Clarks Fork Yellowstone Watershed Project: Water Chemistry, Biological, *E. coli*, Dissolved Oxygen, and Flow 2023

Sampling and Analysis Plan (SAP)
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WQDMASSAP-37

Author(s):

Review and Approval:

Blake Towarnicki, Technical Review	6/7/23 Date
/S/ Erin Louden	
Erin Louden, Quality Assurance Manager	Date
/s/ Darrin Kron	6/5/23
Darrin Kron, Monitoring and Assessment Section Supervisor	Date

Table of Contents

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

ADCP	acoustic doppler current profiler
AFDW	ash free dry weight
AU	assessment unit
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
Chl *a*	Chlorophyll *a*
DEQ	Montana Department of Environmental Quality
DO	dissolved oxygen
DOC	dissolved organic carbon
DQI	data quality indicators
EDD	electronic data deliverables
EPA	U.S. Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
HBI	Hilsenhoff Biotic Index
HCL	hydrochloric acid
HDPE	high-density polyethylene
H_3PO_4	phosphoric acid
HNO_3	nitric acid
HUC	Hydrologic Unit Code
LQAP	laboratory quality assurance program
mg/L	milligrams per liter
µg/L	micrograms per liter
µs/cm	microsiemens per centimeter
ml	milliliters
mmHg	millimeters of mercury
MT-eWQX	Montana EQUIS Water Quality Exchange Database
MPN	most probable number of E. coli
NELAC	National Environmental Laboratory Accreditation Conference
NO_2+NO_3	Nitrate + Nitrite
NH_{3+4}	total ammonia
QA	quality assurance
QC	quality control
SAP	sampling and analysis plan
SOP	standard operating procedures
SRP	Soluble reactive phosphorus (orthophosphate)
SVC	site visit code
SVF	site visit form
TDS	total dissolved solids
TMDL	total maximum daily load
TN	total persulfate nitrogen
TP	total phosphorus
TSS	total suspended solids
ULL	ultra-low level
WQPB	Water Quality Planning Bureau
VPH	Volatile Petroleum Hydrocarbons

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1.0 INTRODUCTION

This section provides background information and context to clarify the motivations for the project and explains the problem statement or need that the monitoring described throughout this sampling and analysis plan (SAP) will support.

1.1 PROBLEM DEFINITION AND PROJECT BACKGROUND

In 2022, the Montana Department of Environmental Quality (DEQ) initiated the water quality planning process for the Clarks Fork Yellowstone Watershed. This included water quality monitoring and assessment, source assessment, and total maximum daily load (TMDL) monitoring and development on the mainstem of the Clarks Fork Yellowstone River and tributaries within the watershed to address the objectives stated in the project plan (DEQ, 2022).

In 2023, DEQ will continue nutrient and metals monitoring on the Clarks Fork Yellowstone River and tributaries. Sites on the Clarks Fork Yellowstone River and selected tributaries will be monitored for nutrient response variables that were previously listed as impaired or determined to have high risks or high value by DEQ. *E. coli* will be monitored on the Clarks Fork Yellowstone River and Rock Creek due to public concern and potential risk. Additional sites will be added on selected tributaries for source assessment information. This SAP describes water quality monitoring efforts in the Clarks Fork Yellowstone Watershed during the 2023 field season.

1.2 PROJECT AREA

The Clarks Fork Yellowstone Watershed project area encompasses the Clarks Fork Yellowstone River from the Wyoming border to the Yellowstone River confluence and contributing tributaries (**Figure 1**) and coincides with the 10070006 Hydrologic Unit Code (HUC). **Section 1.2** of the Clarks Fork Yellowstone Watershed Project Plan (DEQ, 2022) provides additional information on the project area.

