Winter 1-28-2022

SILVER BOW CREEK/BUTTE AREA NPL SITE

TREC Inc., A Woodard and Curran Company

SILVER BOW CREEK/BUTTE AREA NPL SITE

2022 Final Butte Priority Soils Operable Unit Interim Site-Wide Surface Water Monitoring Quality Assurance Project Plan (QAPP)

Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

January 2022

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Prepared for:

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January 28, 2022

APPROVAL PAGE

QUALITY ASSURANCE PROJECT PLAN FOR
BUTTE PRIORITY SOILS OPERABLE UNIT SURFACE WATER MONITORING
SILVER BOW CREEK/BUTTE AREA NPL SITE

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Approved: ______________________________ Date: ______________
Josh Bryson, Liability Manager, Atlantic Richfield Company

Plan is effective on date of last signature above.

DISTRIBUTION LIST

Silver Bow Creek/Butte Area NPL Site
Butte Priority Soils Operable Unit 2020/2021 Site-Wide Surface Water Monitoring Quality Assurance Project Plan (QAPP)
Butte, Silver Bow County, Montana

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Revision No.	Author	Version	Description	Date
	TREC, Inc.	1	Draft Final Submittal 2022 Interim Site-Wide SW Monitoring QAPP	11/16/21
1	TREC, Inc.	2	Draft Final Submittal 2022 Interim Site-Wide SW Monitoring QAPP	12/27/21
2	TREC, Inc.	3	Final Submittal 2022 Interim Site-Wide SW Monitoring QAPP	1/28/22

LIST OF ACRONYMS AND ABBREVIATIONS

APHA	American Public Health Association
ARAR	Applicable Relevant and Appropriate Requirements
ARCO	Atlantic Richfield Company
ASA	American Society of Agronomy
ASTM	American Society of Testing and Materials
BDMS	Butte Data Management System
BG	Buffalo Gulch
BLM	Biotic Ligand Model
BMFOU	Butte Mine Flooding Operable Unit
BMI	Benthic Macroinvertebrate
BMMA	Bert Mooney Municipal Airport
BPSOU	Butte Priority Soils Operable Unit
BSB	Butte Silver Bow
BTC	Blacktail Creek
BTL	Butte Treatment Lagoons
CAP	Corrective Action Plan
CAR	Corrective Action Report
CD	Consent Decree
CFRSSI	Clark Fork River Superfund Site Investigations
COC	Contaminant of Concern
CPM	Contractor Project Manager
DEQ	Department of Environmental Quality
DI	Deionized Water
DMP	Data Management Plan
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DQA	Data Quality Assessment
DQO	Data Quality Objectives
DSR	Data Summary Report
EDD	Electronic Data Deliverable
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Tricoptera
EPTC	Relative abundance of EPT to Chironomidae ratio
EQUIS	Environmental Quality Information System
EWI	Equal Width Increment
FB	Field Blank
FRESOW	Further Remedial Elements Scope of Work

GG	Grove Gulch
GPS	Global Positioning System
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCC	Hydraulic Control Channel
HSP	Health and Safety Plan
ID	Identification
LAO	Lower Area One
LAP	Lab Analysis Plan
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
LD	Laboratory Duplicate
LM	Liability Manager
LWD	Large Woody Debris
MB	Method Blank
MDEQ	Montana Department of Environmental Quality
MDL	Method Detection Limit
MS	Matrix Spike
MS	MICROSOFT
MSD	Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NF	Normal Flow
NPL	National Priorities List
O&M	Operations & Maintenance
OSHA	Occupational Safety & Health Administration
OU	Operable Unit
PEC	Probable Effects Concentration
pH	negative log of the hydrogen concentration
PM	Project Manager
PPE	Personal Protective Equipment
PTD	Percent Taxonomic Disagreement
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBP	Rapid Bioassessment Protocol
RL	Reporting Limit
ROD	Record of Decision
RODA	Record of Decision Amendment
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SBC	Silver Bow Creek

SC	Specific Conductivity
SM	Standard Method
SNOTEL	Snowpack Telemetry
SOP	Standard Operating Procedure
SOW	Scope of Work
SQL	structured query language
SWMP	Surface Water Management Plan
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
uSBC	upper Silver Bow Creek
USGS	United States Geological Survey
WW	Wet Weather

1.0 INTRODUCTION

The purpose of this Quality Assurance Project Plan (QAPP) is to provide guidance for collecting enforcement quality data for site-wide surface water, sediment, benthic macroinvertebrate (BMI), and habitat monitoring activities at the Butte Priority Soils Operable Unit within the Silver Bow Creek/Butte Area National Priorities List (NPL) Site during the 2022 monitoring period and to reference the documents necessary to describe the quality assurance and quality control (QA/QC) policies and procedures to be used during data collection and analysis. Although this QAPP details not only Butte Priority Soils Operable Unit (BPSOU) interim site-wide surface water monitoring, but also sediment, BMI, and habitat monitoring, the title reflects only surface water monitoring to remain consistent with BPSOU Consent Decree (CD) (U.S.A and State of Montana, 2020) documents. This QAPP has been developed in accordance with the *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA 2001a), the *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA AQ/G-4 (EPA 2006b), and the EPA *Region 8 Quality Assurance Document Review Crosswalk* checklist (EPA 2017). This QAPP was prepared in a manner consistent with the *Butte Area NPL Site Butte Priority Soils Operable Unit (BPSOU) Final Quality Management Plan* (QMP) (Atlantic Richfield, 2020a) and includes the four basic element groups:

- Project Management and Objectives;
- Measurement and Data Acquisition;
- Assessment and Oversight; and
- Data Review.

The four sections below provide these project plan elements and include the appropriate content needed for planning the sampling and analysis within the site. The sections in this stand-alone QAPP expand and reference information in other site wide documents to present project specific requirements.

2.0 PROJECT MANAGEMENT

This section addresses project concerns, goals and approaches to be followed during sampling activities on the site.

2.1 Project Organization and Responsibilities

An example organizational chart showing the overall organization of the project team is provided in Figure 1. Responsibilities of key individuals comprising the project team are described below.

<u>Environmental Protection Agency Project Manager – Nikia Greene (EPA)</u>

The Environmental Protection Agency (EPA) Project Manager is responsible for communicating and coordinating EPA requirements with the Atlantic Richfield Liability Manager (LM), such that Agency requirements are met. The EPA Project Manager must also coordinate with the Montana Department of Environmental Quality (DEQ) Project Manager to ensure that the state's concerns and requirements are addressed.

Montana Department of Environmental Quality Project Manager – Daryl Reed (DEQ)

The Montana DEQ Project Manager is responsible for communicating and coordinating with the Atlantic Richfield LM and the EPA Project Manager such that the state's requirements are addressed.

Atlantic Richfield Liability Manager (LM) – Josh Bryson (Atlantic Richfield Company)

The Atlantic Richfield LM monitors the performance of the contractor(s). The LM consults with the Contractor Quality Assurance Officer and Contractor Project Manager(s) on deficiencies and aids in finalizing resolution actions. The Atlantic Richfield LM, or their designee, will be responsible for distributing this QAPP. This QAPP will be distributed electronically to all recipients.

Atlantic Richfield Quality Assurance Manager (QAM) – David Gratson (Environmental Standards)

The Atlantic Richfield QAM interfaces with the Atlantic Richfield LM for company policies regarding quality and has the authority and responsibility to approve quality assurance (QA) documents specific to the project including this QAPP.

Contractor Project Manager (CPM) – Scott Bradshaw (TREC, Inc.)

The CPM is responsible for ensuring that all monitoring addressed in this QAPP is completed and ensuring that the work is performed in accordance with the requirements contained herein. The CPM is also responsible for consulting with the quality assurance personnel identified for the project regarding any deficiencies and finalizing resolution actions. The CPM is also responsible for ensuring communication between all Atlantic Richfield entities that perform monitoring tasks within Blacktail Creek, Silver Bow Creek, and creek tributaries.

Field Team Leader – Alice Drew-Davies (TREC, Inc.)

The Field Team Leader ensures that the QAPP has been reviewed by all members of the field team and is properly followed when implementing field activities. The Field Team Leader is responsible for scheduling all monitoring addressed in this QAPP. The Field Team Leader will conduct daily safety meetings, assist in field activities, and assure that activities are documented in the logbook, or on field forms (either electronic or paper). The Field Team Leader is responsible for equipment, problem solving and decision making in the field, and for technical aspects of the project. In addition, the field team leader provides "on-the-ground" overview of project implementation by observing site activities to ensure compliance with technical project requirements, Health Safety Security and Environment (HSSE) requirements, and the Site Specific Health and Safety Plan. The field team leader identifies potential Integrity Management (IM) issues, as appropriate, and prepares required project documentation. The field team leader is the point of communication for other Atlantic Richfield contractors that perform monitoring tasks within Blacktail Creek, Silver Bow Creek, and creek tributaries. The field team leader is also the point of contact for Atlantic Richfield entities that are discharging water to Blacktail Creek, Silver Bow Creek, and creek tributaries.

Benthic Macroinvertebrate (BMI) Team Advisor – Barry Fulton (Benchmark Environmental)

The BMI Team Advisor will be responsible for training field personnel on how to perform habitat assessments, collect and field-process BMI samples, and calibrate field measurement instruments.

Contractor Quality Assurance Officer (QAO) – Tina Donovan (TREC, Inc.)

The QAO is responsible for field and laboratory data review and evaluation of data quality, including conducting on-site reviews and preparing site review reports for the QAM. The QAO is responsible for maintaining this QAPP.

The QAO represents their assigned projects as the primary spokesperson on matters relating to quality management system implementation. In matters of project QA, this individual will have a direct line of communication to the QAM to ensure issues are resolved.

The QAO is authorized to stop work if, in the judgment of that individual, the work is performed contrary to or in the absence of prescribed quality controls, or approved methods, and further work would make it difficult or impossible to obtain acceptable results. The QAO may also stop work if completion of quality corrective actions is not acceptable.

The QAO is responsible for carrying out field audits to ensure the integrity of field measurements, sample collection, and documentation.

QAOs are responsible for evaluating data and information from instances of nonconformance, inspection reports, surveillance reports, audit and assessment reports, quality system reviews (QSRs), corrective action reports (CARs), corrective action plans (CAPs), stop work orders, and other sources. These data should be used to identify trends or conditions averse to quality, which shall be brought to the attention of the QAM.

Project Safety and Health Manager – Nicole Santifer (TREC, Inc.)

The Project Safety and Health Manager will conduct the initial safety meeting prior to starting fieldwork for the QAPP. The Safety and Health Manager will ensure that work crews comply with all site health and safety requirements and will ensure revisions of the Health and Safety Plan (HSP), as necessary.

Analytical Contract Laboratory (Pace Analytical)

Pace Analytical Laboratory of Minneapolis, Minnesota will be the contract laboratory for BPSOU surface water and sediment monitoring. The Minnesota laboratory can be contacted at (612) 607-1700. Pace's QA personnel are familiar with the approved QAPP and are available to perform the work as specified. Contract Laboratory personnel are responsible for reviewing final analytical reports produced by the laboratory, coordinating scheduling of laboratory analyses and supervising in-house chain-of-custody procedures. Pace Analytical is accredited under the National Environmental Laboratory Accreditation Program (NELAP) and is certified under the Montana Department of Public Health and Human Services (DPHHS) public water supply laboratory certification program to perform organic and inorganic analyses. In addition, Pace is in Atlantic Richfield's Laboratory Management Program, thus is subject to annual auditing. Prior to making any changes in the contract laboratory, potential laboratories will review the QAPP to ensure analytical criteria can be met. Any future laboratory will be NELAP and state of Montana certified for applicable analyses, and the laboratory must be approved by BP's Laboratory Management Program.

Taxonomy Contract Laboratory (GEI)

GEI Consultant's Ecological Laboratory of Denver, Colorado will be the contract laboratory for macroinvertebrate monitoring. All taxonomists responsible for the identifications and QA/QC protocols will have one or more Level 2 Taxonomic Certification from the Society of Freshwater Science.

2.2 Problem Definition and Background

The BPSOU covers approximately 5 square miles and includes the town of Walkerville, along with a large portion of the city of Butte. A small stream, Silver Bow Creek (SBC), runs through the BPSOU. The upper reach of Silver Bow Creek (uSBC) begins near the intersection of Texas Avenue and Civic Center Road, but perennial flow in SBC does not exist above the creek's confluence with Blacktail Creek (BTC). Placer mining for silver and gold began in the Butte area in 1864, and by the 1870s multiple silver and copper mines, mills, and smelting facilities had been established in the area. Over 284 million pounds of copper had been produced by the Butte district by 1910, and the associated wastes "*were disposed of in ponds or dumped in Silver Bow Creek"* (EPA, 2006d). Mine waste, including tailings and waste rock dumps, accumulated across the Butte Hill for more than a century as mining and associated industries flourished. These accumulations impacted SBC via direct run-off to the creek and infiltration to the alluvial aquifer, with the affected groundwater eventually re-expressing as surface water in the creek. As a result of these impacts, SBC was designated a Superfund site by the EPA in September 1983. Given that SBC was impacted by wastes within the Butte area, the Silver Bow Creek Site was expanded to include the Butte Area in 1987.

Multiple remedial actions have been implemented to impact SBC water quality. From 1992 to 1997, over one million cubic yards of mine waste was removed in the western part of the BPSOU. From 1996-1998 storm water issues on the Butte Hill were addressed through constructing sediment basins, channelizing flow, regrading, revegetation, and reclamation. In 2003, Missoula Gulch wet weather flows were segregated from normal flows to allow gravitational removal of solids and metals in catch basins. In 2003, the BPSOU subdrain groundwater capture system was constructed to separate groundwater from wet weather flow in the SBC channel between Texas Avenue and Kaw Avenue. In 2006, additional Missoula Gulch BMPs were implemented to divert normal flow to the Butte Treatment Lagoons (BTL) and to enhance storm water retention of flows exiting catch basin 9. Approximately 7,200 cubic yards of mining impacted material were removed from the streambanks at the confluence of BTC and the SBC in 2010, as well as rip-rapping the streambanks and revegetating the area near the confluence after the removal. Between 2011 and 2013, hydrodynamic devices were installed in stormwater trunk lines at the base of the Butte Hill to capture sediments before water is discharged to SBC. The above remedial actions represent the subset most directly impacting SBC water quality of all remedial actions performed.

The Record of Decision (ROD) (EPA, 2006d) specifies guidelines for selected remedies for surface water within BPSOU. The goals of the remedies are to protect human and environmental health and reduce COC concentrations to quality standards in Grove Gulch, Blacktail Creek, and Silver Bow Creek. As stated in the 2006 ROD, the selected Remedy for surface water consists of the following components:

1. *The Surface Water Management Program which utilizes BMPs to address contaminated storm water runoff and improve storm water quality.*

2. *Excavation and removal to a repository of contaminated sediments from the stream bed, banks, and adjacent floodplain along Blacktail Creek and Silver Bow Creek, from just above the confluence of Blacktail Creek and Metro Storm Drain to the beginning of the reconstructed Silver Bow Creek floodplain at Lower Area One. Following removal of the in-stream sediments, further evaluation of surface water quality in this area will be conducted. If groundwater inflow is found to adversely affect surface water quality, additional hydraulic controls and groundwater capture shall be implemented.*
3. *Capturing and treating storm water runoff up to a specified maximum storm event, if BMPs implemented under the Surface Water Management Program do not achieve the goal of meeting surface water standards in Silver Bow Creek, Grove Gulch, and Blacktail Creek during storm water events.*
4. *Hydraulic control, capture, and treatment of contaminated groundwater to prevent its discharge to Silver Bow Creek surface water (as described above* [in reference to the ROD] *and in Section 12.3.2* [of the ROD]*).*
5. *In-stream flow augmentation as appropriate. Flow augmentation will not be considered until the major remedial components described in this ROD are designed and implemented.*

The Remedy includes the modifications stated in the 2020 Record of Decision Amendment (RODA), (EPA, 2020) as follows:

- *Waiver of the State of Montana's Circular DEQ-7 acute aquatic life standards for copper and zinc based on a total recoverable (unfiltered) sample and adopt the federal acute aquatic life standards based on a dissolved (filtered) sample as shown on in Table 2. This change to federal acute aquatic life standards based on a dissolved sample is protective of surface water in the BPSOU because all contaminated sediments will be removed and replaced with clean sediments and the contaminant pathways to these sediments will be addressed with the additional remedial actions now required.*
- *Adoption of the current Circular DEQ-7 allowance for one exceedance of water quality standards in 3 years. This exceedance rate allowance was accounted for in the TI evaluation and applies to both the chronic and acute standards.*
- *Adoption of the updated Circular DEQ-7 aquatic life standard for cadmium (May 2017). This change applies to both the chronic and acute standards (Tables 1 and 2). Because the cadmium standard is not waived initially, the new Circular DEQ-7 standard will apply unless the contingent post-construction waiver is invoked.*
- *Modification of point of compliance as described in Appendix A. As described in the 2006/2011 BPSOU Record of Decision, an overall remedial goal for Silver Bow Creek is to maintain the in-stream concentration of site-specific COCs below the numeric surface water quality standards identified in Circular DEQ-7 for all flow conditions throughout the length of Blacktail Creek, Grove Gulch Creek, and Silver Bow Creek below its confluence with Blacktail Creek within and directly downstream of the BPSOU. This surface water compliance requirement from the 2006/2011 BPSOU Record of Decision (Section 12.6.6.2) will be changed to two points of compliance at SS-06G and SS-07 only (Figure A-3). Other monitoring stations will remain in the network as needed, but compliance will be determined at these two farthest downstream stations. Effluent from the Butte wastewater treatment plant enters between SS-06G and SS-07. The surface*

water sampling methodology will be modified to allow for additional compositing methods at the compliance sampling locations.

In addition to the Remedy outlined in the ROD and in the 2020 RODA, Further Remedial Elements (FRE) are required under the BPSOU CD. These elements are described in the Further Remedial Elements Scope of Work (FRESOW), which is Attachment C to Appendix D of the BPSOU CD.

The BPSOU Surface Water Management Plan (SWMP), Exhibit 1 to Attachment A of Appendix D of the BPSOU CD, describes how the surface water remedy will be managed following construction of all surface water-related remedy elements and is the overarching plan for how to address all surface water monitoring activities identified in the RODA that are required under the BPSOU FRESOW to evaluate the effectiveness of both the surface water and groundwater remedies. Two requirements of the BPSOU SWMP are benthic macroinvertebrate (BMI) and sediment monitoring once certain further remedial elements have been implemented. The long-term purpose of surface water, groundwater, BMI, and sediment monitoring data is to assess the protectiveness of the surface water remedy throughout the compliance standard determination period and compliance monitoring period. BMI and sediment data collected in the 2022 monitoring period, as well as that collected in 2020 and 2021, will assist in establishing interim monitoring period conditions. The data collected in accordance with this QAPP compliments and augments ongoing surface water and sediment data collection by other contractors, as well as USGS, within the BPSOU, Stream Side Tailings Operable Unit (SSTOU), and the Butte Mine Flooding Operable Unit (BMFOU). Note that site-wide BPSOU groundwater monitoring is addressed in the *Draft Final Butte Priority Souls Operable Unit 2022 Interim Site-Wide Groundwater Monitoring Quality Assurance Project Plan* (Atlantic Richfield, 2021b).

2.3 Project Description and Schedule

The purpose of BPSOU surface water monitoring is to assess compliance with performance standards, as well as the performance and protectiveness of the remedy. Additionally, the plan must provide data to evaluate surface water quality and quantity, and streambed sediment quality; and that data must be of adequate quality to enable remedy review. Results of BMI monitoring do not have triggers or benchmarks that lead directly to further action, but will be used, along with all other appropriate data sources, as lines of evidence to evaluate remedy protectiveness to aquatic life and to inform additional response actions following completion of required remedial actions.

Specific QAPP objectives are to:

1. Present the procedures required to collect surface water data necessary to assess compliance with performance standards;
2. Present the procedures required to collect sediment data;
3. Present the procedures required to perform BMI monitoring and habitat assessment that will be used with sediment data to assess remedy performance;
4. Describe specific requirements for collecting and analyzing surface water, sediment, BMI, and habitat data.

The surface water monitoring network specifically targets the following surface water areas and sub-drainages in order to meet these objectives:

- Silver Bow Creek;
- Blacktail Creek;
- Grove Gulch Sub-drainage;
- uSBC between Texas Avenue and Kaw Avenue;
- Buffalo Gulch Sub-drainage;
- Texas Avenue Sub-drainage;
- Locust Avenue Sub-drainage;
- Missoula Gulch Sub-drainage; and
- Uncaptured Sub-drainages to the south of SBC, west of Lexington Avenue.

