)	200.7/200.8	0.02
Lead (Pb)	200.7/200.8	0.005
Manganese (Mn)	200.7/200.8	0.01
Mercury (Hg)	245.2/245.1/200.8/SM 3112B	0.001
Nickel (Ni)	200.7/200.8	0.01
Selenium (Se)	200.7/200.8/SM 3114B	0.001
Thallium (Tl)	200.7/200.8	0.001
Zinc (Zn)	200.7/200.8	0.01
Metal Speciation (Dissolved) (3)(4)		
Arsenic (As)	E 1632A Mod	0.002
Selenium (Se)	A 3114 B Mod	0.001
Field Parameters (5)		
Static Water Level	HF-SOP-10	0.01 ft
Water Temperature	HF-SOP-20	0.1 °C
Dissolved Oxygen (DO)	HF-SOP-22	0.01 mg/L
pH	HF-SOP-20	0.01 pH standard unit
Turbidity		0.1 NTU
ORP/Eh	HF-SOP-23	1 mV
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).

(2) Private/residential well samples will be analyzed for both total and dissolved trace constituents; monitoring well samples will be analyzed for dissolved metals only

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

(4) Arsenic and selenium speciation will be analyzed at the monitoring wells scheduled for monthly monitoring.

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

Table 5-2. 2014 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	1
Chloride	300.0/SM 4500CL-B	1
Calcium	215.1/200.7	5
Magnesium	242.1/200.7	5
Sodium	273.1/200.7	5
Potassium	258.1/200.7	5
Trace Constituents (Total Recoverable)		
Antimony (Sb)	200.7/200.8	0.0005
Arsenic (As)	200.8/SM 3114B	0.001
Beryllium (Be)	200.7/200.8	0.0008
Cadmium (Cd)	200.7/200.8	0.00003
Chromium (Cr)	200.7/200.8	0.01
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
Nickel (Ni)	200.7/200.8	0.002
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

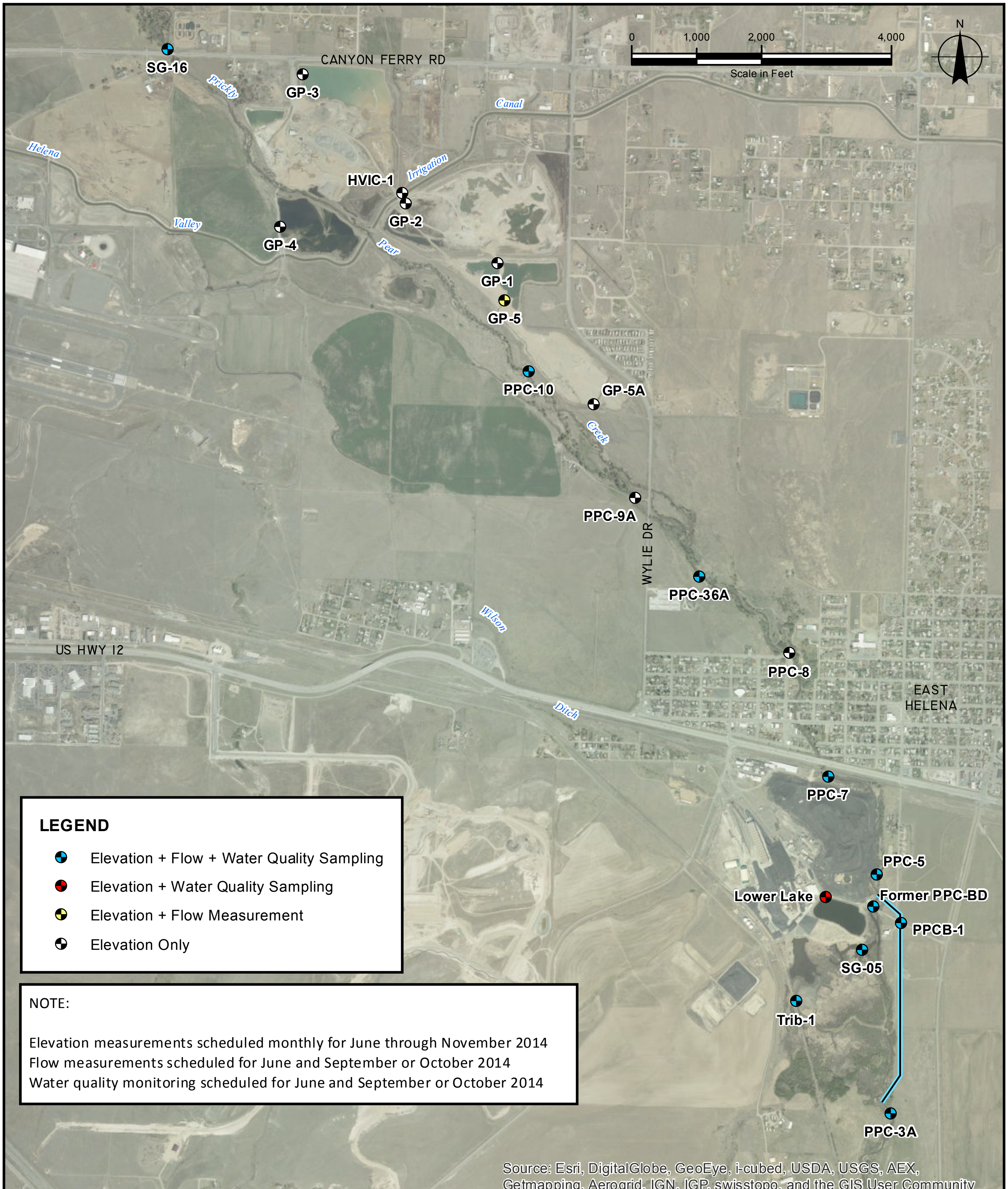
Notes:

(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 Date Saved: 6/9/2014 3:46:30 PM	EAST HELENA FACILITY 2014 CORRECTIVE ACTION MONITORING PLAN	**GENERAL LOCATION MAP**	**FIGURE** **1-1**

Path: V:\10022\GIS\2014 CAMP\2014_General_Location.mxd



Hydrometrics, Inc. Consulting Scientists and Engineers Date Saved: 6/6/2014 11:18:11 AM	EAST HELENA FACILITY 2014 CORRECTIVE ACTION MONITORING PLAN	**2014 SURFACE WATER MONITORING LOCATIONS**	**FIGURE** **2-1**

Path: V:\10022\GIS\2014 CAMP\2014_Surface_Water.mxd

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:

---

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	$\pm$0.1
Temperature (°C)	$\pm$0.2
SC (µmhos/cm)	$\pm$5% (SC $\leq$ 100) or $\pm$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

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

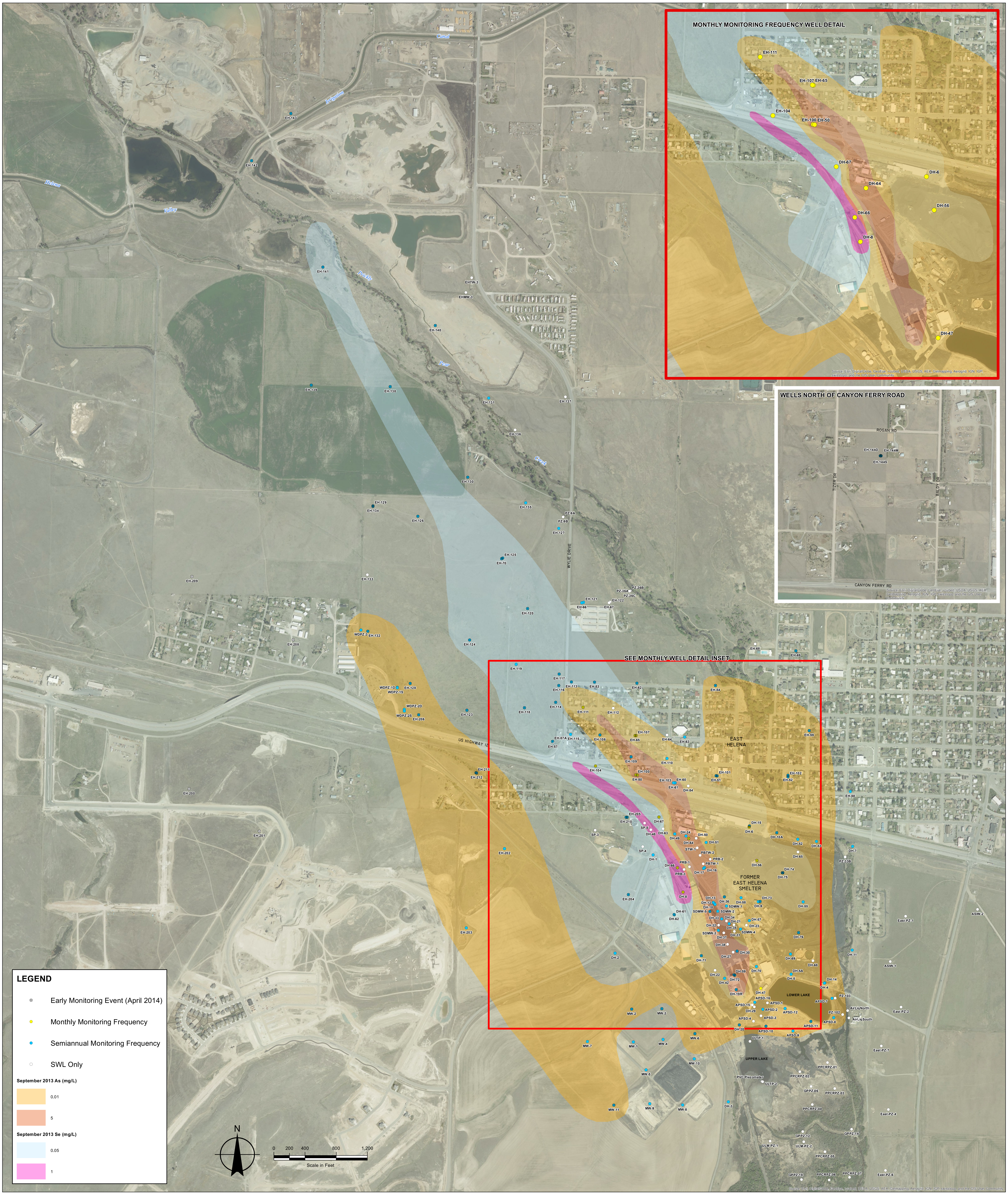
You cooperation is greatly appreciated.