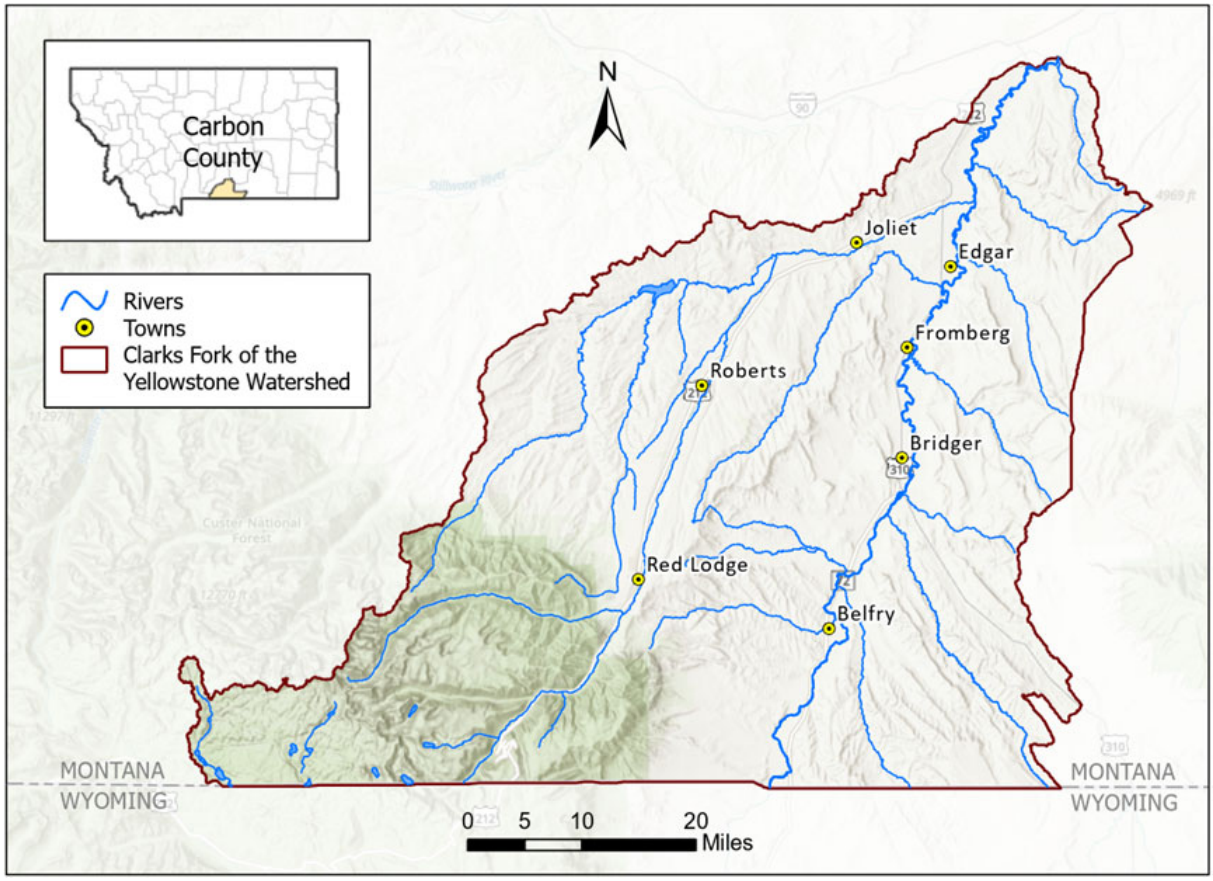

Figure 1. Clarks Fork Yellowstone Watershed Project Area

2.0 Objectives and Sampling Design

This section states the project's objectives, describes key elements of the sampling design such as monitoring locations and the timing of monitoring events, and outlines information about each parameter that will be monitored. An overview of project goals and monitoring objectives is outlined in **Table 1**, and the sampling and monitoring schedule is provided in **Table 2**.

2.1 Monitoring Objectives

In 2023, most assessment units (AU) within the watershed will be sampled at a minimum of two sites. Each site will be sampled five times throughout the year for water chemistry and flow from June through October. This timeframe should represent samples from runoff, the growing season, and baseflow conditions. Biological parameters (algae, periphyton, and macroinvertebrates) will be collected at 30 sites once between July and August. On the Clarks Fork Yellowstone and Rock Creek, *E. coli* will be sampled five times at 15 sites in August. The timeframe for biological and *E.coli* parameters should represent samples during the primary contact recreation and growing seasons. Water chemistry, biological, and *E. coli* parameters that will be collected are provided in **Table 3**. Other field parameters such as temperature, conductivity, pH, and dissolved oxygen (DO) will be measured *in situ* during each site visit. Continuous field parameters will be measured at 25 sites during July and August.

Table 1. Project Goals and Monitoring Objectives

Goal	Objective
To assess current water quality conditions in the Clarks Fork Yellowstone watershed.	To collect nutrients and metals samples in the Clarks Fork Yellowstone watershed from June to October (i.e., runoff, baseflow, and growing season).
	To measure physical parameters with a YSI meter (temperature (°C), DO (mg/L), pH, specific conductivity (µS/cm), and barometric pressure (mmHg)) *in situ* in the Clarks Fork Yellowstone watershed from June to October.
	To measure stream flows during sampling events to calculate discharge and pollutant loads.
	To collect total suspended solids (TSS) and total dissolved solids (TDS) in the Clarks Fork Yellowstone watershed from June to October (i.e., runoff, baseflow, and growing season).
	To collect chlorophyll-*a* (Chl *a*), ash free dry weight (AFDW), periphyton, and macroinvertebrates in the Clarks Fork Yellowstone watershed between July and August (i.e., primary contact recreation and growing season) to determine if nutrients concentrations are impacting aquatic life and/or recreation.
	To collect *E. coli* on the Clarks Fork Yellowstone River and Rock Creek in August (i.e., primary contact recreation).
	To measure continuous DO (mg/L) using MiniDOT sensors in the Clarks Fork Yellowstone watershed in July and August (i.e., growing season).