Sediment and BMI monitoring targets BTC upstream of the BPSOU, SBC within the BPSOU, and SBC below the BPSOU.

A summary of the tasks is provided in Table 1 below.

Table 1 - Summary of Project Tasks

Water Quality Sampling Tasks: Water quality samples will be collected monthly during normal flow conditions using the method described in Section 3.2.2.3. Water quality samples will be collected during wet weather conditions as defined in the Wet Weather Criteria SOP in Appendix A, using the method described in Section 3.2.2.3.

Flow Measurement Tasks: Flow measurements will be taken during normal flow water quality sampling. For wet weather water quality sampling, continuous flow recorders and stage-discharge curves will be used to determine flow. Flow measurement methods are detailed in Section 3.2.2.2

Surface Water Monitoring Schedule: Normal flow sampling will take place once a month, January through December, at eleven locations along Silver Bow and Blacktail Creek. Wet weather sampling will take place up to two times a month at seven creek sites and ten diagnostic stations, April through September, when flow in BTC or SBC exceeds the criteria identified in the Wet Weather Trigger SOP (see Appendix A).

Surface Water Analysis Tasks: Laboratory analysis for water quality parameters consistent with EPA approved test methods for inorganic constituents including: total and dissolved metals and metalloids, anions (nitrate + nitrite, phosphorous, and sulfate), alkalinity, dissolved organic carbon, hardness, nutrients (ammonia and total Kjeldahl nitrogen (TKN)), and total dissolved and suspended solids in accordance with EPA approved analytical methods.

Sediment Monitoring Tasks: Sediment samples will be collected annually using the method described in Section 3.2.2.4.

Sediment Monitoring Schedule: Sampling will be conducted annually on a schedule consistent with BMI monitoring, targeting mid-August to early September of each year.

Sediment Analysis Tasks: Samples will be analyzed for pH and particle size (clay, silt, sand), and bulk samples will be analyzed for total organic carbon (TOC), arsenic, cadmium, copper, lead, mercury, and zinc in accordance with EPA approved analytical methods.

BMI Monitoring Tasks: BMI community monitoring will be performed and physical habitat assessments made using the methods described in Section 3.2.2.5 and 3.2.2.6.

BMI Monitoring Schedule: BMI monitoring will be conducted annually. Habitat monitoring will be conducted every five years or more frequently as necessary. Both monitoring efforts will target a mid-August to early September timeframe.

BMI Analysis Tasks: Laboratory data generated from BMI monitoring will include taxonomic identification and macroinvertebrate density counts.

Quality Control Tasks: All laboratory analytical matrices (surface water and sediment samples) will have the following field QC samples analyzed: 1 field duplicate for every 20 primary samples, and 1 field blank collected for every 20 primary samples if sampling equipment is reused across sample locations. Laboratory QC samples will include method blanks, laboratory control samples, laboratory duplicate samples, and matrix spike samples, as applicable to the method and the sample matrix.

BMI sampling will include field replicate samples collected at each site. Laboratory QC for BMI assessment will include determining the Relative Percent Difference in Enumeration (RPDE) and the Percent Taxonomic Disagreement (PTD). Both the RPDE and PTD are based on confirmation of original counts and taxonomic classifications.

<u>Data Management Tasks:</u> Analytical data will be reviewed and evaluated for quality by the project's QAO and placed in the site database. Taxonomic data will be reviewed by the BMI Team Advisor before being placed in the site database.

<u>Documentation and Records:</u> All surface water samples collected will have surveyed locations. Sediment and BMI samples are collected within stream reaches, and both midpoints and reach endpoints will have surveyed locations. Coordinates for exact sediment monitoring points will be captured with electronic tablets, thus, precise within 5 meters. All samples will have records of each sample collected and all field measurements will be appropriately documented.

<u>Data Packages:</u> Limited (standard) data packages will be provided for all analytical data and will include results in mg/L, or other applicable units, of all constituents analyzed. BMI data packages will present QC results as percentages and taxonomic data will be presented as counts and densities.

2.4 Quality Objectives and Criteria

This section discusses the internal quality control (QC) and review procedures used to ensure that all data collected for this project are of a known quality.

2.4.1 Data Quality Objectives

The DQO process is used to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. Each step of the DQO process defines criteria that will be used to establish the final data collection design following the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006a)

The EPA DQO process consists of seven steps, as follows:

- Step 1: State the Problem;
- Step 2: Identify the Goals of the Study;
- Step 3: Identify Information Inputs;
- Step 4: Define the Boundaries of the Study;
- Step 5: Develop the Analytical Approach;
- Step 6: Specify Performance and Acceptance Criteria; and
- Step 7: Develop the Plan for Collecting Data.

The DQOs, which will be used to guide the data collection and analysis activities, are as follows:

Step 1: State the Problem.

"The purpose of this step is to describe the problem to be studied so that the focus of the investigation will not be ambiguous."

Surface water in BTC and SBC has been impacted by past mining activities. Multiple remedial actions have been instituted to improve and protect BTC and SBC water quality including:

- Removing mine waste from the western part of the BPSOU and the confluence of BTC and SBC;
- Missoula Gulch wet weather flows were segregated from normal flows to allow gravitational removal of solids and metals in catch basins as well as diversion for treatment in Butte Treatment Lagoons (BTL);
- The BPSOU subdrain groundwater capture system was constructed to separate groundwater from wet weather flow in SBC between Texas and Kaw Avenues; and
- Hydrodynamic devices were installed in stormwater trunk lines at the base of the Butte Hill to capture sediments before water is discharged to SBC.

In order to determine the effectiveness of these past BMPs and the necessity of additional BMPs, a monitoring program that assesses water quality compliance and performance monitoring standards during normal and wet weather flows will be implemented. Monitoring will occur for surface water Contaminants of Concern (COCs) which the BPSOU ROD identified as aluminum, arsenic, cadmium, copper, iron, lead, mercury, silver, and zinc. Water quality and flow data are necessary to characterize normal and wet weather flows in SBC and BTC. These data will subsequently be used to monitor water quality compliance and assess the efficacy of implemented BMPs.

The remedial action objectives for surface water monitoring as described in the Record of Decision (ROD, 2006) are:

- *Prevent ingestion or direct contact with contaminated surface water that would result in an unacceptable risk to human health.*
- *Return surface water to a quality that supports beneficial use.*
- *Prevent source areas from releasing contaminants to surface water that would cause the receiving water to violate surface water ARARs and RGs for the OU and prevent degradation of downstream surface water sources, including during storm events.*
- *Ensure that point source discharges from any water treatment facility (e.g., water treatment plant, wetland, etc.) meet ARARs.*
- *Prevent further degradation of surface water.*
- *Meet the more restrictive of chronic aquatic life or human health standards for surface water identified in Circular DEQ-7 (Table 8-2) through the application of B-1 class standards.*

The third and sixth objectives listed above were modified in the 2020 RODA. Performance standards for cadmium were revised to reflect the chronic and acute aquatic life standards in the May 2017 version of Circular DEQ-7, which applies to both normal and wet weather flow situations. The copper and zinc acute aquatic life wet weather performance standards were modified to be based on the federal criteria, which relies on the dissolved concentration, rather than the total recoverable concentration.

Additional RAOs for groundwater and solid media, which affect surface water, include:

- *Prevent groundwater discharge that would lead to violations of surface water ARARs and RGs for the BPSOU*

This BPSOU Interim Site-Wide Surface Water Monitoring QAPP (Site-Wide SW QAPP) addresses the monitoring objectives outlined in the ROD and RODA. These same objectives will be addressed as monitoring moves into the compliance standard determination period, after the BPSOU remedial action construction, and into compliance monitoring, although the monitoring network and frequency may need to be modified for those periods.

The Surface Water Compliance Determination Plan (SWCDP), which is Attachment A to Appendix D of the BPSOU CD, sets forth water quality criteria meant to protect aquatic life within the water column, however the quality of the streambed sediment must also be assessed, as defined in the SWMP. Since site-specific performance standards for sediment have not been established for BPSOU, comparison of sediment concentrations to the Probable Effects Concentrations (PECs) that have been identified in literature for a subset of the BPSOU COCs (i.e., arsenic cadmium, copper, lead, mercury, and zinc), along with BMI data and other lines of evidence, shall be used to assess whether BPSOU streambed sediments are impaired. Along with surface water monitoring, this QAPP will address sediment, BMI, and habitat monitoring efforts to occur for the BPSOU. The BPSOU SWMP specifies that sediment performance monitoring should be conducted to determine concentrations of constituents, along with the temporal, depth, and geographical trends in sediment.

Step 2: Identify the Goal of the Study.

"This step identifies what questions the study will attempt to resolve and what actions may result.

Surface Water Monitoring

Surface water monitoring data collected under this QAPP prior to the CD defined Compliance Standard Determination Period is intended to establish interim monitoring period conditions for creek and sub-drainage concentrations and flows. Once the Compliance Standard Determination Period is initiated as defined in the CD, surface water monitoring data collected under this QAPP will be used to assess if diagnostic response and optimization or other additional response is necessary as specified in the SWMP.

During the interim monitoring period before the Compliance Standard Determination Period, surface water monitoring will provide details for collecting data necessary to:

- Evaluate compliance with Performance Standards at compliance monitoring stations SS-06G and SS-07;
- Evaluate performance of the remedy, in its various stages of implementation; and
- Evaluate any necessary diagnostic data collected for the purpose of identifying currently implemented remedial system component optimization or maintenance, and necessary to inform FRE design.

Sediment, BMI, and Habitat Monitoring

Sediment, BMI, and habitat monitoring data collected under this QAPP prior to the CD defined Compliance Standard Determination Period is intended to establish interim monitoring period conditions for sediment PEC concentrations and the BMI community structure for locations upgradient, within, and down gradient of the BPSOU on an annual basis. Once the Compliance Standard Determination Period is initiated, as defined in the CD, sediment data collected under this QAPP will be used, supported by other lines of evidence from BMI and habitat data, to assess if diagnostic response and sediment removal is necessary as specified in the SWMP.

During the interim monitoring period before the Compliance Monitoring Period, sediment, BMI, and habitat data collected will provide details for collecting data necessary to:

1. Evaluate if sediment sample concentrations exceed the PECs for specific sampling locations and depths in BTC and SBC within the BPSOU and in background/reference reaches in BTC upgradient of BPSOU;
2. Evaluate trends in streambed sediment sample concentrations at sampling locations and depths in BTC and SBC within BPSOU and in background/reference reaches in BTC upgradient of BPSOU;
3. Evaluate BMI community structure and habitat conditions within BPSOU and in background/reference reaches upgradient of BPSOU; and
4. Evaluate BMI community structure and habitat condition trends in relation to the abiotic media collected in background/reference BTC reaches upgradient of BPSOU and SBC reaches within BPSOU.

Step 3: Identify Information Inputs.

"The purpose of this step is to identify the informational variables that will be required to resolve the study goals and determine which variables require environmental measurements."

The following data will be collected to supplement existing data to address the goals of the surface water monitoring program. There will be two main surface water areas monitored: within the Creek (SBC and BTC) and Diagnostic Monitoring in BPSOU sub-drainages.

- Meteorological Data
    - Continuous data including temperature, and precipitation
- Surface water flow monitoring data
    - Creek Normal Flow
        - Conduct manual flow measurements. Utilize data to develop stage-discharge curves
    - Creek Wet Weather
        - Incorporate continuous stage recorders and apply stage-discharge curves to determine flow
    - Sub-Drainage Wet Weather Diagnostic
        - Incorporate continuous flow recorders
        - Opportunistic manual flow measurements may be collected to supplement the continuous flow monitoring as necessary.
- Surface water quality monitoring data
    - Creek Normal flow
        - Enforcement level laboratory analyses for COC metals.
        - Field measurements of pH, specific conductance (SC), dissolved oxygen (DO), and temperature.

- Creek Wet Weather
  - Enforcement level laboratory analyses for COC metals.
  - Continuous in-stream pH measurement.
- Sub-Drainage Wet Weather Diagnostic
  - Enforcement level laboratory analyses for COC metals.

Enforcement level analytical data is required at stations used to determine compliance with water quality standards (SS-01, SS-06G, and SS-07), while analytical data from non-compliance creek stations and sub-drainages will be utilized for future operational optimization. Data will be obtained from sampling as described in Sections 3.2.2.1 through 3.2.2.3 The data will be used with previously collected data to assess water quality trends in SBC and BTC. Applicable water quality standards are provided in Table 2.

Table 2 - Creek Monitoring Performance Criteria

Analyte	Chronic Performance Standards (ug/L)[1]	Acute Performance Standards (ug/L)[2,3]
Dissolved Aluminum	87	750
Total Arsenic	10	340
Total Cadmium	0.26	0.49
Total Copper	2.85	3.60
Total Iron	1000	NA
Total Lead	0.545	13.98
Total Mercury	0.05	1.7
Total Silver	NA	0.374
Total Zinc	37	37

[1] Chronic (Normal Flow Conditions) Performance Standards based on 2020 RODA (using hardness of 25 mg/L).
[2] Acute (Wet Weather Conditions) Performance Standard based on 2020 RODA (using hardness of 25 mg/L).
[3] Per 2020 RODA, Acute Performance Standard for Copper and Zinc Standard are based on dissolved concentration.

Sediment data will include spatially composited sediment samples in stream reaches upstream and within, the BPSOU, targeting high deposition areas within each reach. Sediment samples will be collected at 0-2 inch, 2-6 inch, and 6-12 inch depth intervals, provided that substrate composition is sufficient to collect samples at these depths.

Data will be obtained from sampling as described in Section 3.2.2.4. The data will be used with any existing data to assess sediment quality trends in SBC and BTC. Performance Standards for sediment have not been established for BPSOU. Sediment concentrations from samples collected at the 0-2 inch and 2-6 inch depth increments will be compared to PECs to determine if further investigation is required. PEC are concentrations of individual metals above which adverse effects to the BMI community may be expected to occur but do not account for site-specific conditions such as habitat and sediment chemistry (Ingersoll et al. 2000, MacDonald et al. 2000). The PECs are listed in Table 3.

Table 3 – Sediment Probable Effect Concentrations

(Ingersoll *et al.* 2000, MacDonald *et al.* 2000)

Analyte	Probable Effect Concentration (mg/kg, dry weight, bulk sample)
Arsenic	33
Cadmium	4.98
Copper	149
Lead	128
Mercury	1.06
Zinc	459

BMI monitoring will include replicate BMI community samples and in-situ measurements of pH, temperature, dissolved oxygen, and specific conductance at each site. Data will be obtained from sampling as described in Sections 3.2.2.5.

Habitat characteristics will be assessed along entire monitoring reaches every five years, at a minimum, and annually at discrete stream transects. The annual assessment will employ EPA's Rapid Bioassessment Protocols (RBP) (Barbour et al, 1999), while the five-year assessments will include elements of EPA's Environmental Monitoring and Assessment Program (EMAP) (EPA, 1998). Both methods include epifaunal substrate and available cover; embeddedness and pool substrate characterization; velocity, depth, and pool variability; sediment deposition; channel flow status; channel alteration; frequency of riffles and channel sinuosity; bank stability; vegetative protection; and the riparian vegetative zone. Habitat assessment monitoring is discussed in Section 3.2.2.6.

Step 4: Define the Boundaries of the Study.

"The purpose of this step is to identify the target population of interest and specify the spatial and temporal features of that population that are pertinent for decision-making."

Surface water monitoring will occur within and upstream of the BPSOU boundary, along BTC and SBC from Harrison Avenue to the western terminus of the BPSOU, and within SBC and BTC sub-drainages. Water quality sampling will be performed during wet weather when monitoring is not impeded by freezing conditions, generally between April and September, and year-round during normal flow conditions. Continuous stage and flow monitoring will occur throughout the year regardless of conditions.

Creek normal flow water quality sampling and flow monitoring will be conducted monthly, a total of 12 times per year. Normal flow events collected during the months of February through June will likely be high normal flow events with higher than average incoming flows from BTC, depending on snowpack, precipitation, and temperature. Normal Flow monitoring stations, specified in Table 4 and Table 5, were selected to monitor seasonal and perennial drainages during normal flow. These stations are displayed in Figure 2 - Normal Flow and Wet Weather Monitoring Locations. Section 3.0 details monitoring methods.

Creek wet weather sampling is not identified during freezing conditions due to the small probability that a storm will occur, and the difficulties associated with sampling equipment functionality under freezing conditions. Absent freezing conditions, generally between April and September, monitoring will occur at locations specified in Table 4, Table 5, and Figure 2 and as described in Section 3.0 , to assess conditions within the stream at compliance stations or to evaluate BMP efficacy. Wet Weather sampling criteria are described in the SOP which can be found in Appendix A. Creek stage data will be collected continuously.

Sub-drainage wet weather diagnostic sampling and monitoring will be performed during wet weather when monitoring is not impeded by freezing conditions, generally between April and September, at various elevations within BTC and SBC sub-drainages. BPSOU sub-drainage sampling will occur throughout the wet weather season as described in Section 3.0. Sub-drainage wet weather diagnostic sampling and monitoring stations are shown in Figure 3 and listed in Table 4 and Table 5. Sub-drainage flow data will be collected continuously.

Opportunistic samples may be collected throughout the monitoring season in response to observed unusual in-channel conditions. These may include run-off occurring in the absence of precipitation or discolored water within a channel.

Table 4- Flow Measurement Sites, Frequency, and Monitoring Method

Site	Creek Normal Flow Monitoring	Creek Wet Weather Monitoring	Sub-Drainage Wet Weather Diagnostic Monitoring
SS-01	Monthly Manual Flow Measurement with portable flow meter	Continuous Stage Monitoring with ISCO Flow Meter and Solinst pressure transducer	N/A
SS-01.35	Monthly Manual Flow Measurement with portable flow meter	Continuous Stage Monitoring with ISCO Flow Meter. Monitored by USGS.	N/A
SS-04	Monthly Manual Flow Measurement with portable flow meter	Continuous Stage Monitoring with ISCO Flow Meter. Stage monitoring only	N/A
SS-05	Monthly Manual Flow Measurement with portable flow meter	Continuous Stage Monitoring with ISCO Flow Meter and H350 stage recorder. Monitored by USGS.	N/A
SS-05A	Monthly Manual Flow Measurement with portable flow meter	N/A	N/A
SS-06A	Monthly Manual Flow Measurement with portable flow meter	Continuous Stage Monitoring with ISCO Flow Meter	N/A

Site	Creek Normal Flow Monitoring	Creek Wet Weather Monitoring	Sub-Drainage Wet Weather Diagnostic Monitoring
SS-06G	Monthly Manual Flow Measurement with portable flow meter	Continuous Stage Monitoring with ISCO Flow Meter	N/A
SS-07	Monthly Manual Flow Measurement with portable flow meter	Continuous Stage Monitoring with ISCO Flow Meter. Monitored by USGS	N/A
BG-CLV-1	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
GG-CH-1	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
GG-CLV-C	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
GG-CLV-D	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
GG-CLV-I	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
LC-CLV-1	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
MG-CLV-0	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
MPTP-CLV-1	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter
MSD-CLV-3A	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter and Sutron Stage Recorder
TX-HD-OUT	N/A	N/A	Continuous Flow Monitoring with ISCO A-V Meter

Table 5 - Water Quality Sites, Frequency, and Sampling Method

Site	Creek Normal Flow Monitoring	Creek Wet Weather Monitoring[1]	Sub-Drainage Wet Weather Diagnostic Monitoring[2]
SS-01	Manual Monthly Sample	ISCO 3700 and D-TEC TIENet 301/ISCO Signature continuous pH	N/A
SS-01.35	Manual Monthly Sample	ISCO 3700 and D-TEC	NA
SS-04	Manual Monthly Sample	ISCO 3700 and D-TEC	N/A
SS-05	Manual Monthly Sample	ISCO 3700 and D-TEC	N/A
SS-05A	Manual Monthly Sample	N/A	N/A
SS-06A	Manual Monthly Sample	ISCO 3700 and D-TEC	N/A
SS-06G	Manual Monthly Sample	ISCO 3700 and D-TEC TIENet 301/ISCO Signature continuous pH	N/A
SS-07	Manual Monthly Sample	ISCO 3700 and D-TEC TIENet 301/ISCO Signature continuous pH	N/A
BG-CLV-1	N/A	N/A	ISCO 3700
GG-CH-1	N/A	N/A	ISCO 3700
GG-CLV-C	N/A	N/A	ISCO 3700
GG-CLV-D	N/A	N/A	ISCO 3700
GG-CLV-I	N/A	N/A	ISCO 3700
LC-CLV-1	N/A	N/A	ISCO 3700
MG-CLV-0[3]	N/A	N/A	ISCO 3700
MPTP-CLV-1	N/A	N/A	ISCO 3700
MSD-CLV-3A	N/A	N/A	ISCO3700
TX-HD-OUT	N/A	N/A	ISCO 3700

[1] All Creek Wet Weather sites will be sampled at a frequency determined by actual rain events that cause creek conditions to meet the general wet weather sampling criteria as defined in the Wet Weather Criteria SOP in Appendix A.