Sincerely,

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

EXHIBIT 1

EAST HELENA FACILITY
2014 MONITORING WELL SAMPLING LOCATIONS



Hydrometrics, Inc.
Consulting Scientists and Engineers

Date Saved: 7/20/2014 1:32:46 PM
Path: V:\10022\GIS\2014 CAMP\2014_MonWells.mxd

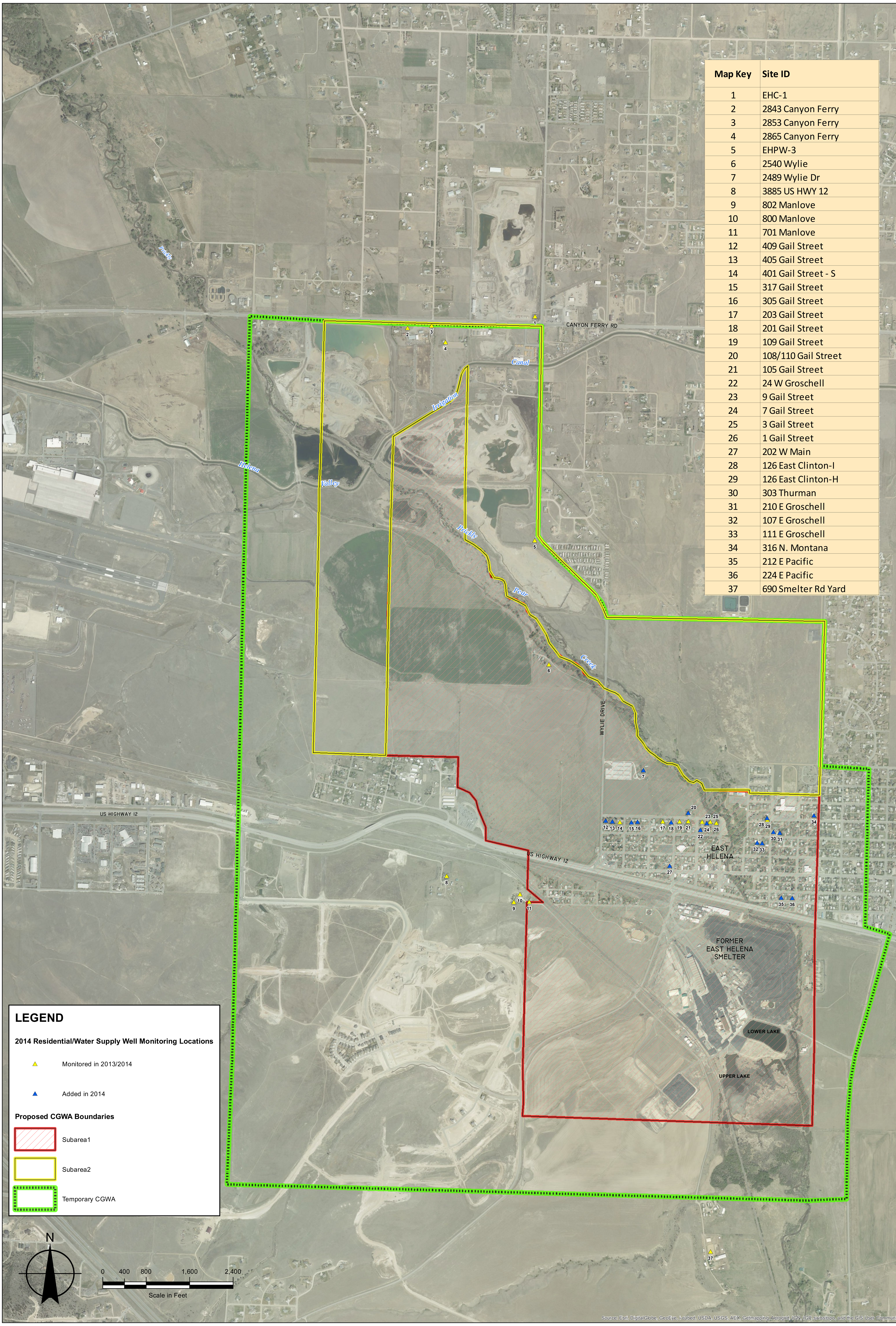
2014 EAST HELENA CORRECTIVE ACTION MONITORING PLAN	EAST HELENA FACILITY 2014 MONITORING WELL SAMPLING LOCATIONS	EXHIBIT 1

EXHIBIT 2

EAST HELENA FACILITY

2014 RESIDENTIAL / WATER SUPPLY

WELL MONITORING LOCATIONS



Map Key	Site ID
1	EHC-1
2	2843 Canyon Ferry
3	2853 Canyon Ferry
4	2865 Canyon Ferry
5	EHPW-3
6	2540 Wylie
7	2489 Wylie Dr
8	3885 US HWY 12
9	802 Manlove
10	800 Manlove
11	701 Manlove
12	409 Gail Street
13	405 Gail Street
14	401 Gail Street - S
15	317 Gail Street
16	305 Gail Street
17	203 Gail Street
18	201 Gail Street
19	109 Gail Street
20	108/110 Gail Street
21	105 Gail Street
22	24 W Groschell
23	9 Gail Street
24	7 Gail Street
25	3 Gail Street
26	1 Gail Street
27	202 W Main
28	126 East Clinton-I
29	126 East Clinton-H
30	303 Thurman
31	210 E Groschell
32	107 E Groschell
33	111 E Groschell
34	316 N. Montana
35	212 E Pacific
36	224 E Pacific
37	690 Smelter Rd Yard

Hydrometrics, Inc.
Consulting Scientists and Engineers

Date Saved: 7/25/2014 12:05:30 PM

Path: V:\10022\GIS\2014 CAMP\2014_ResWells.mxd

2014 EAST HELENA CORRECTIVE ACTION MONITORING PLAN	EAST HELENA FACILITY 2014 RESIDENTIAL/WATER SUPPLY WELL MONITORING LOCATIONS	EXHIBIT 2