[2] All Sub-Drainage Wet Weather Diagnostic sites will be sampled at a frequency determined by actual rain events over 0.15” and up to two events per month.

[3]Opportunistic sampling may occur at this location due to O&M activities at Missoula Gulch basins. Sampling event will be triggered by a notification from BSB that O&M activities are being conducted

In past years, there have been several changes to historical monitoring stations. In late 2019, the BMFOU Berkeley Pit and Discharge Pilot Project (BMFOU Discharge Pilot Project) began, with treated water being discharged at variable rates to SBC just upstream of its confluence with BTC. The discharge causes backwater at former United States Geological Service (USGS) station 12323240 (SS-04), and the backwater combined with variable flow rates, limited the ability of the USGS to establish a stage-discharge relationship at this site. Therefore, the USGS discontinued monitoring at station 12323240 in April 2020 and in June 2020 established station 12323233 (co-located with Atlantic Richfield station SS-01.35), as well as a downstream station at Montana Street, 12323242. Station 12323242 is located on the upstream side of the Montana Street bridge, while Atlantic Richfield station SS-05 is located on the downstream side of the Montana Street bridge.

The geographic scope of sediment and BMI sampling includes sampling locations upstream of BPSOU, within BPSOU, and at the terminus of BPSOU. The locations upstream of the BPSOU boundary will establish the background/reference locations for the monitoring project. Proposed monitoring reaches are identified in Table 6 and on Figure 4. Sediment sampling locations will occur within the reaches specified in Table 6, but exact locations will be chosen in the field depending on sediment deposit availability. BMI monitoring will also occur within the Table 6 reaches, but exact sample points will be chosen in the field depending on observed habitats, such as riffles with cobble substrate. Habitat assessment will be conducted along the reach length. To the extent possible, sediment sampling locations will be collocated within previously established (2019) BMI sampling reaches as well as collocated with BMI and habitat sampling locations established in previous Streamside Tailings Operable Unit (SSTOU) biomonitoring projects.

Sediment and BMI monitoring will be conducted annually, while habitat monitoring will be conducted every five years at a minimum. These monitoring efforts will target a mid-August to early-September timeframe.

Table 6 –- Proposed Sediment and BMI Monitoring Stream Reach Locations and Sampling Frequency

Reach	Description	Associated Surface Water Station	SW Station Location with respect to Reach	Frequency
1	BTC above BPSOU	SS-01	Endpoint, reach extends ~ 500 ft upstream	Annually
2	SBC within BPSOU, below the BTC and SBC confluence within LAO	SS-06A	Approximate midpoint, equal distances upstream and downstream	Annually
3	SBC near western boundary of BPSOU	SS-06G	Endpoint, reach extends upstream to just below BTL effluent	Annually

Step 5: Develop the Analytic Approach.

"The purpose of this step is to define the parameters of interest, specify action levels, and integrate any previous DQO inputs into a single statement that describes a logical basis for choosing among alternative actions."

Surface Water

Surface water normal flow creek monitoring will occur once a month, January through December, weather permitting, with four monthly events targeting high normal flow conditions. Normal flow monitoring will include sample collection and flow measurements, consistent with techniques employed by the USGS. Field measured parameters include stage, flow (completed after sampling to minimize sediment mobilization), water temperature, specific conductance, dissolved oxygen, and pH. Samples will be collected into clean laboratory bottles. Appropriate preservative (nitric acid for metals, sulfuric acid for DOC, NO_2/NO_3, NH_3, TKN, and phosphorus) will be present within or added to the sample bottle. Samples will be sent to the lab and analyzed for total and dissolved fractions of multiple metals, anions, nutrients, alkalinity, and solids.

Wet weather samples will be collected using automated samplers (ISCO 3700 and D-TECs) set to collect at a pre-determined stage, which ideally occurs within the first half hour of a wet weather event. Once triggered to sample, ISCO automated samplers will collect four time-composited samples in the first four hours of the runoff hydrograph. D-TEC automated samplers will collect one sample at the beginning of the runoff hydrograph and will be submitted for analysis in the event of an ISCO sampler failure. Samples will be retrieved quickly after sampling and transported to the office for sample preparation. Appropriate preservative, as specified above, will be present within or added to the sample bottle. Samples will be sent to the laboratory and analyzed for total and dissolved fractions of multiple metals, anions, nutrients, alkalinity, and solids. Field measured parameters include stage at all stations and continuous temperature and pH measurements at SS-01, SS-06G, and SS-07.

Diagnostic samples will be collected using automated samplers (ISCO 3700) set to collect within the first half hour of a wet weather event. Samplers will be collected if the rainfall criteria of greater than 0.15 inches is met. Once triggered to sample, ISCO 3700 automated samplers will collect six to eight samples throughout the runoff hydrograph. Samples will be retrieved quickly after they have collected, preserved on ice, and transported to the office for sample preparation. Appropriate preservative will be present within or added to the sample bottle. Samples will be sent to the laboratory and analyzed for total and dissolved fractions of multiple metals, sulfate, and TSS.

Opportunistic samples may be collected in response to unusual conditions, such as discolored water or significant overland flow appearing in the absence of wet weather conditions. Opportunistic samples may be either manually collected or collected with automatic samplers (ISCO 3700). Automatic sampler programming for opportunistic samples will be identical to that employed for wet weather sampling, but the number of samples collected will vary depending on the flow conditions which triggered the sampling. Samples from automatic samplers will be retrieved quickly after they have collected, preserved on ice, and transported to the office for sample preparation. Appropriate preservative (nitric acid for metals) will be present within or added to the sample bottle. Samples will be sent to the laboratory and analyzed for total and dissolved fractions of multiple metals, at a minimum.

Sediment

Qualitative and quantitative sediment data will be collected. Spatially composited sediment samples will be collected within the stream reaches identified in Table 6. The spatial interval will consist of five sub-sample points within each stream reach. If condition prevent collection of five subsamples, as many as possible will be collected and the deviation will be recorded in the field notes. An attempt will be made to sample at an equal number of sub-sample points within each stream reach, and to collect an equal volume of sample material at each reach. Each sub-sample will be collected by hand pushing a sediment tube into the streambed and removing the tube in a manner which retains a sediment core. At each sub-sample point, the retained material will be separated into three depth intervals, 0-2 inches, 2-6 inches, and 6-12 inches, provided sediment composition is sufficient to sample to these depths. A brief description of sediment characteristics for each depth interval will be recorded. This description will include color, odor, an estimate of grain size (clay, silt, sand, etc.), and an estimate of grain size distribution (poorly sorted, well sorted).

Sediment samples will be sieved to < 2mm, and a split of the resulting sample will be sieved to three size fractions, < 0.063 mm, 0.063–1 mm, and 1-2 mm. Mass percent of each fraction will be determined, but individual fractions will not undergo analysis. The remaining < 2 mm bulk sample will be analyzed for pH, total organic carbon (TOC), arsenic, cadmium, copper, lead, mercury, and zinc by EPA approved methods.

Once sufficient (at least four) sampling rounds have occurred following completion of the further remedial elements specified in the FRESOW, sediment data for each depth interval will be assessed for trend analysis using standardized statistical procedures appropriate to the underlying distributions (normal, log-normal, etc.).

BMI

The biomonitoring sampling design described in this QAPP is adapted from EPA's long-term biomonitoring conducted in other portions of the Clark Fork River basin. BMI community structure metrics collected under this QAPP will include but not be limited to taxa richness, Shannon diversity, EPT richness, EPT/EPTC ratio, Hydropsychinae/Trichoptera ratio, Baetidae/Ephemeroptera ratio, density, biotic index, percent filter feeders, metal tolerance index, percent dominant, percent tolerant. These twelve BMI community structure metrics are presented in Table 7.

Table 7 – BMI Community Metrics

Metric	Definition
Taxa Richness	Number of BMI taxa per Hess sample, measures variety of assemblage. Historically the best measure of site conditions.
Shannon diversity	Influenced by taxa richness and distribution of individuals among taxa (evenness).
EPT/EPTC	Relative abundance of Ephemeroptera, Plecoptera, Trichoptera to Chironomidae ratio
Hydropsychinae/ Trichoptera	Hydropsychinae is relatively more tolerant of pollution than most other caddisflies.
Baetidae/ Ephemeroptera	Baetidae are most pollution-tolerant mayflies.
Density *+	Number of individuals per unit of area.

Metric	Definition
Biotic Index *	SUM (%RAi * ti), %RAi is the percent relative abundance of each taxon and ti is the tolerance value of the taxon.
Percent Filter Feeders *	Abundance of these functional feeding groups provides information on energy transfer, food resources, and organic loading.
EPT richness+	Richness of Ephemeroptera, Plecoptera, and Trichoptera
Metal Tolerance Index+	Quantifies changes in BMI community and based on Hilsenhoff's biotic index with tolerance values assigned to taxon.
Percent dominant	Percent of most dominant taxon in a sample.
Percent tolerant	Organisms (%) sensitive to perturbation.

(*) indicates metric is part of a subset used for indicating organic pollution and (+) indicates metric is part of a subset used for indicating metals pollution.

Step 6: Specify Performance or Acceptance Criteria.

"The purpose of this step is to specify the decision-maker's tolerable limits on decision errors, which are used to establish performance goals for the data collection design."

Acceptance criteria for analytical data are detailed in Section 2.4.2, and Section 3.5.2 provides even greater detail. Briefly, analytical data must be of screening or enforcement quality to be deemed usable. Data usability will be determined through the data validation and data quality assessment proceses which will follow guidelines set forth in the *TREC Data Validation Guidelines for Inorganic Chemistry* (TREC, 2021) (TREC Data Validation Guidelines) and Section 5.2. The TREC Data Validation Guidelines aligns with those specified in the *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2020b), but relies on method specific control limits. The TREC Data Validation Guidelines document is provided as Appendix B.

The QA/QC protocols for BMI field sampling and laboratory subsampling, sorting, and taxonomy described in the Montana DEQ *Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Community SOP* (DEQ, 2012) (Appendix C) will be followed. Acceptance criteria are briefly described in Section 2.4.2, with Section 3.5.4 providing greater detail. Section 3.5.3 discusses QC and acceptance protocols for habitat assessment.

Step 7: Develop the Plan for Obtaining Data.

"The purpose of this step is to identify a resource-effective data collection design for generating data that are expected to satisfy the DQOs."

The data collection plan detailed in the following sections is designed to ensure that the data will be of sufficient quality and quantity to assess surface water quality in relation to performance standards. Data from the previous and current investigations will be comparable due to compatible approaches. The monitoring plan described in this QAPP is designed to provide adequate information to meet the objectives described in Section 2.4. The QAPP data collection design (sampling program) is described in detail in Section 3.0 Meteorological monitoring data will be collected continually at the sites indicated in Figure 6. Ambient meteorological data will include temperature and precipitation. Although wind direction and wind speed are also collected at the stations identified in Figure 6, several of these stations were sited to collect precipitation only. Thus, the wind data collected at a subset of the stations may not be reliable. Additionally, for the purposes of this QAPP, precipitation is the parameter of interest.

Normal Flow surface water monitoring will be performed monthly at the sites specified in Table 5, with a target of monitoring eight events under normal flow conditions and four events under seasonal high normal flow conditions. All aspects of normal flow monitoring will be performed consistent with techniques employed by the USGS. Water quality sampling will include both field parameter measurements and laboratory analyses. Field-measured data will include stage, flow, water temperature, specific conductance, dissolved oxygen, and pH. Laboratory measurements will include TDS, TSS, hardness, total recoverable and dissolved metals (aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, mercury, silver, and zinc), dissolved calcium, dissolved magnesium, alkalinity, sulfate, and nitrate/nitrite. TKN, total phosphorus, ammonia, and dissolved organic carbon are measured each month at compliance stations.

Creek wet weather water quality data will be collected on average, when wet weather conditions exist, two times per month, from April to September depending on weather conditions. A wet weather event is defined in the Wet Weather Criteria SOP in Appendix A. Samples will be collected using automatic or mechanical samplers. Laboratory measurements will include TDS, TSS, hardness, total recoverable and dissolved metals (aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, mercury, silver, and zinc), dissolved calcium and magnesium, alkalinity, sulfate, and nitrate/nitrite at all stations, during all sampling events. On the first wet weather event of each month, laboratory analysis will also include TKN, total phosphorus, ammonia, and dissolved organic carbon at compliance stations. Creek stage data will be collected continuously and downloaded monthly. Continuous creek pH and temperature data will be collected at SS-01, SS-06G, and SS-07 to assist in ascertaining Biotic Ligand Model (BLM) standard parameters. BLM input parameters include sodium, potassium, and chloride, and estimates of humic acid; however, none of these parameters are collected under BPSOU site-wide surface water monitoring. Sodium, potassium, and chloride concentrations are measured at SS-01, SS-06G, and SS-07 under other surface water monitoring programs (BMFOU Discharge Pilot Project) and historical data exists for these parameters. The more applicable of the two alternate data sets (reflects conditions for the period being studied) will be used to estimate sodium, potassium, and chloride values.

Sub-drainage wet weather diagnostic water quality sampling data will generally be collected when the creek wet-weather criteria is met; but collection will be determined on a case by case basis. On average, and when wet weather conditions exist, two sub-drainage wet weather diagnostic water quality sample sets will be collected per month. Samples will be collected using automatic and mechanical samplers; therefore, no field measured data will be collected. Laboratory measurements will include TSS, sulfate, and total recoverable and dissolved trace elements (arsenic, cadmium, copper, iron, lead, mercury, and zinc). Sub-drainage flow data will be collected continuously, and data downloaded monthly.

Opportunistic surface water samples may be collected in response to unusual in-channel conditions such as run-off occurring in the absence of precipitation or discolored water within a channel. Opportunistic samples will be manually collected or collected with automatic samplers. Opportunistic sampling will not include field measured data. At a minimum, opportunistic samples will be analyzed for total recoverable and dissolved trace elements (arsenic, cadmium, copper, iron, lead, mercury, and zinc).

The sediment data collection plan outlined in this QAPP is designed to ensure that the data will be of sufficient quality and quantity to assess sediment quality in relation to PECs. Data from previous and current investigations will be comparable due to compatible approaches. Spatially composited sediment samples will be collected at three depth intervals, 0-2 inches, 2-6 inches, and 6-12 inches, as sediment depth allows. Sediment characteristics will be recorded in the field, and samples will be laboratory sieved to < 2 mm and analyzed for arsenic, cadmium, copper, lead, mercury, zinc, TOC, and pH. Additionally, mass percent of three size fractions, < 0.063 mm, 0.063-1 mm, and 1-2 mm, will be determined.

The BMI and habitat monitoring outlined in this QAPP are designed to ensure that the data will be of the quality and quantity needed for use as lines of evidence to inform further remedial actions, as well as to support the 5-year review process for assessing the protectiveness of the Remedy. The BMI and habitat sampling designs are described in Section 3.0 .

2.4.2 Measurement Performance Criteria for Data

All data collection will be conducted under CFRSSI or other applicable SOPs to maintain consistent techniques. Surface water and sediment sample analysis will be performed by an analytical laboratory which is NELAP accredited and certified under the Montana DPHHS public water supply laboratory certification program to perform the applicable analyses. Macroinvertebrate sample processing will be performed by a qualified taxonomic laboratory. In addition, analytical protocols will be consistent with those specified in the *Clark Fork River Superfund Site Investigations Laboratory Analytical Protocol (LAP)*, (ARCO, 1992a).

Measurement performance criteria are established by defining acceptance criteria and quantitative or qualitative goals (e.g., control limits) for accuracy, precision, representativeness, comparability and completeness of measurement data. The definitions of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) are provided below along with the acceptance criteria for data collected. Equations for calculation of precision, accuracy and completeness are provided in Table 8. Information pertaining to the analytical methods that will be employed, and the project's target quantitation limits can be found in Section 3.4.2.

Table 8 - Precision, Accuracy and Completeness Calculation Equations

Characteristic	Formula	Symbols
Precision (as relative percent difference, RPD)	$RPD = \frac{(x_i - x_j)}{\left(\frac{x_i + x_j}{2}\right)} \times 100$	x_i, x_j: replicate values of x
Precision (as relative standard deviation, RSD, otherwise known as coefficient of variation)	$RSD = \frac{\sigma}{\bar{x}} \times 100$	σ: sample standard deviation $\bar{x}$: sample mean
Precision (as percent taxonomic disagreement (PTD)	$PTD = \left[1 - \left(\frac{comp_{pos}}{N}\right)\right] \times 100$	$comp_{pos:}$ the number of agreements N: total number of organisms
Accuracy (as percent recovery, R, for samples without a background level of the analyte, such as reference materials, laboratory control samples and performance evaluation samples)	$R = \frac{x}{t} \times 100$	x: sample value t: true or assumed value
Accuracy (as percent recovery, R, for samples with a background level of the analyte, such as matrix spikes)	$R = \frac{SSR - SR}{SA} \times 100$	SSR: spiked sample result SR: sample result SA: spike added
Accuracy (as percent difference, D, for samples > 50X the MDL, which have undergone at least a five-fold dilution, with the result, S, corrected for the dilution)	$D = \frac{\lvert I - S \rvert}{I} \times 100$	I: initial sample result S: serial dilution result
Completeness (as a percentage, C)	$C = \frac{n}{N} \times 100$	n: number of valid data points produced N: total number of samples taken

<u>Precision</u>

Precision is the level of agreement among repeated measurements of the same characteristic. There are two general forms of uncertainty. The first is the random error component of the data collection process. The second is inherent stochastic variability, which cannot be eliminated but can be described.

Data precision is assessed by determining the agreement between replicate measurements of the same sample and/or measurements of duplicate samples. The overall random error component of precision is a function of the sampling. Precision in sample collection is determined by the collection and analysis of field duplicates, and laboratory precision is measured by replicate analyses of the same sample, or by analysis of sample splits. A laboratory duplicate is the preferred measure of analytical method precision. When analytes are present in samples at concentrations below or near the quantitation limit, precision may be evaluated using duplicate analyses of laboratory prepared samples such as duplicate laboratory matrix spike samples (MS/MSD), duplicate laboratory control spike samples (LCS/LCSD), and/or laboratory duplicate (LD) samples. Precision can be measured as relative percent difference (RPD) or as relative standard deviation (RSD, also known as a coefficient of variation). Formulae for both are presented in Table 8.

For surface water and sediment sampling, precision shall be determined by the analysis of field and laboratory duplicates and the evaluation of the RPD for the paired measurements. The RPD goals for measures of analytical precision are provided in Table 9, which is provided in the Tables section due to its size.

The RPD precision goal for surface water field duplicates will be 20 percent, while the target precision for sediment field duplicates will be 35 percent. For both surface water and sediment samples these precision goals are for sample pairs with both sample results being greater than five times the reporting limit (RL). For field and laboratory duplicate pairs with one or both sample results less than five times the RL, a difference of ≤ RL (surface water) or ≤ 2xRL (sediment) will be used as the precision goal. The precision goal for analytical duplicates ranges from 10-30%, depending on the analytical method, and these are provided in Table 9.

Table 9 – Summary of Laboratory Quality Control Checks (see Tables Section)

BMI sampling precision measures the extent of variability in the sampling method and is related to the variability of collecting replicate samples within a reach. BMI sampling precision is estimated by collecting replicate samples of the BMI communities within the same reach during the same day. Precision is estimated by comparing replicate samples with an RSD goal of 20% or less for the taxa richness metric.

To assess laboratory enumeration precision, 10% of the sample set is counted and identified by a second taxonomist. The RPD between the original and second count should be ≤ 10% (or > 90% similarity). Laboratory identification precision is measured by the Percent Taxonomic Disagreement (PTD), the formula for which is provided in Table 8. The assessment of PTD accounts for straight disagreements, hierarchical difference, and missing specimens. PTD is assessed in the same manner that RPD is assessed, by comparing results of the original taxonomic identification to the results obtained by a second taxonomist. Acceptance criteria for PTD is ≤ 15%.

<u>Accuracy/Bias</u>

Accuracy is the degree of difference between the measured or calculated value and the true value. It is a measure of the bias or systematic error of the entire data collection process. Potential sources of systematic errors include:

- sample collection methods;
- physical or chemical instability of the samples;
- interference effects during sample analysis;
- calibration of the measurement system; and
- contamination.

Field blanks (FBs) and laboratory method blanks (MBs) may be analyzed to assess artifacts introduced during sampling, transport and/or analysis that may affect the accuracy of the data. In addition, laboratory control samples (LCS) and matrix spike samples (MS) are used to verify that sample concentrations are accurately measured by the analytical instrument throughout the analytical run.

Bias in field activities shall be determined by the collection and analysis of FBs, as described in Section 3.5.1. Field blank accuracy goals include target analyte concentrations less than the method detection limit. Laboratory accuracy will be determined by the analysis of laboratory control samples, matrix spike samples, and laboratory blank samples. Accuracy/Bias goals for the specific analytical methods are summarized in Table 9.

Bias and accuracy for macroinvertebrate monitoring are qualitative, rather than quantitative measurements. Bias refers to the difference between the population mean and the true value. Bias usually describes a systematic difference reoccurring over time and is characteristic to both the sampling method and parameter(s) being measured. Bias may occur while sampling due to the same field investigator performing the same task at each site or due to consistent misinterpretation of protocols by a group of field investigators. Sampling bias will be minimized by ensuring all staff are experienced and qualified in conducting biomonitoring assessments and performing all tasks according to methods and procedures described in this QAPP and applicable SOPs.

Laboratory bias may occur from dichotomous keys or morphological features being misinterpreted consistently, inadequate sample processing, or equipment inadequacy. Accuracy is defined as the degree to which a measurement conforms to the true measure. Laboratories must utilize taxonomic references; and, these may be museum-based material, the most current and accepted taxonomic literature, or a verified reference collection.

Representativeness

Data representativeness is defined as the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point or environmental conditions. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Representativeness of samples shall be achieved through the careful selection of sampling locations and methods. With respect to BMI monitoring, this includes selecting sites representative of minimally or least disturbed conditions in the sampled stream. The BMI and habitat protocols included in this QAPP are designed to produce consistent and repeatable results in each stream reach. Physical variability of habitat within a reach is accounted for through reach-wide sampling of the various water depths, substrates, and flow conditions throughout the stream. The monitoring networks defined in this QAPP will provide samples that are representative of the medium being sampled as well as sufficient samples to meet the project DQOs.

Sample representativeness may also be evaluated using the RPDs or RSDs for field replicate results.

Comparability

Data comparability is defined as the measure of the confidence with which one data set can be compared to another. Comparability is a qualitative parameter but must be considered in the design of sampling plans and selection of analytical methods, quality control protocols and data reporting requirements.

Comparability shall be ensured by collecting and analyzing samples obtained in accordance with appropriate SOPs. BMI monitoring protocols in this monitoring plan are consistent with BMI protocols used in the Clark Fork River basin and incorporate EPA habitat protocols (Barbour et al., 1999; EPA 1998). Adherence to these commonly accepted protocols will result in standardized data collection.

The results of analyses collected under this QAPP will be compared with previously collected data for sites specified in Table 5 and Table 6. All data should be calculated and reported in units consistent with standard reporting procedures so that the results of the analyses can be compared with those of other laboratories, if necessary.

Completeness

Completeness refers to the amount of usable data produced during a sampling and analysis program. The procedures established in this QAPP are designed to ensure, to the extent possible, that data shall be valid and usable. To achieve this objective, every effort shall be made to collect each required sample and to avoid sample loss. The QAPP completeness goal is 95 percent for each matrix.

Sensitivity

Sensitivity refers to the capability to quantify an analyte at a given concentration, and this parameter is associated with the instrument and method detection limits, and the project reporting limits. The desired analytical sensitivity for surface water are method detection limits less than the applicable water quality standards specified in Table 2. The desired sensitivity for sediment analyses are method detection limits less than the PECs displayed in Table 3. Table 11, Table 12, and Table 14 in Section 3.1 display analytical sensitivity. Taxonomic sensitivity is the ability to identify specimens to the lowest practical taxonomic level. However, limitations such as specimen damage exist; thus, the required taxonomic sensitivity is to the family.

2.5 Special Training

All personnel engaged in on-site activities are required to have proper health and safety training as required by the Occupational Safety & Health Administration (OSHA) Regulation 29 CFR 1910.120 (HAZWOPER). Personnel who completed their initial HAZWOPER training more than 12 months prior to the start of the project must have completed an 8-hour refresher course within the appropriate time frame relative to their duties. The Project Safety and Health Manager is responsible for ensuring the field crews are compliant with HAZWOPER training.

Field personnel shall be trained in the requirements of this QAPP in a project meeting held prior to the initiation of any field activity. All personnel shall also read the QAPP document prior to the start of fieldwork and shall acknowledge that they have read the document at the time of the project meeting. In addition, prior to conducting sampling activities, the CPM, or designee, shall review field procedures and sampling requirements to better ensure that samples are collected and handled according to the QAPP requirements.

Field personnel will be trained in the use of field equipment, decontamination procedures and chain-of-custody procedures in accordance with field data collection SOPs used for the sampling event. This training will be documented within the appropriate section of each SOP. The CPM will be responsible for ensuring that training requirements are fulfilled.

One hard copy of the current approved version of this QAPP shall be maintained for ready reference purposes in the field vehicle or field office. All field team members shall have access to pdf files of the complete QAPP.

Laboratories providing analytical services will have a documented quality system that complies with EPA Requirements for Quality Management Plans (QA/R-2) (EPA, 2001b). The Laboratory Quality Manager will be responsible for ensuring that all personnel have been properly trained and are qualified to perform assigned tasks.

2.6 Documents and Records

This section briefly describes the procedures for management of project documentation and records for this QAPP from initial generation of the data to its final use and storage in the project files.

2.6.1 Property Access Agreements

Atlantic Richfield will request that property owners grant access for monitoring related activities which may occur on private property. The CPM or their designee will manage requests for access, track the status of access requests and maintain copies of completed agreements received from property owners. Completed agreements will be scanned and stored on a server with other project records.

2.6.2 Field Logbooks/Data Sheets

Documentation of observations in the field provides information on conditions at the time of sampling and a permanent record of field activities. Field records will be kept in a bound field logbook, in field forms (electronic or paper), or both. The logbook may reference more detailed records found in the electronic field forms, or vice versa. Each logbook shall have a unique document control number, and the logbooks will be bound and have consecutively numbered pages. The information recorded in the logbooks shall be written in indelible ink. Whenever a sample is collected, or a measurement is made, the sample site identification and any additional observations will be recorded in the field book. Electronic forms for the majority of tasks associated with this QAPP will be developed, and these forms will be available on digital tablets. Paper forms may be used for habitat assessment. Each form, whether electronic or paper, will have a unique document control number, and once completed, the forms will be checked for accuracy and completeness, and saved. The forms will be uploaded to a main server daily.

Field logbooks and electronic field forms will include the information listed below, at a minimum:

- Date of the field work
- Names and titles of field personnel;
- Meteorological conditions at the beginning of field work and any ensuing changes in the weather conditions;
- A description of the field task;
- Time field work started;
- All field measurements made;

- Any field analysis results;
- Personnel and equipment decontamination procedures.
- Identifying information of any field contacts or site visitors (e.g., agency representatives, auditors, etc.);
- Details of the field work performed and the field forms used, with special attention to any deviation from the QAPP or applicable SOPs.

For sample collection, the following entries will also be made, as applicable to the sample type:

- Calibration of any field equipment;
- Identification of field equipment, including make, model, and serial number if available;
- Sample location and ID number;
- Staff gauge reading;
- Date and time of sample collection;
- Sample type collected;
- Sample field preparation;
- Sample preservative;
- Final field parameters (temperature, pH, SC, etc.);
- Split samples taken by other parties (note the type of sample, sample location, time/date, name of person, person's affiliation and any other pertinent information);
- Sampling method, particularly any deviations from the SOPs;
- Documentation or reference of preparation procedures for reagents or supplies that will become an integral part of the sample (if any used in the field).

Changes or deletions in the field logbook will be recorded with a single strike mark through the changed entry, with the sampler's initials and the date recording the new entry. All entries must remain legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without having to rely on the sampler's memory.

Completed field data forms will be stored electronically on a main server, using a file structure that separates forms by project and date. No electronic field forms will be deleted, even if they contain inaccuracies that require a replacement document.

Within the time period this QAPP will be implemented, effluent may be entering Silver Bow Creek, near its confluence with Blacktail Creek, as part of the BMFOU Discharge Pilot Project. As stated above in Section 2.1, the field team leader will be the point of contact for communications regarding BMFOU related discharge. Prior to conducting normal flow monitoring, the Field Team Leader will be informed of the discharge status (steady-state, planned fluctuations, shut-down, etc.). This communication will be documented in the field logbook, or on electronic field forms, as appropriate. Should upset conditions occur during normal flow monitoring, this will be documented in the field logbook/field form. *The Silver Bow Creek/Butte Area NPL Site Butte Mine Flooding Operable Unit Draft Final Silver Bow Creek/Butte Area NPL Site Communication Plan* (Atlantic Richfield, 2021a) details how the upset conditions are communicated to the Field Team Leader. Wet weather monitoring will occur, regardless of the discharge status; however, any upset conditions which occurred during the storm event hydrograph will be communicated to the field team leader and documented in the field logbook/field form.

2.6.3 Field Photographs

When photographs of field activities are taken, a digital camera will be used. Specifically, photographs should be taken of unexpected circumstances (i.e. a damaged staff gauge). Photographs should include a scale in the picture when practical. With respect to habitat assessments, photographs will be taken as necessary to document site conditions and stream habitat features to support and illustrate rating categories for the visual-based RBP.

The following items shall be recorded on the electronic field record for each photograph taken:

- The photographer's name, date, time, and the general direction faced;
- A brief description of the subject and the fieldwork portrayed in the picture; and
- Sequential number of the photograph.

The digital files shall be placed in project files with copies of supporting documentation from the bound field logbooks.

2.6.4 Chain of Custody Records

After samples have been collected, they will be maintained under strict chain-of-custody protocols in accordance with CFRSSI SOP-G-7. The field sampling personnel will complete a chain-of-custody form for each sample shipment (e.g., batch of coolers) delivered to the laboratory for analysis. The sampler is responsible for ensuring that the chain-of-custody is initiated and completed. The chain-of-custody for a sample shipment will list only the samples in that shipment.

Information contained on the chain-of-custody will include the following, as applicable to the sample media:

- Project name and identification number;
- Sampler's signature and affiliation;
- Date and time of collection (date only for BMI samples);
- Sample identification number and matrix;
- Analyses requested;
- Preservative used;
- Remarks such as any additional notes to laboratory personnel (e.g., filter in lab or known sample hazards);
- Signature of persons relinquishing custody, dates and times; and
- Signature of persons accepting custody, dates and times.

Any documentation, including chain-of-custody forms, placed inside the cooler during sample shipment should be placed inside a re-closeable plastic bag.

The sampler whose signature appears on the chain-of-custody is responsible for the custody of the samples from the time of sample collection until custody of the sample is transferred to a designated laboratory, a courier or another project employee for the purpose of transporting the samples to the designated laboratory. The sample is considered to be in custody when the sample is: (1) in the responsible individual's physical possession; (2) in the responsible individual's visual range after having taken possession; (3) secured by the responsible individual so that no tampering can occur, (4) secured or locked by the responsible individual in an area in which access is restricted to authorized personnel; or (5) transferred to authorized personnel.

An electronic copy of each transmitted chain-of-custody will be stored on a main server, within project record files (refer to Section 3.9).

2.6.5 Laboratory Records

Results received from the laboratories will be documented both in report form and in an electronic format. Laboratory documentation includes copies of the signed chain-of-custody forms, laboratory confirmation reports including information on how samples have been batched and the analyses requested, data packages including the lab report and the electronic data deliverable (EDD), and any change requests or corrective action requests. Taxonomy laboratory reports will indicate whether the samples were sub-sorted. Section 5.1.3 presents the project's laboratory reporting requirements in detail. Electronic report deliverables ("data package" or "report") issued by the laboratories will include data necessary to complete validation of laboratory results in accordance with specifications in Section 5.2.2.

Original hard copy deliverables and electronic files received from laboratories will be maintained with the project quality records (refer to Section 3.9).

2.6.6 Project Data Reports

A Data Summary Report (DSR) will be prepared based on guidelines in the *CFRSSI Pilot Data Report Addendum* (ARCO, 2000b) following each year of data collection and evaluation. The DSR will describe the field activities performed during implementation of the QAPP and the physical characteristics of the study area. The DSR will include field documentation, documentation of field QC procedures, and results of all field and laboratory measurements and analyses. A detailed listing of any deviations from the approved QAPP will also be provided, with an explanation for each deviation and a description of the effect on data quality and usability, if any. A discussion of the data quality assessment, which is addressed in greater detail in Section 5.0, will be included in the DSR.

Annually, a Surface Water Compliance Comparison and Interpretation Report will be submitted in draft form to the EPA for review. This report will present validated COC data for all perennial surface water stations from the previous year's monitoring effort. Compliance station data and performance station data will be compared to the surface water Performance Criteria presented in Table 2. The total number of exceedances and deviations for each COC for the calendar year, as well as the running total of any previous exceedances, will be included. Should exceedances have occurred, the number of surface water deviations will be detailed. The report may include additional interpretation of surface water data collected under the QAPP, but interpretation is not necessary.

Quarterly reports will be submitted within 60 days of the end of each quarter. These reports will consist of a cover letter, Excel spreadsheets containing provisional analytical and field measured data collected in the previous quarter, and a link to TREC's data portal. The submittal will be limited to data collected under this Interim Site-Wide Surface Water QAPP. The cover letter will inventory the attached spreadsheets and provide the validation status of the analytical data. The cover letter will also explain that validated analytical data will be provided in the forthcoming DSR.

The CPM and QAO are responsible for preparation of the DSR and the Compliance Comparison and Interpretation Report which will be submitted in draft form to the EPA for review. The DSR will be submitted annually, by May 31 of the year following monitoring. The Compliance Comparison and Interpretation Report will be submitted annually by June 30 of the year following monitoring. Within 60 days of receipt of Agency comments, the draft DSR will be revised to address the comments and resubmitted to the EPA for final approval. Numerical data presented in Annual Reports will be stored in the Butte Data Management System (BDMS) database. Finalized reports will reside on the BPSOU Document Sharepoint Site. Data management is fully described in the *Draft Final BPSOU Data Management Plan* (DMP) (Atlantic Richfield, 2020b)

2.6.7 Program Quality Records

Program quality records are defined as completed, legible documents that furnish objective evidence of the quality of items, services, or activities affecting quality, or the completeness of data. These records shall be organized and managed by the Atlantic Richfield contractor and shall include, at a minimum:

- This QAPP and any approved revisions or addenda;
- Approved versions of the Health and Safety Plan (HSP) and any addenda;
- Copies of SOPs for field data collection, with any updates, revisions or addenda to those SOPs;
- Incoming and outgoing project correspondence (letters, telephone conversation records, and e-mail messages);
- Electronic field forms;
- Habitat assessment forms
- Electronic copies of completed sample chain-of-custody forms;
- Copies of all laboratory agreements and amendments;
- As-received laboratory data packages;
- Documentation of field and/or laboratory audit findings and any corrective actions; and
- Draft and final delivered versions of all reports and supporting procedures such as statistical analyses, numerical models, etc.

3.0 MEASUREMENT AND DATA ACQUISITION

The elements in this section address all aspects of project design and implementation for the generation and acquisition of data. Implementation of these elements ensures that appropriate methods for sampling, sample handling, laboratory analysis, field and laboratory QC, instrument/equipment testing, inspection, and maintenance, instrument/equipment calibration, data management and data security are used for all phases of the investigation.

3.1 Sampling Process and Design

This QAPP has been developed to define the requirements for normal flow, wet weather, and diagnostic surface water monitoring within the BPSOU. The following provides a description of the monitoring objectives, locations, frequencies, and analytes.

3.1.1 Surface Water Monitoring Objectives

The objectives of the BPSOU Surface Water monitoring program are:

- Evaluate compliance with Performance Standards at point of compliance monitoring stations;
- Evaluate performance of the remedy, in its various stages of implementation; and
- Evaluate any necessary diagnostic data collected for the purpose of identifying currently implemented remedial system component optimization or maintenance, and necessary to inform FRE design.

3.1.2 Surface Water Monitoring Network, Frequencies, and Analytes

Surface water monitoring performed under this QAPP includes stage and flow measurements at the sites specified in Table 4, as well as collecting water quality samples at the sites specified in Table 5. These tables also specify the monitoring frequency. The monitoring locations are shown in Figure 2 for Creek Monitoring and Figure 3 for Sub-Drainage Diagnostic Monitoring. Site coordinates are provided in Table 10. Table 11 specifies field parameter measurements and laboratory analysis for creek stations, while Table 12 specifies laboratory analysis for sub-drainage stations. Contaminants of concern, aluminum, arsenic, cadmium, copper, iron, lead, mercury, silver, and zinc, are critical information; while additional parameters are considered informational data.

Table 10 – Surface Water Monitoring Site Coordinates and Location Description

Site	Coordinates		Description
	Latitude	Longitude	
SS-01	45.985271	-112.507762	Blacktail Creek (BTC) USGS Station at Harrison Ave, upstream of the BPSOU. USGS WQ monitoring to be discontinued at this site with the establishment of station 12323233 (SS-01.35)
SS-01.35	45.991139	-112.527239	Blacktail Creek USGS station upstream of Grove Gulch
SS-04	45.994635	-112.536114	Blacktail Creek upstream of its confluence with the SBC near George Street.
SS-05	45.995769	-112.539176	SBC station at Montana Street, downstream of the SBC-BTC confluence and below the BG outfall.
SS-05A	45.996215	-112.544249	Station located at the beginning of the SBC rebuilt floodplain at the east end of LAO; downstream of old SBC diversion channel.
SS-06A	45.994484	-112.551751	Station located in rebuilt SBC floodplain upstream of the Montana Pole Treatment Plant (MPTP) effluent discharge.
SS-06G	45.996413	-112.562797	Station located at end of the SBC rebuilt floodplain at the west end of LAO, downstream of the Montana Pole Treatment Plant and Butte Treatment Lagoons discharge points and upstream of the historic HCC outlet and the Butte Metro Sewage Treatment Plant effluent.
SS-07	45.996626	-112.563646	Station located downstream of all BPSOU drainage outfalls as SBC exits the OU near Interstate 90.
BG-CLV-1	45.996249	-112.537154	Provides diagnostic monitoring for the entire BG drainage just before confluence with SBC above Montana St.
GG-CH-1	45.989613	-112.528865	Provides diagnostic monitoring of the GG drainage just before entering BTC. This drainage is primarily urban.
GG-CLV-C	45.992814	-112.55211	Located in inflow of culvert off Greenwood Avenue. Will provide diagnostic monitoring for uncaptured surface flow in Sub-drainage C
GG-CLV-D	45.989581	-112.547453	Located in inflow of culvert off Greenwood Avenue. Will provide diagnostic monitoring for uncaptured surface flow in Sub-drainage D

Site	Coordinates		Description
	Latitude	Longitude	
GG-CLV-I	45.993951	-112.55113	On MPTP property. Will provide diagnostic monitoring for uncaptured surface flow in Sub-drainage I
LC-CLV-1	46.001692	-112.513436	Located in a culvert on Locust Street just prior to discharge into SBC. This will provide diagnostic monitoring at the bottom of a large basin east of SBC.
MG-CLV-0	45.996758	-112.544017	Provides diagnostic monitoring of Missoula Gulch discharge entering into SBC between SS-05A and SS-05B.
MPTP-CLV-1	45.994099	-112.548682	Provides diagnostic monitoring for the Montana Pole Treatment Plant surface water runoff entering into Silver Bow Creek between SS-05A and SS-06A.
MSD-CLV-3A	45.995375	-112.530662	Post reclamation SBC station located upstream of its confluence with BTC, just east of Kaw Ave, and upstream of the end of the sub-drain collection pipe.
TX-HD-OUT	46.002462	-112.512355	Provides diagnostic monitoring of the large urban area to the southeast of SBC just before the drainage enters SBC.

Table 11 - Creek Monitoring Parameter List and Associated Analytical Methods, Approximate Method Detection Limits, Reporting Limits, and Holding Times

Analyte	Resolution	Accuracy	Source	Event Monitored
Field Parameters - Field Measured with YSI Professional Plus				
Dissolved Oxygen (mg/L)	0.01	Greater of ± 2% or reading or 0.2 mg/L	CFRSSI SOPs	NF
Temperature (℃)	0.1	0.2	CFRSSI SOPs	NF
pH (s.u.)	0.01	0.2	CFRSSI SOPs	NF
Specific Conductivity (µs/cm)	0 to 500 µS/cm: 1 µS/cm 501 to 5000 µS/cm: 10 µS/cm	Greater of 1 µS/cm or ± 0.5% of reading	CFRSSI SOPs	NF

Trace Elements – Total Recoverable and Dissolved Fractions[1] (ug/L)						
Analyte	**MDL (µg/L)**	**Reporting Limit (µg/L)**	**Holding time (days)**	**Method**	**Source**	**Event Monitored**
Aluminum	8.0	20	180 Days	EPA 200.8	EPA	NF, WW
Arsenic	0.083	0.50	180 Days	EPA 200.8	EPA	NF, WW
Cadmium	0.016	0.080	180 Days	EPA 200.8	EPA	NF, WW
Dissolved Calcium	18	40.0	180 Days	EPA 200.8	EPA	NF, WW
Copper	0.50	1.0	180 Days	EPA 200.8	EPA	NF, WW
Iron	12	50.0	180 Days	EPA 200.8	EPA	NF, WW
Lead	0.028	0.10	180 Days	EPA 200.8	EPA	NF, WW
Dissolved Magnesium	3.4	10	180 Days	EPA 200.8	EPA	NF, WW
Mercury	0.0047	0.010	28 Days	EPA 245.1	EPA	NF, WW
Molybdenum	0.094	0.50	180 Days	EPA 200.8	EPA	NF, WW
Silver	0.16	0.50	180 Days	EPA 200.8	EPA	NF, WW
Zinc	2.0	5.0	180 Days	EPA 200.8	EPA	NF, WW
General Laboratory (mg/L)						
Analyte	**MDL (mg/L)**	**RL (mg/L)**	**Holding time (days)**	**Method**	**Source**	**Event Monitored**
Hardness (as $CaCO_3$)	0.060	0.14	180 Days	SM 2340B	Standard Methods	NF, WW
Alkalinity (as $CaCO_3$)	1.8	5	14 Days	SM 2320B[2]	Standard Methods	NF, WW
Nitrate + Nitrite	0.078	0.20	28 Days	SM 4500-NO_3 H[3]	Standard Methods	NF, WW
Sulfate	0.34	1.2	28 Days	EPA 300.0	EPA	NF, WW
TDS	5	10	7 Days	SM 2540C[2]	Standard Methods	NF, WW
TSS	5	10	7 Days	SM 2540D[2]	Standard Methods	NF, WW
Additional Parameters (mg/L) (only applied to specific stations as listed in QAPP)						
Analyte	**Resolution**	**Accuracy**	**Holding time (days)**	**Method**	**Source**	**Event Monitored**
pH (s.u.)	0.01	0.1	Continuously field measured	TIENet 301/ISCO Signature	CFRSSI SOPs	WW
Analyte	**MDL (mg/L)**	**RL (mg/L)**	**Holding time (days)**	**Method**	**Source**	**Event Monitored[4]**
Ammonia	0.030	0.10	28 Days	EPA 350.1	EPA	NF, WW

Analyte	MDL (mg/L)	RL (mg/L)	Holding time (days)	Method	Source	Event Monitored[4]
Dissolved Organic Carbon	0.30	1.0	28 Days	SM 5310C[5]	Standard Methods	NF, WW
Total Phosphate	0.050	0.10	28 Days	SM 4500-P-F[2]	Standard Methods	NF, WW
Total Kjeldahl Nitrogen	0.48	0.50	28 Days	EPA 351.2	EPA	NF, WW

[1] Calcium and Magnesium dissolved fraction only

[2] Standard method run by 1997 edition

[3] Standard method run by1997 and 2000 editions

[4] NH_3, DOC, TKN, and Total P collected only for the first WW event of the month. NF and WW collected only at SS-01, SS-01.35, SS-06G, and SS-07

[5] Standard method run by 2000 edition

Table 12 - Sub-Drainage Diagnostic Monitoring Parameter List and Associated Analytical Methods, Approximate Method Detection Limits, Reporting Limits, and Holding Times

Analyte	MDL (µg/L)	RL (µg/L)	Holding time (days)	Method	Source
Trace Elements – Total Recoverable and Dissolved Fractions (ug/L)					
Arsenic	0.083	0.50	180 Days	EPA 200.8	EPA
Cadmium	0.016	0.080	180 Days	EPA 200.8	EPA
Copper	0.50	1.0	180 Days	EPA 200.8	EPA
Iron	12	50.0	180 Days	EPA 200.8	EPA
Lead	0.028	0.10	180 Days	EPA 200.8	EPA
Mercury	0.0047	0.010	28 Days	EPA 245.1	EPA
Zinc	2.0	5.0	180 Days	EPA 200.8	EPA
General Laboratory (mg/L)					
Sulfate	0.34	1.2	28 Days	EPA 300.0	EPA
TSS	5	10	7 Days	SM 2540D	EPA

Variability in surface water quality and flow data is expected considering the range of monitoring conditions which may occur. However, normal flow COC concentrations should remain within recent historical ranges. Wet weather flow COC concentrations are far more likely to have outliers, but extreme outliers will be investigated. To limit variability due to stage readings, flow measurements, sampling, and analysis, consistent methods will be used in accordance with applicable SOPs. Field documentation will occur during surface water monitoring, and should significant variability be found in stage, flow, or water quality results, this documentation will be consulted. In addition, unexpected analytical results will be verified by contacting the laboratory and requesting a data review, and by validating 100% of analytical data to ensure that laboratory QC criteria were met.

3.1.3 Sediment, BMI, and Habitat Monitoring Objectives

The objectives of the BPSOU sediment monitoring program are:

1. Evaluate if sediment sample concentrations exceed the PECs for specific sampling locations and depths in BTC and SBC within the BPSOU and in background/reference reaches in BTC upgradient of BPSOU;
2. Evaluate trends for streambed sediment sample concentrations of PEC metals in SBC within BPSOU and in background/reference reaches in BTC upgradient of BPSOU;
3. Evaluate benthic community structures and habitat conditions within BPSOU and in background/reference reaches upgradient of BPSOU; and
4. Evaluate trends in the benthic community structures and habitat conditions in BTC and SBC within BPSOU and in background/reference reaches in BTC upgradient of BPSOU.

3.1.4 Sediment, BMI, and Habitat Monitoring Locations, and Frequencies

Sediment and BMI samples will be collected annually in the reaches specified in Table 6. Both sediment and BMI sampling will occur in mid-August to early-September of each year. Habitat assessment will be conducted every five years or more frequently as necessary. Table 13 provides approximate coordinates of sediment/BMI monitoring stream reach endpoints and the reaches are displayed on Figure 4.

Reach lengths for BMI and habitat assessments will be determined as 40 times the channel width or a minimum of 150 meters (~ 500 ft). Each reach is determined by measuring the wetted width at five representative locations within the proposed reach. The average of the five widths is calculated to the nearest meter, and the reach length is defined as 40 times the average width or a minimum of 150 meters. Starting at the estimated midpoint of the sampling reach, a distance of 20 channel widths is measured downstream using a tape measure. The distance is measured by walking along the streambank and paralleling the middle of the channel to avoid disturbing the stream channel prior to sampling activities. The downstream endpoint of the 20 channel widths is flagged as transect “A”. Subsequently, one-tenth of the required stream length is measured upstream from the starting point (transect A), and this location is flagged as the next cross-section transect (transect B). This process is continued in the upstream direction at intervals equal to one-tenth of the reach length, flagging the positions of the eight additional transects (labeled “C” through “J”). These transects will serve as monitoring locations in years that habitat assessments are made. Figure 5 presents an example of a sample reach layout.

Sediment and BMI sampling during wet weather events will be avoided because of the unsafe conditions associated with high flows and the difficulty performing the monitoring in high flows. Additionally, biological and chemical conditions of the stream may be significantly different during wet weather events than those during base flow. The decision to sample during or following any precipitation will be based on the judgment of the field team and documented as appropriate.

Care will be taken to minimize seasonal variation by sampling as close as possible to the same date each year. Mid-August to early-September provides a target index period appropriate for biomonitoring in this region for several reasons. First, adequate time has passed for the stream habitat to stabilize following snowmelt runoff. Second, the representation of the BMI community reaches a maximum from mid-spring to late summer.

Table 13 – Sediment, BMI, and Habitat Monitoring Stream Reach Coordinates

Reach number Associated SW Site	Approximate Upstream Endpoint		Approximate Downstream Endpoint		Description
	Latitude	Longitude	Latitude	Longitude	
Reach 1 SS-01	45.9852	-112.5062	45.985271	-112.50776	BTC above BPSOU Reach extends upstream from SS-01
Reach 2 SS-06A	45.9946	-112.5511	45.99429	-112.55208	BTC within BPSOU Reach midpoint
Reach 3 SS-06G	45.9963	-112.5616	45.996413	-112.5628	SBC at BPSOU terminus Reach extends upstream from SS-06G

3.1.5 Sediment Monitoring Analytes

Sediment samples will be sieved to less than 2 mm and analyzed for the parameters listed in Table 14. Particle size analysis will include percent clay, silt, and sand; but, the differing particle sizes will not undergo chemical analysis. Metals concentrations are critical data, while all other analyses are informational.

Table 14 - Sediment Monitoring Parameter List and Associated Analytical Methods, Approximate Method Detection Limits, Reporting Limits, and Holding Times

Analyte	MDL[1] (mg/Kg)	RL (mg/Kg)	Holding time (days)	Method	Source
Arsenic	0.10	0.50	180 Days	EPA 6020B	EPA
Cadmium	0.030	0.08	180 Days	EPA 6020B	EPA
Copper	0.23	1.0	180 Days	EPA 6020B	EPA
Lead	0.028	0.20	180 Days	EPA 6020B	EPA
Mercury	0.0081	0.02	28 Days	EPA 7471B	EPA
Zinc	0.86	5.0	180 Days	EPA 6020B	EPA
TOC	25.5	100	28 Days	Walkley-Black	EPA
pH (s.u.)	0.10	0.10	NA	ASA 10-3.2	ASA
Particle Size	0.1%	0.1%	NA	ASA 15-5	ASA

[1]The MDLs presented represent 2021 (most recent) values. MDLs are determined annually and may fluctuate.

3.1.6 BMI Monitoring Parameters

The stream reaches specified in Table 6 will be sampled for BMI community structure, and Table 7 lists the metrics used for BMI assessment. In-situ measurements of pH, temperature, dissolved oxygen, and specific conductance will be made during BMI monitoring efforts. BMI community data are considered critical information, while other parameters are informational.

3.1.6.1 Physical (Habitat) Parameters

Habitat characteristics assessed will include epifaunal substrate and available cover; embeddedness and pool substrate characterization; velocity, depth, and pool variability; sediment deposition; channel flow status; channel alteration; frequency of riffles and channel sinuosity; bank stability; vegetative protection; and the riparian vegetative zone. Habitat assessment is considered informational data.

Should a surface water, sediment, or BMI monitoring site become inaccessible on a temporary basis, if possible, the monitoring schedule will be revised to provide accessibility. Should a monitoring site become permanently inaccessible, the need for the site will be evaluated. If it is determined that the monitoring objectives can be achieved without the inaccessible site, with Agency approval, it will be removed from the monitoring network. Should the site be deemed necessary, actions to provide access will be implemented or an alternate site will be proposed.

3.2 Sampling Methods

This section details methods that will be used to carry out all aspects of surface water, sediment, and BMI monitoring and habitat assessments.

3.2.1 Applicable Standard Operating Procedures (SOPs)

A list of the SOPs used for the site investigation are listed below in Table 15 and included in Appendix A. SOPs may be updated as needed, upon approval from the Agencies. All samples will be collected following guidelines set forth in the Clark Fork River Superfund Site Investigations Standard Operating Procedures (CFRSSI SOPs) (ARCO, 1992) or TREC internal SOPs.

Table 15 - Project Sampling SOP References

Reference Number	Title, Revision Date	Originating Organization
G-4	Field Logbook/Photographs	ARCO
G-5	Sample Packaging and Shipping	ARCO
G-6	Field Quality Control Samples	ARCO
G-7	Sample Custody	ARCO
SOP G-8	Decontamination of Equipment Used to Sample Soil and Water	ARCO
SOP-H-01	Water Sampling Equipment Decontamination	TREC, Inc.
SOP-H-02	Downloading Transducers	TREC, Inc.

Reference Number	Title, Revision Date	Originating Organization
SOP-H-03	Download Weather Station	TREC, Inc.
SOP-H-05	Calibrate YSI Professional Plus Multi-Meter	TREC, Inc.
SOP-S-01	Bump Testing the VENTIS MX4 Gas Meter	TREC, Inc.
SOP SS-3	Sediment Sampling Streams, Ponds and Lakes	ARCO
SOP SS-6	Compositing of Soil Sample	ARCO
SOP-SW-01	Surface Water Sampling	TREC, Inc.
SOP-SW-02	Flow Measurements in Wadable Streams	TREC, Inc.
SOP-SW-03	Change H350 Stage Recorder Data Card	TREC, Inc.
SOP-SW-04	Download ISCO Stage Recorder	TREC, Inc.
SOP-SW-05	Download Sutron Stage Recorder	TREC, Inc.
SOP-SW-06	Read Staff Gauge	TREC, Inc.
SOP-SW-07	Change ISCO Batteries	TREC, Inc.
SOP-SW-08	Automatic and Mechanical Sampler Setup	TREC, Inc.
SOP-SW-09	Collect Sample from DTEC Sampler	TREC, Inc.
SOP-SW-10	Collect Sample from ISCO Sampler	TREC, Inc.
SOP-SW-11	D-TEC Sample Preparation	TREC, Inc.
SOP-SW-12	Surface Water Wet Weather Sample Preparation	TREC, Inc.
SOP-SW-13	Change ISCO Batteries on Samplers Located in Manholes	TREC, Inc.
SOP-SW-14	Collect Sample from ISCO Sampler in Manhole	TREC, Inc.
SOP-SW-16	Signature Bubbler Setup	TREC, Inc.
SOP-SW-17	Construction of TTEC Sampler	TREC, Inc.
SOP-SW-18	Calibrate TieNet 301 pH Sensor (Signature Bubbler)	TREC, Inc.
SOP-SW-19	Download Signature Bubbler Data Files with Laptop	TREC, Inc.
SOP-SW-20	Wet Weather Trigger Criteria	TREC, Inc.
SOP-SW-21	Stage-Discharge Curve Creation	TREC, Inc

3.2.2 Data Collection Method

Data collection methods for all aspects of surface water monitoring, sediment monitoring, BMI monitoring, and habitat assessment are described within this section.

3.2.2.1 Meteorological Data

Meteorological monitoring will occur throughout the monitoring period, including during wet weather events, so that relationships between rainfall and runoff can continue to be evaluated. Figure 6 identifies the sites for which meteorological measurements will be made. Precipitation is currently being monitored at CB-1, Kelley Mine, Blacktail Canyon, BMMA, BTL/LAO, and the Basin Creek SNOTEL site. The frequency of measurements varies by station. BMMA and Basin Creek stations report daily data, Blacktail Canyon reports hourly data, and CB-1 report 30-minute data. BTL/LAO data are reported on a 15-minute frequency, while Kelley Mine data are reported every 6 minutes. Weather stations Kelley Mine, CB-1, and BTL/LAO make measurements with a Davis Instruments Vantage Pro2, which measures wind direction and speed, precipitation, and temperature, along with several other meteorological parameters. TREC maintains the weather stations at Kelley Mine and CB-1, while Pioneer Technical Services is responsible for the BTL/LAO station. The Kelley Mine and BTL/LAO weather stations upload data to Weather Underground, thus have infinite storage capacity. Storage capacity for the CB-1 weather stations is approximately 45 days at a 30-minute recording rate. Weather stations other than Kelley Mine, CB-1, and BTL/LAO are maintained by other entities and use various equipment to report weather parameters.

3.2.2.2 Flow Measurements

Surface water flow measurements will be performed according to the applicable TREC and CFRSSI SOPs (ARCO 1992d). Surface water flow measurements are to be conducted with equipment consistent with CFRSSI SOPs, unless updated equipment is available, in which case that equipment can be used with the appropriate SOPs. Table 4 identifies the sites for which surface water flow measurements will be made, along with the frequency for normal flow and wet weather monitoring. Table 16 identifies the precision for each type of flow monitoring equipment that will be used for BPSOU surface water monitoring. Equipment listed in Table 16 will be maintained in accordance with manufacturer's instructions. Much of the equipment in Table 16 is permanently deployed at dedicated sites and is in contact only with the water body in which it is deployed. Thus, cross-contamination or contamination from outside sources is not applicable. However, the equipment will be inspected on a regular basis, and fouling agents removed if necessary. At several sites, ISCO equipment is removed during winter months; and prior to re-deployment, that equipment will be thoroughly cleaned.

Table 16 - Flow Measurement Equipment Specifications

Parameter	Equipment	Unit	Resolution
Manual Flow	Flo Mate 2000	ft/s	0.01 ft/s
Continual Flow	ISCO 2150 A-V meter	cfs	0.01 cfs
Continual Stage	ISCO 4230 Flow Meter	feet	0.01 ft
Continual Stage	Water Log H350/355 Bubbler System	Feet	0.01 ft
Continual Stage	Solinst Pressure Transducer	Feet	0.01 ft
Continual Stage	Sutron 9210 XLITE Bubbler System	Feet	0.01 ft

Creek Normal Flow Conditions

Staff gauges will be read to an accuracy of 0.01 feet before and after flow measurements are taken. Staff gauges are installed and secured with a cement foundation or other method to prevent movement during higher flows. Manual flow measurements will be made with a Marsh McBirney Flo Mate 2000 in accordance with SOP-SW-02. Continual water depth measurements will be made with continuous stage recorders such as ISCO Signature, ISCO 4230, Water Log H350, and Sutron 9210 X-Lite bubbler systems, and Solinst pressure transducers. Continual stage monitoring equipment will be set to collect a data point every 15 minutes. Water Log, Sutron, and Solinst equipment are set in linear mode, while ISCO equipment is set in roll-over mode. The minimum storage capacity for these devices is 75 days; thus, data loss should not occur if data is downloaded monthly. Although storage capacity is sufficient to prevent data loss, several of the ISCO stage recorders run on battery power, and health and safety concerns beyond the control of Atlantic Richfield may prevent regular battery maintenance, resulting in data losses. Table 4 shows the flow measurement method to be used for each site. Table 16 identifies the precision for each type of flow monitoring equipment.

Creek Wet Weather Conditions

Continuous stage recorders, in combination with stage-discharge curves developed from manual flow measurements, will be used for continuous flow monitoring at Creek sites. Continuous stage recorders will be downloaded with a laptop computer, or a hand-held field device specific to the recorder type, with appropriate communication cables. Stage-discharge curves are developed according to USGS protocol (Sauer 2002). Stations SS-01.35, SS-05, and SS-07 continuous flows are maintained by USGS, and the USGS developed curves are used. Table 4 shows the flow measurement method to be used for each site. Table 16 identifies the precision for each type of flow monitoring equipment.

Sub-Drainage Wet Weather Conditions (Diagnostic Monitoring)

For diagnostic continuous flow measurements, ISCO 2150 area-velocity (A-V) meters will be used. A-V meters record water velocity and flow depth, then calculate flow, based on these parameters. This method will be applied to storm drain pipes, culverts, and/or weirs installed in channels. A-V meters are set to record at 5-minute intervals. A-V meters will be downloaded with a laptop computer, an electronic tablet, or a hand-held field device specific to the recorder type, with appropriate communication cables. Table 4 shows the flow measurement method to be used for each site. Table 16 identifies the precision for each type of flow monitoring equipment.

3.2.2.3 Surface Water Sample Collection

Surface water sampling and sample handling, preservation, custody, and other associated activities will be performed per the applicable TREC and CFRSSI SOPs for surface water sampling and sample water filtration. Surface water sampling is to be conducted with equipment consistent with CFRSSI SOPs, unless updated equipment has been made available, in which case updated equipment can be used. Table 5 identifies the sites for which surface water samples will be collected along with the frequency. Table 5 also identifies the type of sampling equipment used at each wet weather and diagnostic location. Water quality samples will be taken in accordance with SOP-SW-01 for normal flow, and SOP-SW-09, SOP-SW-10, SOP-SW-11, and SOP-SW-12 for wet weather flow. Table 17 provides a bottle count and preservative used for each laboratory analysis. Table 11 provides a list of analytical parameters for creek normal flow and wet weather sampling events, while Table 12 lists analytical parameters for sub-drainage wet weather diagnostic events.

Table 17 – Surface Water Monitoring Analytical Bottle Count and Preservative Addition

Analytes	Sampling Container	Preservative	Filter	Comments
General Laboratory				
Alkalinity (as CaCO3)	Polyethylene, 1 x 1 L	None, refrigerate 0°C-6°C	None	1 container for all four analyses
Sulfate	Polyethylene, 1 x 1 L	None, refrigerate 0°C-6°C	None	
Total Dissolved Solids	Polyethylene, 1 x 1 L	None, refrigerate 0°C-6°C	None	
Total Suspended Solids	Polyethylene, 1 x 1 L	None, refrigerate 0°C-6°C	None	
Inorganic Chemicals				
Ammonia	Polyethylene, 1 x 250 mL	pH<2 sulfuric acid, refrigerate 0°C-6°C	None	1 container for all three analyses
Nitrate+Nitrite	Polyethylene, 1 x 250 mL	pH<2 sulfuric acid, refrigerate 0°C-6°C	None	
Total Phosphorous	Polyethylene, 1 x 250 mL	pH<2 sulfuric acid, refrigerate 0°C-6°C	None	
Metals				
Dissolved Metals[A,B]	Polyethylene, 1 x 250 mL	pH<2 nitric acid, refrigerate 0°C-6°C	0.45-micron filter	1 container for all metals
Total Metals[C]	Polyethylene, 1 x 250 mL	pH<2 nitric acid, refrigerate 0°C-6°C	None	1 container for all metals
Additional Parameters				
Dissolved Organic Carbon	Amber Glass, 1 x 250 mL	pH<2 sulfuric acid, refrigerate 0°C-6°C	0.45-micron filter	-
Total Kjeldahl Nitrogen	Polyethylene, 1 x 250 mL	pH<2 sulfuric acid, refrigerate 0°C-6°C	None	-

[A]Dissolved metals analysis includes: Aluminum, Arsenic, Cadmium, Calcium, Copper, Iron, Lead, Magnesium, Mercury, Molybdenum, Silver, and Zinc.

[B]Hardness determined by SM2340B; calculation using dissolved Calcium and Magnesium concentrations.

[C]Total metals analysis includes: Arsenic, Cadmium, Copper, Iron, Lead, Mercury, Molybdenum, Silver, and Zinc.

Creek Normal Flow Conditions

Samples will be collected as per SOP-SW-01. Samples will be collected using equal width increment (EWI) sampling techniques; and at areas where the stream is not well mixed, a churn splitter will be used to adequately mix stream water. To minimize impacts from sediment mobilization, sites will first be sampled for water quality, and flow measurements will follow; additionally, sites will be sampled in a downstream to upstream order. Samples to be analyzed for dissolved metals and dissolved organic carbon will be field filtered through 0.45-micron disposable filters into clean laboratory bottles. Appropriate preservative (nitric acid for metals, sulfuric acid for DOC, NO_2/NO_3, NH_3, TKN, and phosphorus) will be present within or added to the sample bottle. Samples will be sent to the lab and analyzed for the parameters indicated in Table 11.

Field parameters will be measured using a hand-held field meter(s) which measures dissolved oxygen (DO), pH, specific conductivity (SC), and temperature. The meter bulkhead will be placed as near to mid-stream as possible, but this is controlled by the cord length. Field parameters will be allowed to stabilize prior to being recorded. Field parameter measurement units and precision are specified in Table 11.

Creek Wet Weather Conditions

Samples will be collected using automated samplers (ISCO 3700 and D-TECs) as defined in Section 2.4.1. Sample collection will be initiated at a pre-determined stage; and, ideally this stage will be reached within the first half hour of a wet weather event. Once initiated, ISCO 3700 automated samplers will collect four time-composited samples through the first four hours of the runoff hydrograph. Each of the four samples will consist of six sample aliquots collected at ten-minute intervals, over one hour. D-TECs will collect one sample at the beginning of the runoff hydrograph and will be submitted for analysis in the event of an ISCO failure. Samples will be retrieved quickly after sampling, preserved on ice, and transported to the office for sample preparation. Samples to be analyzed for dissolved metals and DOC will be filtered through 0.45-micron disposable filters into the bottle type indicated in Table 17. Appropriate preservative (nitric acid for metals, sulfuric acid for DOC, NO2/NO3, NH3, TKN, and phosphorus) will be present within or added to the sample bottle. Samples will be sent to the lab and analyzed for the parameters detailed in Table 11.

Continuous pH measurements will be made at 15-minute intervals with a TIENet 301 – ISCO Signature pH sensors system at SS-01, SS-06G, and SS-07. With the TIENet/Signature system, an ISCO pH probe is placed in the water body and connected to the TIENet sensor device. The sensor device transmits to the Signature flow meter where the data is recorded and stored. Measurement units, accuracy, and resolution for all parameters are specified in Table 11.

Sub-Drainage Wet Weather Conditions (Diagnostic Monitoring)

Samples will be collected using automated samplers (ISCO 3700) set to collect within the first half hour of a wet weather event as defined in Section 2.4.1. Samplers will be set to trigger/collect at a stage as low as practical but will only be collected if meeting the rainfall criteria of greater than 0.15 inches, and the frequency criteria of up to two sample events per month. Once triggered to sample, ISCO 3700 automated samplers will collect six to eight samples throughout the runoff hydrograph, until the programming routine has completed, or runoff ceases. Samples will be collected quickly after collecting, preserved on ice, and transported to the office for sample preparation. Samples to be analyzed for dissolved metals will be filtered through 0.45-micron disposable filters into clean laboratory bottles. Appropriate preservative (nitric acid for metals) will be present within or added to the sample bottle. Samples will be sent to the laboratory and analyzed for the parameters detailed in Table 12**.**

BSB will perform occasional Operations and Maintenance (O&M) activities on the Missoula Gulch catch basins that may result in a discharge from CB-9. TREC will be informed by BSB of O&M activates prior to commencement of the activity. If discharge from CB-9 occurs and water flows through channel to SBC during the wet weather season, a sample will be collected by the automated sampler at MG-CLV-0 and will be labeled as such. If discharge from CB-9 occurs and water flows through channel to SBC outside of wet weather season, when automated samplers are not deployed, an opportunistic field grab sample will be collected as per SOP-SW-01 using equal width increment sampling techniques if flow width deems it necessary. Samples will be prepped and preserved as stated above and sent to the laboratory to be analyzed for parameters listed in Table 12.

ISCO 3700 samplers will be deployed in-situ during wet weather season. When automatic samplers collect, polyethylene sample bottles are filled. Prior to re-use, these bottles will be thoroughly decontaminated. When deployed, ISCO 3700 samplers include intake tubing and an intake screen. New tubing will be used and the intake screen will be thoroughly cleaned at the beginning of each sampling season. The tubing and screen will be periodically checked for damage or fouling throughout the wet weather season and cleaned or replaced as necessary. Continual pH measurements will be monitored at select sites with a TIENet 301 – ISCO Signature pH sensors system. Similar to the checks on sampler tubing and intake screens, pH probes will be periodically checked for fouling or damage and cleaned or replaced as necessary.

3.2.2.4 Sediment Sample Collection

Sediment samples will be collected using the methods in SOP SS-3 along the stream reaches specified in Table 13 and displayed on Figure 4. Spatially composited samples will be collected within each stream reach. If condition prevent collection of five subsamples, as many as possible will be collected and the deviation will be recorded in the field notes. Sediment sampling tubes will be used to obtain the samples, providing variable depth-controlled samples. Sub-sample locations will be spread along the stream reach. Exact sub-sample locations will be determined in the field, since these will be dependent on the location of sediment deposits. For each stream reach, the sub-samples will be composited into a single sample for each of three depth intervals. Target depth intervals will be 0-2 inches, 2-6 inches, and 6-12 inches; thus, each stream reach will result in a maximum of three spatially composited samples. Although an attempt will be made to identify and sample depositional areas, sediment depth may limit collection of the deeper intervals.

Sample collection will proceed in a downstream to upstream order. Bed sediment samples will be collected at each sub-sample location by directly pushing a plastic sediment sampling tube or auger straight down into the streambed. The sampling device may be a clear tube or a clam-digger type device. The sampler will be pushed by hand, without the aid of any additional means (i.e., hammering). Once the sampler has been pushed into the bed sediment, sampling personnel will provide suction by either sealing the top of the tube (i.e., with a gloved hand) or sealing the clam-digger by covering the suction hole, and slowly extract the tube, in a manner that retains the sample. Once extracted, a sampling depth will be determined for each subsample location by measuring the length of sediment in the tube. This depth, along with sediment characteristics (color, texture, odor, grain size and sorting estimate) will be recorded in the field book or appropriate field form. Subsamples from each location will be composited into a single site sample by depositing all subsamples (specific to each depth increment) into a stainless-steel bowl, homogenizing the sample (as described in SOP-SS-6), and recovering a portion of the sample for laboratory submittal. An attempt will be made to collect equal volumes at each sub-sample location, and to produce equal volume samples for each of the three stream reaches. Table 18 specifies container and preservative requirements for sediment samples. Since the subsamples will be composited, it is unnecessary to decontaminate the tube between subsample locations. Bowls will be dedicated to each site, disposable mixing devices will be used, and a new tube or dedicated clam-digger will be used at each sample site. Although no equipment will be re-used, any equipment which is not disposed of will be decontaminated both prior to and after use.

Whenever possible, samples will be collected over the full depth of sediment to the hard bottom. If no hard bottom is present, the maximum depth of sampling will be 12 inches. The depth of each sub-sample will be recorded in the field book, or on the electronic field form, along with soil characteristics of each sub-sample.

Table 18 – Sediment Monitoring Sample Container Requirements

Analytes	Sampling Container	Preservative
Metals[A]	4 oz Amber Glass Jar or equivalent volume in quart re-sealable plastic bag or	None, refrigerate 0°C-6°C
TOC	4 oz Amber Glass Jar	None, refrigerate 0°C-6°C
pH, Particle Size	Quart re-sealable plastic bag (500 g minimum sample volume)	None, refrigerate 0°C-6°C

[A]Metals analysis includes: Arsenic, Cadmium, Copper, Lead, Mercury, and Zinc.

3.2.2.5 BMI Sample Collection

At each site, four replicate BMI samples will be collected from riffle habitats using a Hess sampler with 1,000-micron mesh netting. BMI sampling will be conducted in riffle habitats from the least embedded, most heterogenous cobble substrates found at each site. In the event where a riffle is not found, a run will be sampled instead.

When the field team arrives to the stream site, they will first confirm the stream is not unduly influenced by rain events and that stream conditions are safe. The sampling reach from within which all subsequent sampling activities are conducted is first established (Section 3.1.4). In-situ water chemistry measurements are made followed by BMI sampling and then habitat assessments if in a 5-year cycle monitoring period. Sediment monitoring will occur within seven days of BMI monitoring and surface water monitoring may occur within the same week as BMI monitoring. If manual surface water monitoring is conducted in the same week as BMI monitoring, a minimum of two days will pass between BMI monitoring and surface water monitoring, if BMI monitoring precedes surface water monitoring. Sediment monitoring will follow both BMI and surface water monitoring. If surface water and BMI monitoring are conducted in separate weeks, sediment monitoring may immediately follow BMI monitoring; however, BMI monitoring will be completed at each stream reach prior to sediment monitoring. This sequence of sampling events will avoid instream disturbances that may influence water chemistry, in-situ water measurements, and BMI samples.

BMI samples are collected by placing the Hess sampler (see Figure 7) on the stream bottom with the net portion downstream and the screened opening of the cylinder facing into the current. The Hess sampler is placed quickly and firmly to the stream bottom to ensure fast-moving invertebrates are enclosed within the cylinder portion of the sampler. Once the sampler is in place with the screened opening of the Hess sampler facing the current, the net is stretched, and invertebrates are collected in the sample device. Gravel and cobble are lightly scrubbed by hand inside the cylinder portion of the sampler to dislodge and carry specimens by the current through the downstream window into the net and sample device. Each stone is examined for organisms, larval or pupal cases that may be clinging to it before discarding. After cleaning off all cobble and larger gravel within the sampler, the remaining gravel and sand are stirred by hand to dislodge bottom-dwelling organisms.

After removing the sampler from the stream, the net is rinsed from the outside into the collection bucket and carefully examined for small organisms clinging to it. If present, these are removed with forceps and placed in the sample.

Replicate samples (4) from each sampling reach are collected and transferred into pre-cleaned, 1-liter wide-mouthed plastic containers and preserved in the field with 95% ethanol. Fish or other non-BMI organisms are excluded from the sample.

3.2.2.6 Habitat Sampling

The objective of habitat assessments is to characterize geomorphology, riparian and in-stream habitat, and physical characteristics that influence the structure and function of BMI communities. Habitat assessment employs EPA's RBP (Barbour et al, 1999) and EPA's EMAP stream habitat procedure (EPA, 1998). RBPs will be performed concurrently with BMI monitoring and the EMAP stream habitat procedure will be performed immediately following BMI sample collection in years that habitat assessments are completed.

The RBP is a visual-based stream assessment in which field biologists record observations of catchment and stream characteristics that are useful for future data interpretation. The RBP method will be applied during each annual biomonitoring event. The EMAP procedure employs more quantitative data collection on physical habitat. The full EMAP method (provided in Appendix D) will be applied during the first biomonitoring event and on five-year cycles, at a minimum. Select components (e.g., slope, sinuosity, canopy cover) of these assessments which are not expected to significantly change may be reduced or eliminated following the initial biomonitoring events.

The RBP procedure involves rating 10 habitat parameters on a scale from 0 to 20 according to EPA's scoring criteria (Barbour et al, 1999) along each stream reach. Ratings for each parameter are based on a continuum of conditions including optimum, suboptimal, marginal, and poor. Field forms and field assessment guidelines for rating each parameter are provided in Appendix D. The following provides a brief description of each parameter.

1. **Epifaunal Substrate/Available Cover:** includes relative quantity and variety of natural structures in the stream, such as riffles, substrate type, woody debris, and bank structure.
2. **Embeddedness/Pool Substrate Characterization:** includes degree to which substrate are covered or embedded with fine-grain sediment.
3. **Velocity / Depth / Pool Variability:** includes the variety of pools found in the reach considering depth, size, and velocity.
4. **Sediment Deposition:** includes the degree of sediment accumulation and deposition on stream substrates.
5. **Channel Flow Status:** includes the extent to which the stream channel is filled with water including over stream substrates.

6. **Channel Alteration:** includes channel configuration and/or channel alteration (channelization or other channel modifications).
7. **Frequency of Riffles/Channel Sinuosity:** includes the frequency of riffle habitat (heterogeneity of instream physical habitats) and degree of sinuosity.
8. **Bank Stability:** includes condition of banks/potential for bank erosion considering steepness (incision), vegetative cover, and overall stability.
9. **Vegetative Protection:** includes extent of vegetative protection to streambank and near-stream portion of the riparian zone.
10. **Riparian Vegetative Zone:** includes the width of vegetation from streambank through riparian zone.

Each RBP metric is summed to provide an overall habitat score for the site which can range from 0 to 240.

In the EMAP procedure, measurements are taken systematically along the entire sample reach. The sample reach, established as 40 times the wetted width or a minimum of 150 m, is divided into 11 channel cross-sections at equal intervals along the reach length, as described in Section 3.1.4. Flagging or other markers are placed on streambanks to mark the 11 channel cross-sections. Figure 5 presents a plan view diagram of a sample reach layout for conducting the EMAP habitat assessment.

There are four components of EPA's 1998 EMAP physical habitat characterization: Thalweg Profile, the Large Woody Debris Tally, Channel and Riparian Cross-Sections, and Stream Discharge. Note that discharge measurements are not necessary at sites co-located with USGS gaging stations which supply 15-minute interval discharge data. Elements of the remaining three EMAP components are provided in Appendix D, following the RBP assessment forms.

3.2.3 Sampling Equipment

The complete field equipment needs for sampling are:

- Hard or electronic copy of the QAPP;
- Electronic field tablet, which is loaded with appropriate sampling forms;
- Bound and numbered field notebook;
- Long and short impervious gloves
- Sample labels and waterproof marker;
- Sample containers
- Sample coolers and ice;
- Required Level D Personal Protective Equipment (PPE) including hard hat, safety glasses with side shields, high visibility vest (or shirt), long-sleeved shirt, and safety-toed boots/waders

Surface Water

- Padlock keys;
- Churn Splitter;
- Multi-meter, or individual DO, pH, SC, and temperature meters;
- Peristaltic pump;
- Appropriate tubing;

- 0.45-micron disposable filters;
- Sample bottles
- Decontamination water, decontamination solutions
- Portable flow meter, wading rod, and cloth tape measure (English scale with 1/10th markings)

<u>Sediment</u>

- GPS device
- Sampling device (tubes or clam-digger type samplers)
- Stainless-steel bowls
- Disposable plastic scoops
- Sample containers, amber jars and re-sealable plastic freezer bags
- Decontamination water, decontamination solutions

<u>BMI</u>

- Field measurement forms
- Field operations and methods manual
- Procedure tables and quick reference guide
- 1-gallon re-sealable plastic freezer bags
- GPS device
- Multi-meter, or individual DO, pH, SC, and temperature meters
- Modified Hess sampler (0.1 m^2 diameter)
- 2 White buckets/containers, 8-quart capacity
- 2 Forceps
- Small spatula, spoon, or scoop for sample transfer
- Funnel with large bore spout
- Sample jars
- Ethanol preservative

<u>Habitat Assessment</u>

- Pencils (#2)
- Channel/Riparian cross-section and Thalweg forms
- Slope and bearing form
- Rapid bioassessment form for riffle/run prevalent streams
- Rapid bioassessment form for pool/glide prevalent streams
- Assessment form for visual stream assessment
- Hip chain (metric) for measuring stream lengths
- 50-m fiberglass measuring tape/reel
- Surveyor’s flagging or flags/stakes
- Surveyor’s telescoping rod (metric scale, 7.5 m extended)
- Digital camera or camera capable tablet
- Clinometer (or Abney level) with percent and degree scales
- Spherical convex canopy densiometer, modified with taped “V”

- Bearing compass (backpacking style)

Unexpected problems relating to data collection may include samples being spilled and equipment failures. In the event of a sample spill in the field, the site will be re-sampled. Since surface water sampling is synoptic and associated with specific flow conditions, re-sampling a single surface water site at a later date is not judicious. Thus, the chance of surface water spills in route to the lab will be minimized by packing coolers in a manner which eliminates void spaces and retains sample bottles in an upright position. Although sediment and BMI sites can be re-sampled, within reasonable time frames, if sample spills occur during shipping, these samples will also be packed in a manner which eliminates void spaces and minimizes the chance of spills. Field team members will be responsible for resampling when sample spills occur in the field. The Field Team Leader will be informed of sample spills which occur during storage or shipment and will document such spills in the project records (field logbook, electronic forms).

Equipment failures may occur with pumps, batteries, field meters, laptop computers, communication cables, or manufacturer specific download devices. Spare pumps, batteries, laptop computers, and communication cables will be kept on hand. Two field multi-meters will be available, and spare probes will be kept on hand for the meters. However, there may be meter failures which require factory repair, in which case a rental meter will be obtained. Solints® transducers are downloaded with manufacturer specific download devices (Leveloader or Bluetooth® device); however, a laptop computer can be used in the event of Leveloader/Bluetooth® failure. The Field Team Leader will be responsible for maintaining an inventory of spare equipment, as well as ordering replacement or rental equipment.

3.3 Sample Handling and Custody

3.3.1 Sample Holding Time

Maximum holding times between sample collection and sample laboratory analysis are provide in Table 11 and Table 12 (surface water) and Table 14 (sediment). BMI samples can be held indefinitely, providing preservative is changed every three months. Continuous water level monitors at BPSOU sites are set to record data on 5-minute (A-V meters) or 15-minute intervals, and these recorders will typically be downloaded on a monthly basis. Since continuous water level monitors deployed at BPSOU sites have a 75-day storage capacity, there is adequate storage capacity for a monthly download schedule. However, several of the ISCO continuous recorders run on battery power, and health and safety concerns beyond the control of Atlantic Richfield may prevent batteries being maintained on a schedule which avoids data loss.

3.3.2 Sample Handling and Storage

After collection and labeling, surface water and sediment samples will be placed in coolers and kept between 0 and 6°C. BMI samples have neither temperature nor holding time requirements; thus, will be stored in coolers at room temperature. All samples will be maintained under strict chain-of-custody protocols. Field sampling personnel will complete a chain-of-custody form for each laboratory delivery/shipment. The chain-of-custody form(s) will be placed in a re-sealable plastic bag and placed in the cooler with the samples. CFRSSI SOP G-5 states that samples will be shipped within two weeks of sample collection; however, an attempt will be made to ship/deliver surface water samples collected under this QAPP within one day of sample collection/preparation. Analyses for TDS, and TSS have a 7-day holding time, which requires that samples are shipped as soon as possible after collection. Sediment and

BMI samples will be shipped at least weekly. Surface water and sediment samples will be placed in coolers, along with a sufficient volume of double-bagged ice to maintain a sample temperature of 0 to 6°C up until the time of sample receipt by the laboratory. Since BMI samples do not have a temperature requirement, they will be placed in coolers, without ice, for laboratory shipment. Should void spaces exist in coolers containing any of the three sample medias, these spaces will be filled with non-contaminating packing material to prevent samples from shifting, and possibly spilling, during shipment. Coolers which are shipped will be custody sealed, securely taped shut, and have a shipping label securely adhered to the cooler. Sample containers hand delivered to the laboratory do not need to be prepared for shipping, but surface water and sediment sample temperature must be maintained between 0 and 6 °C.

The sampling personnel whose signature appears on the chain-of-custody is responsible for the custody of the samples from the time of sample collection until custody of the samples is transferred to a designated laboratory, a courier, or to another project employee for the purpose of transporting the samples to the designated laboratory. Custody is transferred when both parties to the transfer complete the portion of the chain-of-custody under "Relinquished by" and "Received by”. Signatures, printed names, company names, dates and times are required. Upon transfer of custody, the sampling personnel who relinquished the samples will retain the third sheet (pink copy) or photocopy of the chain-of-custody. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody. The tracking number of any sample container shipped will be recorded in the logbook. Copies, receipts and carbons of Bills of Lading will be retained as part of the permanent documentation in the project file. It is not necessary for courier personnel to sign the chain-of-custody as long as custody seal(s) remain intact until receipt by the intended entity.

Upon laboratory receipt, the samples will be inspected for sample integrity. The chain-of-custody will be immediately signed, dated and reviewed by laboratory personnel to verify completeness. Any discrepancies between the chain-of-custody and sample labels and any problems or questions noted upon sample receipt will be communicated immediately to the Field Team Leader. The laboratory shall provide the Field Team Leader and Contractor Quality Assurance Officer with the associated sample-receipt information within two working days of sample receipt. The sample-receipt information routinely provided will include sample receipt date, sample IDs transcribed from the chain-of-custodies, sample matrix type and list of analyses to be performed for each sample. Broken custody seals, damaged sample containers, sample labeling discrepancies between container labels and the chain-of-custody form, and analytical request discrepancies shall be noted on the chain-of-custody form. The Field Team Leader and Contractor Quality Assurance Officer shall be notified of any such problems; and discrepancies or non-conformances shall be resolved and addressed before the samples are analyzed.

The laboratory will be responsible for following their internal custody procedures from the time of sample receipt until sample disposal. Samples and extracts shall be stored in a secure area controlled by the laboratory’s designated sample custodian. Samples shall be removed from the shipping container and stored in their original containers unless damaged. Damaged samples shall be disposed of in an appropriate manner after notifying the Field Team Leader and Contractor Quality Assurance Officer, and authorization to dispose is received and documented. In addition, samples shall be stored after completion of analyses in accordance with contractual requirements.

3.3.3 Field Documentation

All field entries will be recorded in a bound logbook, on electronic or paper field forms (habitat assessment), or both the logbook and form. Logbook entries and field forms will be completed prior to proceeding to the next sample location. All field logbook and field form entries will be consistent with CFRSSI SOP G-4. Specific entries will include but are not necessarily limited to the following: sample location; sample date and time; staff gauge reading (as applicable); sample identification number; sample analysis, sample field preparation, sample preservative, final field parameters (as applicable), sampling equipment decontamination, weather conditions, personnel present and associated organization, and any deviations from the QAPP protocol.

3.3.4 Sample Identification and Labeling

All samples collected will have a unique sample ID that follows an alpha-numeric code. A label will be placed on each sample bottle, and every label will contain the following information: sample ID, sample date, sample time, requested analysis, preservative added, field preparation method (i.e. filtered), and samplers' initials. The same information will be recorded on the field form, along with the sample site. The sample ID on the bottle will exactly match the sample ID on the field form and on the chain-of-custody.

The field sample identification scheme consists of letters to identify the sample type, followed by a 3 or 4-digit number to identify sample number. The sample number is followed by 6 digits representing the monitoring date. The following are examples of sample identification codes:

Sample Code: SWWW0073-081222

SW	=	Surface Water Sample
WW	=	Wet Weather Sample (BF=Normal Flow) (SD=Storm Drain) (OM=Operations and Maintenance sample)
0073	=	Sample number of 73
081222	=	Monitoring date of 8/12/2022

Sample Code: SED001-081222-0612

SED	=	Bed Sediment
001	=	Sample number of 1
081222	=	Sample date
0612	=	Depth interval (inches)

Sample Code: BMI001-A-081222

BMI	=	Benthic macroinvertebrate
001	=	Sample number of 1
A	=	Replicate A of sample number 1
081222	=	Sample date

3.3.5 Sample Chain of Custody

The sampler is responsible for initiating and filling out the chain-of-custody. Each sample in the shipment will be listed on the chain-of-custody; and, the chain-of-custody will contain the project code, the project name, sample IDs, sample dates, samples times, analyses requested, preservative used for each sample analysis, any remarks, name and signature of person relinquishing samples, date and time samples were relinquished, name and signature of sample recipient, and date and time samples were received. Sample time is not required on the BMI chain of custody. Example chain of custody forms can be found in Appendix E.

3.3.6 Sample Disposal

Disposable equipment and all other solid waste associated with sample collection will be immediately placed in trash bags to avoid cross-contamination and to maintain an orderly work environment. The bagged trash will be disposed of at a waste disposal facility.

3.4 Laboratory Methods

Surface water and sediment samples will be analyzed using the appropriate methods consistent with the CFRSSOU LAP, (ARCO, 1992a), American Public Health Association (APHA) Standard Methods for the Examination of Water and Wastewater, EPA, and American Society of Agronomy (ASA) protocols. The analytical method and detection limit requirements will be updated as required by the governing regulatory agency. BMI samples will be processed using protocols for laboratory subsampling, sorting, and taxonomy described in the Montana DEQ *Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Community SOP* (DEQ, 2012).

3.4.1 Sample Preparation Methods

Surface water and sediment samples will be prepared for analysis as the EPA approved methods dictate. BMI samples will be prepared for processing as outline in the Montana DEQ *Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Community SOP* (DEQ, 2012).

3.4.2 Sample Analysis Methods

Surface water and sediment samples will be analyzed in accordance with the appropriate EPA approved method. A summary of sample analyses and methods is provided for Creek monitoring in Table 11, for Sub-drainage diagnostic monitoring in Table 12, and for sediment monitoring in Table 14. These tables include current detection and reporting limits, but these are determined on an annual basis; thus, they will fluctuate and will be updated in the annual revisions to this QAPP as necessary. BMI samples will be processed as outline in the Montana DEQ *Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Community SOP* (DEQ, 2012).

3.4.3 Laboratory Equipment

Required laboratory equipment are an inductively coupled plasma mass spectrometer, an autosampler, and an analytical balance for metals/metalloids analysis by EPA 200.8 and SW846 6020B. Mercury analysis requires a cold vapor atomic adsorption analyzer, an autosampler, a block digester, and an analytical balance. Anion analysis requires an ion chromatograph and TKN analyses require a discrete analyzer. Alkalinity analysis requires a pH meter, magnetic stir plates and magnetic stir bars, an autotitrator system, a hot plate, and an analytical balance. Gravimetric samples require an analytical balance, drying ovens, a muffle furnace, a vacuum filtration system, and a desiccator.

Additional laboratory equipment needs are a colorimetric analyzer, stir plates, magnetic stirrers, a block digestor, a vortex mixer, a carbonaceous analyzer, a pH meter, a spectrophotometer, and appropriate gases, oils, glassware, pipettes, tubing.

Sediment sample preparation equipment requirements are a drying cabinet, number 10 sieves, pipettes, digestion cups, plunge filters, a hot block, and an analytical balance. Sediment pH measurements require a pH meter, spatula, cups with caps, funnels, a vacuum pump, filter paper, filter holder, test tubes with stoppers, weigh pans, an analytical balance, and an oven. Additional equipment requirements are a spectrophotometer for sediment TOC analysis and appropriately sized sieves, a hydrometer, a mechanical shaker, a sedimentation cylinder, and shaker bottle for sediment particle size analysis.

BMI laboratory equipment requirements are a microscope, associated slide and slide mounting materials, and taxonomy reference materials.

3.4.4 Sample Disposal

Disposable equipment associated with laboratory analyses will be immediately placed in trash receptables and disposed of at appropriate waste disposal facilities. Samples which are shipped to the laboratory will be archived for six months, and after that time the laboratory is responsible for sample disposal.

3.5 Quality Control

Field and laboratory QC requirements are similar for surface water and sediment sampling; however, QC requirements for BMI and habitat monitoring differ considerably. Therefore, QC requirements for surface water and sediment samples are discussed first, and BMI and habitat QC assessments follow.

Field sample QC protocols for surface water sampling will be consistent with CFRSSI SOP G-6 and will include 1 field duplicate for every 20 primary samples and 1 field blank collected for every 20 primary samples. Field sample QC samples for sediment sampling will be 1 field duplicate for every 20 primary samples. Since sediment sampling equipment is site-dedicated or disposable, field blanks are not required. Any deviation from the CFRSSI or other SOPs, or this QAPP, will be identified in the logbook and discussed in a data summary report, or similar, if required.

3.5.1 Surface Water and Sediment Field Quality Control Samples

Field quality control samples are introduced into the measurement process to provide information on transport, storage and field handling biases, and field sampling precision. The QC samples that follow will be collected for analysis identical to that which is required on primary samples. Brief descriptions of the QC samples to be utilized during surface water and sediment sampling are provided below, along with instructions for their frequencies of collection and analysis.

<u>Field Duplicate</u>

A field duplicate is a second sample collected from the same location in immediate succession to the primary sample, using identical techniques. Duplicate samples will be collected for surface water and sediment sampling. The duplicate sample will have its own unique sample identification number, but will be sealed, handled, shipped, and analyzed in the same manner as the primary sample. Analysis will be identical for the primary and duplicate sample. The analytical results of the duplicate sample will be compared to determine sampling precision, with a target precision of ≤ 20% RPD for aqueous samples and ≤ 35% RPD for sediment samples. The 20%/35% RPD between the sample and duplicate are applicable if both the sample and duplicate are ≥ five times the RL. If either the sample or duplicate is < five times the RL, the control limit is an absolute difference between the sample and duplicate ≤ RL for aqueous samples and ≤ 2X RL for solid samples. Field duplicate samples will be collected at a frequency of one per 20 samples or once per sampling event.

Field Blank

Field Blanks will be used to help identify possible contamination from the sampling environment, from sampling equipment, or from sample handling. A Field Blank (FB) for aqueous samples is deionized water and appropriate preservatives prepared in the field. The FB is contained in a sample container randomly chosen from each lot of containers received from the supplier. Aqueous field blanks will be collected by pouring ASTM Type II DI water into a single-use plastic container and triple rinsing. The container will then be filled with ASTM Type II DI water, and sample aliquots requiring filtration will be pumped from this container. Sample aliquots which do not require filtration will be poured from the DI carboy, directly into the sample bottle.

Creek normal flow surface water sampling involves use of a churn splitter at SS-05 and SS-07. A separate site-dedicated churn splitter is used at each site, and the churn splitters are thoroughly decontaminated in the field laboratory after each use. For normal flow sampling, the field blank will be collected quarterly at a site which requires use of a churn splitter. Since churn splitters are decontaminated in the field laboratory after each use, the field blank will be collected prior to sample collection. ASTM Type II DI water will be poured into the churn splitter and a small amount of DI water will be briefly run through the spigot. Bottles designated for sample analyses that do not require filtration will be collected first, and aliquots which require filtration will be collected last. Unfiltered samples will be collected by dispensing DI water through the spigot. Filtered samples will be collected by dropping tubing into the churn splitter and pumping water through the filter into the sample bottles. The exterior portion of the tubing will be rinsed with DI water prior to dropping it into the churn splitter. Field blanks collected in this manner mimic the procedures used for dispensing natural samples through a churn splitter.

Field blanks for solid samples will consist of clean silica sand poured over decontaminated sampling equipment, into the sample container.

The FB sample will be given its own sample identification, but will be sealed, handled, shipped, and analyzed in the same manner as the primary sample. With the exception that sediment field blanks will not include particle size and pH analysis, field blank analysis will be identical to the primary samples. Field Blanks will be prepared at a frequency of one per 20 samples collected, or one per sampling event, whichever is more frequent. The target is to achieve concentrations less than the method detection limit (MDL) in field blanks.

3.5.2 Surface Water and Sediment Laboratory Quality Control Samples

Laboratory QC samples are introduced into the measurement process to evaluate laboratory performance and sample measurement bias. Laboratory QC samples may be prepared from environmental samples or generated from standard materials in the laboratory. The appropriate type and frequency of laboratory QC samples are described in the associated method. Examples of typical laboratory QC samples are listed in Table 9.

Method Blank

Method blanks should be prepared and analyzed for every 20 samples analyzed. The method blank is laboratory DI water which has gone through the applicable sample preparation and analysis procedure. Control limits are a concentration < ½ RL. The complete control limits and corrective actions for control limit failures are outlined in Table 9.

Laboratory Control Sample

A laboratory control sample (LCS) consists of a laboratory blank sample with a known concentration of the target analyte. The LCS sample is prepared and analyzed in the same manner as field samples. Percent recovery of the target analytes in the LCS helps determine whether the laboratory's methodology is accurate. For the majority of analyses, one LCS should be analyzed for every 20 samples analyzed. As Table 9 shows, control limits vary depending on the analysis. If the LCS fails to meet the specified control limit, the analysis must be terminated, the problem corrected, and samples in the failed LCS batch must be re-analyzed.

Laboratory Duplicates

Laboratory duplicate (LD) samples test laboratory precision, and one LD sample should be analyzed for every 10 to 20 samples, as indicated in Table 9. Samples which are known to be field blanks cannot be used for LD samples. Control limits vary depending on the analysis, and these are summarized in Table 9. The relative percent differences (RPD) between the sample and duplicate are specified in these tables and are applicable if both the sample and duplicate are ≥ five times the RL. If either the sample or duplicate is < five times the RL, the control limit is an absolute difference between the sample and duplicate no greater than the RL. Should LD samples fail to meet control limits, and the samples in the associated batch are of a similar matrix, then associated sample results should be flagged. If samples in the associated batch are not similar to the parent sample used for the LD, then only the parent sample used to prepare the duplicate should be flagged.

A laboratory control spike duplicate (LCSD) is a duplicate of the LCS. The LCSD tests laboratory reproducibility. As Table 9 indicates, LCSD samples are not required for all analyses. In the event of LCSD precision outside of control limits, affected data should be flagged.

A matrix spike duplicate (MSD) is a duplicate of the matrix spike (MS). The MSD is used to determine analytical precision and bias of a method in a sample matrix. As Table 9 indicates, MSD samples are not required for all analyses, and criteria vary depending on the method. In the event of MSD precision outside of control limits, the parent sample and associated batch will be flagged. If the associated batch is of a dissimilar matrix to the parent sample, only the parent sample shall be flagged.

Matrix Spike

Matrix spike (MS) samples evaluate the effect of the sample matrix on sample preparation and measurement methodology. One MS must be analyzed for each group of 10-20 samples, as indicated in Table 9. The control limit for MS samples varies depending on the analysis, and these are stated in Table 9. The control limits are applicable when the parent sample concentration is < four times the spike added. If the parent sample concentration is ≥ four times the spike added, this recovery criterion is waived. Samples which are known to be field blanks cannot be used for MS samples. In the event of MS recovery outside of control limits, the parent sample and associated batch will be flagged. If the associated batch is of a dissimilar matrix to the parent sample, only the parent sample shall be flagged.

3.5.3 BMI and Habitat Assessment Field Quality Control

Field sampling precision measures the extent of variability in the sampling method and is related to the variability of collecting replicate samples within a reach. Sampling precision is estimated by collecting four replicate samples of the BMI communities within the same reach during the same day. The precision goal is an RSD of ≤ 20% among the four replicate samples for the taxa richness metric.

The habitat assessment is based on field measurements and observations so there is no sample collection associated with this procedure. Each biologist will be trained and experienced in the visual-based RBP and EMAP procedure for application to western U.S. streams. A team of two biologists will observe all habitat features along the stream corridor and come to a consensus on determining the quality and ratings. Ratings will be supported via photo documentation of relevant habitat features.

The data sheets on which the habitat measurements are recorded in the field at each site will be reviewed for reasonableness, completeness, and transcription errors. Calculations necessary to compute the various habitat parameters described will be checked for accuracy. Before leaving a stream sampling reach, all field forms will be checked for completeness by a second person.

3.5.4 Taxonomy Laboratory Quality Control

The QA/QC protocols for laboratory subsampling, sorting, and taxonomy described in the Montana DEQ Benthic Macroinvertebrate Community SOP will be followed in addition to those described below.

Completeness

All samples will be checked for completeness after sorting by the taxonomist. Ten percent of the samples will be checked by a second taxonomist. A sample passes this check if the second taxonomist finds less than a 5% difference in the number of organisms found by the original taxonomist. If there is greater than a 5% difference between the original and second count, then extraction continues in those portions picked, and the sample is rechecked until there is less than a 5% difference between the subsequent and original counts.

Taxonomy and Enumeration

Quality assurance for taxonomy and enumeration (Whittaker, 1975; Stribling, 2003) is conducted on a randomly assigned set of 10% of the samples. Under this protocol, a second taxonomist re-identifies and counts all organisms in the sample, and an abundance-weighted similarity index is calculated between the results from the two taxonomists. A percent similarity greater than 95% is required to pass. If the percent similarity is less than 95% and the sample is rejected as a result of a misidentification, then all other samples with the same misidentification are rechecked and an additional sample is selected for a QA check. This process continues until the percent similarity for identifications and counts for the selected sample is greater than 95%

3.6 Instrument/Equipment Testing, Inspection and Maintenance

In order to ensure continual quality performance of any instrument or equipment, testing, inspection and maintenance shall be performed and recorded as described in this section.

3.6.1 Field Equipment

Field equipment will be examined to certify that it is in proper operating order prior to its first use. Equipment, instruments, tools, gauges and other items requiring preventative maintenance will be serviced in accordance with the manufacturer's specified recommendations. Field equipment will be cleaned and safely stored between each use. Any routine maintenance recommended by the equipment manufacturer will also be performed and documented in field logbooks or appropriate data sheets. Equipment will be inspected and the calibration checked, if applicable, before it is transported to a field setting for use. Personnel responsible for field equipment examination, cleaning, maintenance, and storage include the field team leader, the QAO, and field team personnel.

3.6.2 Laboratory Equipment

Instruments used by the laboratories will be maintained in accordance with each laboratory's Quality Assurance Plan and analytical method requirements. All analytical measurement instruments and equipment used by the laboratory shall be controlled by a formal calibration and preventive maintenance program.

The laboratories will keep maintenance records and make them available for review, if requested, during laboratory audits. Laboratory preventive maintenance will include routine equipment inspection and calibration at the beginning of each day or each analytical batch, per the laboratory's internal SOPs and method requirements. Laboratory personnel are responsible for laboratory equipment examination, cleaning, maintenance, and storage.

3.7 Instrument/Equipment Calibrations and Frequency

Field multi-meters will be calibrated, prior to use as necessary. Meters will be calibrated following manufacturer's instructions, and using manufacturer recommended calibration solutions. Calibration logs will be stored electronically within project files, recorded within project field logbooks, or both. Calibration failures will result in meters being immediately removed from service. Once repaired, and successfully calibrated, meters will be returned to service. Calibration of multi-meters will be done in accordance with updated versions of CFRSSI SOPs HG-7 and HG-8 and calibration of the TieNet 301/ISCO Signature pH sensor will be done in accordance with SOP SW-18.

3.8 Inspection/Acceptance of Supplies and Consumables

All supplies and consumables received for the project (e.g., sampling equipment, calibration standards, etc.) will be checked for damage and other deficiencies that would affect their performance. The types of equipment that will be needed to complete sampling activities are described in the relevant SOPs. Inspections of field supplies will be performed by the Field Team Leader or Field Team Members.

The personnel at each laboratory will be responsible for performing inspections of laboratory supplies in accordance with their QA program.

3.9 Data Management Procedures

This section describes the management of data for the project including field and laboratory data. The program quality records will be maintained by Atlantic Richfield. These records, either electronic or hard copy in form, may include:

- Project work plans with any approved modifications, updates, and addenda;
- Project QAPP, including this QAPP, with any approved modifications, updates, addenda, and any approved corrective or preventative actions;
- Field documentation;
- Chain-of-custody records;
- Laboratory documentation (results received from the laboratory will be documented both in report form and in an electronic deliverable format); and
- DSRs.

Hard-copy field and laboratory records shall be maintained in the project's central data file, where original field and laboratory documents are filed chronologically for future reference. These records are also scanned to produce electronic copies. These electronic copies, along with all electronic field and laboratory records, are maintained on a central server system with backup scheduled daily, as described in the BPSOU Final Data Management Plan (DMP) (Atlantic Richfield, 2020b). The Server Administrator is responsible for data backups, and potential data restoration.

Before field and laboratory data are incorporated into the project database, the data and supporting documentation shall be subject to appropriate review to ensure the accuracy and completeness of original data records. Field data that has been reviewed in a hard-copy format will be entered into electronic data files for upload to the project database. All manual data entry into an electronic format will be reviewed by a separate party before such data are incorporated into the database. Laboratory electronic data deliverables (EDDs) and related data packages will be reviewed as part of the internal data review process. The data flow process is described in greater detail below. The Data Base Coordinator will be responsible for ensuring data integrity prior to database uploads. Following these review steps, field and laboratory electronic data files will be imported to the project database. Procedures for data storage, archival, and retrieval are fully explained in the DMP (Atlantic Richfield, 2020b).

The DMP describes the complete data flow process, from data acquisition, to data production, storage, and retrieval. Data collectors (acquisition) collect data, and provide documentation in logbooks, electronic field forms, and paper field forms (habitat assessment) in conformance with this QAPP. For data collected under this QAPP, laboratories will provide data directly to the BPSOU database coordinator or to Atlantic Richfield's EQuIS data management system, or both. Once analytical data is submitted, the data undergoes QA/QC, to verify the data was collected and produced in accordance with the QAPPs, and once verified, the data is incorporated into the database. Macro-enabled Excel spreadsheets have been developed to enable data retrieval for validation. These spreadsheets are populated during the data validation process and resubmitted to the data management team. The validated data, including associated validation qualifiers, codes, quality designation for each data point and Level A/B status for each sample, is then uploaded to the database. Analytical data submitted directly to the BPSOU database coordinator will be submitted to the EQuIS system once review and validation is complete. QA/QC checks are in place to ensure that data upload is successful, and that data quality is preserved. Once data has been uploaded to the database, only the data management system coordinator has access to perform any edits. Data can be retrieved through the EQuIS system, or by written request to the database coordinator.

Currently geospatial data is stored in a Geodatabase, non-geospatial data is stored in Microsoft (MS) Structured Query Language (SQL) databases or MS Access databases. This SQL/Geodatabase combination allows integration of spatial data (site locations, property information, geographic place names, site features, topography, and aerial collected imagery) with non-spatial information (analytical data) to provide a comprehensive database that contains all relevant site information.

As part of the duties of operating and maintaining the database, the Database Coordinator, including the EQuIS system administrator, shall develop specific procedures, forms, and systems for accurate import and export of data. For instance, the Database coordinator shall work with Data Collectors or Data Producers to identify appropriate formats and procedures for receiving data into the system. Part of these formats will include a confirmation that the data was collected following the correct standardized procedure. This may mean that Data Producers supply laboratory data in standard, approved EDDs. The Database Coordinator shall verify the accurate import of data supplied by Data Collectors and Data Producers. This shall include working with Data Collectors/Producers to perform appropriate QA and input of appropriate supplemental information (e.g., metadata) to document and describe the receipt and handling of the data. The Database Coordinator will also develop standard request forms or procedures by which Data Users may request data to be exported from the database.

4.0 ASSESSMENT AND OVERSIGHT

Assessment and oversight of data collection and reporting activities are designed to verify that sampling, chemical analyses, and taxonomic processing are performed in accordance with the procedures established in this QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits. Internal audits will be performed by the QAO and/or QAM as necessary, and audit reports will be submitted to the CPM. External audits will be performed by the EPA as necessary.

Performance and systems audits of field and laboratory data collection and reporting procedures are described in this section.

4.1 Corrective Actions

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out-of-control QC performance which can affect data quality. Corrective action can occur during field activities, laboratory analysis, laboratory processing, and data assessment.

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect data quality and attainment of the project's quality objectives will be identified, controlled, and reported in a timely manner. The person finding the nonconformity is responsible for reporting to the field team leader and ensuring that the condition is reported to the project manager. In regard to equipment nonconformity, the field team leader, or their designee is responsible for recording the nonconformity in the electronic equipment log, and for ensuring that the nonconformity is corrected. In regard to conditions that are not equipment related, the person finding the irregular condition is responsible for providing documentation in the field book and the electronic field form. The field book entry may reference a more thorough entry on the electronic form, or vice versa, but the cross-reference must be provided. For this QAPP, a nonconformance is defined as a malfunction, failure, deficiency or deviation that renders the quality of an item unacceptable or indeterminate in meeting the project's quality objectives.

Corrective action in the laboratory may occur prior to, during and after initial analyses or taxonomic processing and will be reported to the LM and QAO. Several conditions such as broken sample containers (taxonomy or analytical laboratory), preservation or holding-time issues and potentially high-concentration samples may be identified during sample log-in, just prior to analysis, or during analysis. Corrective actions to address these conditions will be taken in consultation with the LM and QAO and reported on a CAR, an example of which is included in Appendix F. If corrective action requests are not in complete accordance with approved project planning documents, the LM will consult with EPA, and concurrence will be obtained before the change is implemented.

If during analysis of the samples, the associated laboratory QC results fall outside of the project's performance criteria, the laboratory should initiate corrective actions immediately. Table 9 indicates the performance criteria for specific analytical methods and the appropriate corrective actions to be completed if QC results are outside of the project specifications. Following consultation with lab analysts and section leaders, it may be necessary for the Laboratory Quality Manager to approve the implementation of a corrective action. These conditions may include dilution of samples, additional sample extract cleanup, automatic re-analysis when certain QC criteria are not met, etc. If the laboratory cannot correct the situation that caused the nonconformance and an out-of-control situation continues to occur, or is expected to occur, then the laboratory will immediately contact the QAO and request instructions regarding how to proceed with sample analyses.

If problems associated with BMI or habitat assessment fieldwork or laboratory processing are identified prior to the end of the index period (June 21 to October 15), a CAR will be completed and the CAP will include a review of the protocols and methods described within this QAPP. After this review, a repeat site visit may be made to re-collect the sample if the dataset is incomplete or incorrectly collected. If problems are identified in the BMI data, those problems should be addressed by again collecting all in-situ water chemistry and BMI parameters. However, because habitat is mostly constant within an index period, if the data in question are related to habitat, only the missing habitat information needs to be collected. Before the second sampling, the investigator must review the biomonitoring portions of this QAPP and supporting information, where appropriate, to understand the protocols.

If problems associated with biomonitoring are identified after the index period, a CAR, and subsequent CAP, will be completed, the data will be flagged and a narrative explaining the problem will be included in the DSR. If the data are incomplete, or if a DQO was not met, the data will not be considered as having met the objectives of BPSOU biomonitoring.

Completion of any corrective action should be evidenced by data once again falling within the project's performance criteria. If this is not the case, and an error in laboratory procedures or sample collection and handling procedures cannot be found, the results will be reviewed by the LM, or their designee, with input from others to assess whether re-analysis or re-sampling is required.

All corrective actions taken by the laboratory will be documented in writing by the Laboratory Project Manager and reported to the CPM and QAO. If corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted, and concurrence will be obtained before the change is implemented. All corrective action records will be included in the program's quality records.

4.2 Corrective Action during Data Assessment

The QAO may identify the need for corrective action during data assessment. Potential types of corrective action may include re-sampling by the field team, re-analysis of samples by the laboratory or re-submission of data packages with corrected clerical errors. The appropriate and feasible corrective actions are dependent upon the ability to mobilize the field team and whether the data to be collected is necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded, etc.). If corrective action requests are not in complete accordance with approved project planning documents, the EPA will be consulted by the LM and QAM and concurrence will be obtained before the change is implemented. Corrective actions of this type will be documented by the QAO on a CAR and will be included in any subsequent reports.

4.3 Quality Assurance Reports to Management

Quality Assurance Reports to management will include DSRs, quarterly data reports, Field Audit Reports, CARs, and Data Assessment Reports (within DSRs). Atlantic Richfield will prepare a DSR for the sampling activities described in this QAPP annually. The DSR will contain a discussion of the data quality assessment, which is also referred to as a data validation report, as an appendix. The data quality discussions/data validation report will contain, on a routine basis, the results of any associated field and laboratory measurements and analyses, information generated on the achievement of specific DQOs, and a summary of any corrective actions that were implemented and their immediate results on the project.

The CPM and QAO are responsible for preparation of the DSR. The DSR will be submitted in draft form to the EPA for review in May of the year following data acquisition. Upon receipt of comments, the draft DSR will be revised to address the comments and resubmitted to the EPA within 60 days for final approval.

Any Field Audit Reports and CARs associated with the project will be submitted to management on a quarterly basis.

5.0 DATA VALIDATION AND USABILITY

The following sections address the final project checks conducted after the data collection phase of the project is completed to confirm that the data obtained meet the project objectives and to estimate the effect of any deviations on data usability.

5.1 Data Review and Verification

The process to be used for reviewing and verifying field data and the internal laboratory data review and reporting process are described in the following sections. Laboratory data reporting requirements, which describe how results are conveyed to data validators, are also discussed.

5.1.1 Field Data Review

Raw field data shall be entered in field logbooks, on electronic field forms, or on paper forms (habitat assessment), which shall be reviewed for accuracy and completeness by either the Field Team Leader or the BMI Team Leader, as appropriate, before those records are considered final. The Field Team Leader or the BMI Team Leader may designate a qualified team member to review field logbooks and field forms. The overall quality of the field data from any given sampling round shall be further evaluated during the process of data review and reporting.

Field data review and reporting procedures will be minimal in scope compared to those implemented in the laboratory setting. Field data review will include verification that any QC checks and calibrations, if necessary, are recorded properly in the field logbooks and/or on electronic forms and that any necessary and appropriate corrective actions were implemented and recorded. QC checks, calibrations, and any corrective actions will be written into field logbook and/or recorded on forms immediately after they occur. If errors are made in logbooks or on habitat assessment forms, results will be legibly crossed out, initialed, and dated by the field team member, and corrected in a space adjacent to the original (erroneous) entry. If mistakes are made in electronic forms, the original form and output file are preserved, a revised output file is developed, and the data in the replacement file is entered into the database. In a reasonable time frame, the Field Team Leader, the BMI Team Leader, or a designee, will proof the field logbooks and electronic field forms to determine whether any transcription errors have been made by the field crew. If transcription errors have been made, the Field Team Leader and field crew will address the errors to provide resolution.

Appropriate field measurement data will be uploaded from electronic field forms for project database entry. Data entries will be made directly from electronic field forms which have been reviewed for accuracy and completeness by a separate party, prior to submittal to the database manager. Electronic files of field measurement data will be maintained as part of the project's quality records.

Should the database manager, or a data user, find suspect data, the suspect data point will be investigated. If the data point is found to be in error, it will be corrected in the database, and the database manager will be responsible for any necessary notifications of the data revision or redistributions of the data.

5.1.2 Laboratory Data Review

Internal laboratory data review and reporting procedures will be per each laboratory's Quality Management Plan. At a minimum, records shall be maintained by the analysts to document sample identification number with sample results and other details, such as the analytical method used (e.g., method SOP #), name of analyst, the date of analysis, matrix sampled, reagent concentrations, instrument settings, and the raw data. These records shall be signed and dated by the analyst. Minimal requirements for taxonomy laboratories include records maintained by the taxonomist to document sample identification number with sample results, name of the taxonomist and the date(s) of subsampling, sorting, and taxonomic identification, with the records signed and dated by the taxonomist. Secondary review of records by the laboratory's supervisor (or designee) shall take place prior to final data reporting to Atlantic Richfield. Laboratories shall appropriately flag unacceptable data in the data package. Shall any deficiencies with the potential to change analytical results be found during laboratory review of previously reported data, Atlantic Richfield, or their representative, will be immediately notified, and a revised report and EDD will be issued.

5.1.3 Laboratory Data Reporting Requirements

Laboratories shall prepare electronic data packages for transmittal of results and associated QC information to Atlantic Richfield or their designee. Analytical data will undergo Level 2a validation for all surface water and sediment samples. A Limited (Level 2a validation) analytical data package shall include at a minimum, the case narrative, all sample results, units and quality control sample results. Limited data packages shall be transmitted to Atlantic Richfield or their designee within 14 days of laboratory sample receipt. Refer to Appendix G for the components of a Limited analytical data packages.

The analytical laboratory shall prepare electronic data packages for transmittal of results and associated QC information to Atlantic Richfield, or their designee, in a format compatible with contractor database and EQuIS requirements. Deviations from these specifications may be acceptable provided the electronic report presents all requested types of information in an organized, consistent, and readily reviewable format.

Taxonomic laboratory packages will include a case narrative, all sample results, and QA/QC sample results, at a minimum. Taxonomic laboratory data packages will be transmitted to Atlantic Richfield or their designee within a six-month turnaround time.

5.1.4 Laboratory Electronic Data Deliverable

Each electronic data package, as described above, shall be accompanied by an EDD prepared by the laboratory. The EDD will contain sample results in a spreadsheet format. Additional laboratory QC data can be included in the EDD. EDDs will be cross checked against corresponding data reports to confirm consistency in results reported in these two separate formats. This cross check will take place as part of the data review process.

5.1.5 Specific Quality Control/Assessment Procedures

The accuracy, precision, completeness, representativeness, and sensitivity of analytical data will be described relative to the project's control limits through a process of field and laboratory data quality review. Results from these reviews will be documented in a Data Quality Assessment Report prepared for all data users. Any qualification of the data resulting from that review will also be incorporated into the project's electronic database so that all data users are aware of any uncertainties associated with individual results.

5.2 Internal Data Review

Data review is the process of verifying that information generated relative to a given sample is complete and accurate. Data review involves examining each data point to see that it meets frequency, accuracy, and precision criteria. Data review procedures shall be performed for both field and laboratory operations as described below and in accordance with the criteria in Table 19. A thorough review of data enables the subsequent data assessment, which is further described below.

Table 19 – Validation Criteria for Analytical Laboratory and Field Quality Control Samples (see Tables section)

5.2.1 Field Quality Control Data

The results of field quality control sample analyses associated with each laboratory data package will be reviewed to allow for evaluation of field blanks and other field QC samples and further indications of the data quality. If a problem is identified through the review of field QC data, all associated field samples will be identified, and if possible, corrective actions can be instituted and documented on a CAR. If corrective action requests are not in complete accordance with approved project planning documents, the EPA will be consulted, and concurrence will be obtained before the change is implemented. If data are compromised due to a problem identified via field QC sample review, appropriate data qualifications will be used to identify the data for future data users. These qualifiers will be included with tabulated data presented in the Data Assessment section of DSRs.

The handling, preservation and storage of samples collected during the sampling program will be monitored on an on-going basis. The project laboratories will document sample receipt including proper containers and preservation at the time samples are logged in by the laboratory. The sample receipt records (a required data package deliverable), as well as the chain-of-custody documentation, will also be assessed during data review.

5.2.2 Analytical Laboratory Data

The second level of analytical data review will be performed by the QAO, or their designee, and will include a review of laboratory performance criteria and sample-specific criteria. One hundred percent of project data will be reviewed and validated. Data validation will follow the TREC Data Validation Guidelines which incorporate validation guidelines from the National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA, 2020b), but align with method-specific criteria. An additional responsibility of the QAO will be to determine whether the DQOs have been met and calculate the data completeness for the project.

Data quality review is a process to determine if the data meet project DQOs. Data quality review will include verification of the following:

- Compliance with the QAPP,
- Proper sample collection and handling procedures,
- Holding times,
- Field QC results,
- Laboratory blank analysis,
- Laboratory control sample percent recovery,
- Detection limits,
- Laboratory duplicate relative percent differences,
- MS/MSD percent recoveries and relative percent differences,
- Data completeness and format, and
- Data qualifiers assigned by the laboratory.

Refer to Appendix H, Exhibit 1 for components of Level 2a data quality review. Qualifiers that may be applied to the data include the following:

U The analyte was analyzed for but was not detected above the method detection limit.

J The analyte was positively identified but was not detected above the reporting limit; the associated numerical value is an estimate of the concentration of the analyte in the sample.

UJ The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Additional qualifiers can be found in Appendix H, Exhibit 4. Data that are only qualified as a result of the value reported between the laboratory reporting and the detection limit are also considered enforcement quality.

A Data Quality Assessment (DQA) will be performed to determine whether the project-specific DQOs have been satisfied. The DQA consists of five steps that relate the quality of the results to the intended use of the data:

Step 1: Review DQOs and sampling design

Step 2: Conduct preliminary data review

Step 3: Apply Statistical test(s) as described in this QAPP to the data set

Step 4: Verify assumptions

Step 5: Draw conclusions about the quality of the data (data report will not include interpretation of results, but will state conclusions regarding the quality of the results).

Data points may be assigned a qualifier during data review based on a failure to meet frequency, accuracy, or precision criteria. Appendix H, Exhibit 4 provides a description of data validation qualifiers. Data assessment involves assigning a status of Enforcement (E), Screening (S), or Rejected (R) to each data point. Table 20 provides a summary of status assignment. Enforcement quality data meet all QA/QC and documentation requirements. Screening quality data do not meet the applicable QA/QC requirements and/or documentation requirements. Unusable data (R) may result from inappropriate sampling, analysis, or documentation procedures. In reviewing documentation requirements, a Level A/B checklist is completed. This checklist is provided as Exhibit 3 in Appendix H. Level A data partially meets documentation requirements; while level B data meets all documentation requirements. Level A/B status is not assigned to individual data points, but rather to samples (all data points for an individual sample).

Table 20 – Summary of Status Assignment (Enforcement/Screening/Unusable)

Data Validation Qualifier	Level A/B Designation		
	Level B	Level A	Rejected
No qualifier or U	Enforcement	Screening	Unusable
J or UJ	Screening	Screening	Unusable
R	Unusable	Unusable	Unusable

If, as a result of the DQA process, it is determined that data do not satisfy all DQOs, then corrective action(s) should be recommended and documented in the data reporting. Corrective actions include, but are not limited to, revision of the DQOs, based on the results of the investigation, or collection of more information or data. It may be determined that corrective actions are not required, or the decision process may continue with the existing data, with recognition of the limitations of the data.

A Level 2a laboratory data validation checklists is included in Appendix H as Exhibit 1. A field checklist is provided as Exhibit 2. A Level A/B criteria screening checklist is included as Exhibit 3.

Results of the QA review and/or validation will be included in any subsequent report, which will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions. The QAO is responsible for review of project QA and/or validation.

5.2.3 Taxonomic Laboratory Data

Taxonomy data quality review will include verification of the following:

- Compliance with the QAPP;
- Proper sample collection and handling procedures;
- Proper sample preservation;
- Field QC results;
- Data completeness and format;
- Taxonomy QA/QC procedures (Section 3.5.4); and
- Data qualifiers or taxonomic assumptions (resolution) assigned by the laboratory.

If, as a result of the DQA process, it is determined that data do not satisfy all DQOs, then corrective action will be recommended and documented in the data reporting. Corrective actions can include, but are not limited to, revising the DQOs, based on the results of the investigation, or collecting more information. It could be determined that corrective actions are not required, or the decision process should continue with the existing data, with recognition of the limitations of the data.

The results from the DQA process will be presented as an appendix to the DSR. If the need for corrective actions are identified during collection of field data or laboratory processing of BMI samples and warrant additional field sampling that same year as described in Section 4.1, EPA will be notified, and corrective actions will be proposed to occur as soon as practical.

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TABLES

FIGURES

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Appendix H – Data Validation Checklists

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Exhibit 4 – Laboratory and Data Validation Qualifier and Code Definitions

Exhibit 1 – Level 2a Analytical Checklist

Exhibit 2 – Analytical Field Checklist

Exhibit 3 – Analytical Level A/B Checklist

Exhibit 4 – Laboratory and Data Validation Qualifier and Code Definitions