2.2 SAMPLING DESIGN

Sampling design for the Clarks Fork Yellowstone project will follow the beneficial use assessment, metals assessment, nutrient assessment, *E. coli* assessment, and DO assessment requirements and may help identify sources for TMDL development and restoration planning. A streamlined risk assessment was completed to determine which assessment units, waterbodies, and parameters to monitor (DEQ, 2022). In 2023, all rivers and streams currently listed as impaired, assessed, or previously monitored will be monitored for water chemistry and flow. North Fork Dry Creek and South Fork Dry Creek will be monitored due to being the main tributaries to Dry Creek. The mouth of West Fork Rock Creek will be monitored due to being a main tributary to Rock Creek. Most assessment units will have a minimum of two sample sites to meet minimum data requirements for assessments and sites are selected to be representative of water quality condition. In 2023, two additional sites were selected on Silvertip Creek for more robust source assessment efforts, and oil and gas related parameters will be monitored at four sites on Silvertip Creek.

2.3 MONITORING LOCATIONS

A total of 53 sites will be sampled in 2023 within the Clarks Fork Yellowstone watershed. **Figures 2 and 3** provide general site locations and **Appendix A** lists monitoring locations, parameters to be collected,

and rationale for site selection. Sites are located where there are changes in land use, mouths of tributaries, above or below sources, and above or below confluences of contributing tributaries to assist in identifying sources throughout the watershed. Where possible, sites are located outside of areas of mixing with tributaries or discrete sources.

Sites are located on public and private land. The project lead will seek permission to access any privately owned site locations from the appropriate landowners before sampling. Access is granted with a verbal agreement and documented in field planning spreadsheets. If permission is not obtained the site may be moved or abandoned for this sampling event.

Field personnel will locate the sites with GPS assistance as well as directional notes. Once at a site, field personnel will follow the guidelines in the Sample Collection for Chemistry: Water, Sediment, and Biological Tissue Standard Operating Procedure (SOP) to choose the exact location to collect the samples (Section 7.2, Makarowski, 2019).

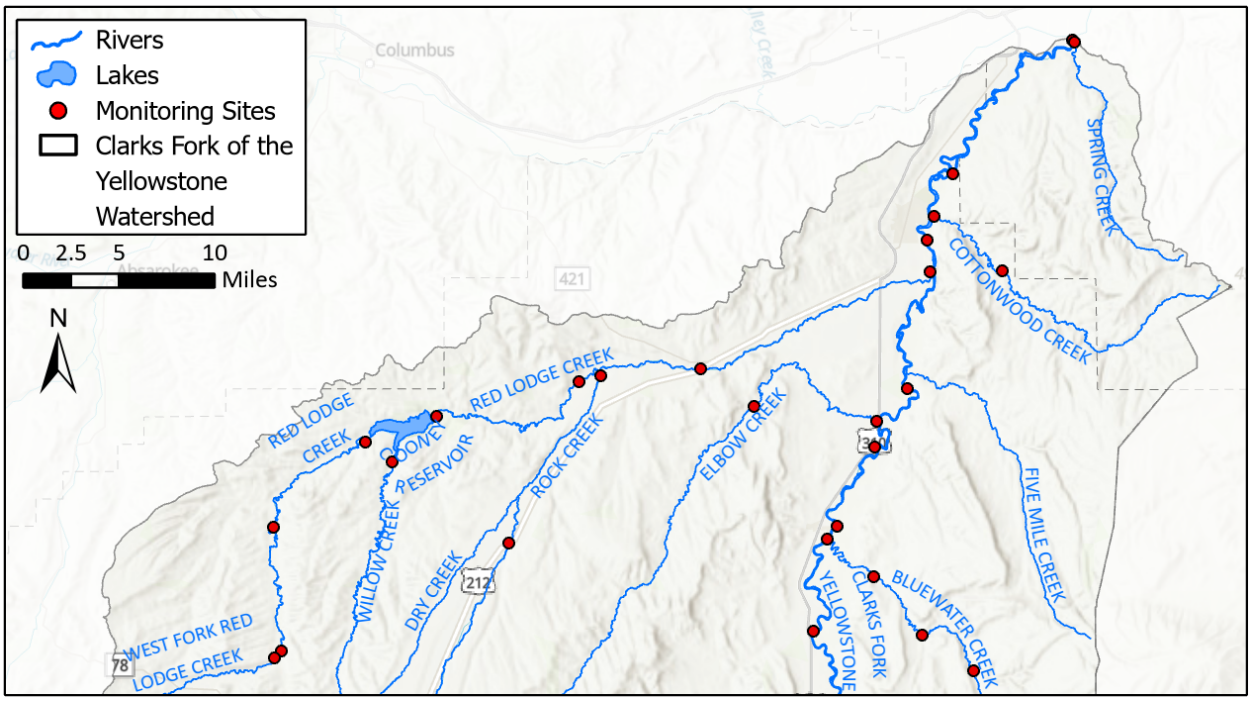

Figure 2. Monitoring site locations in the north section of the watershed.

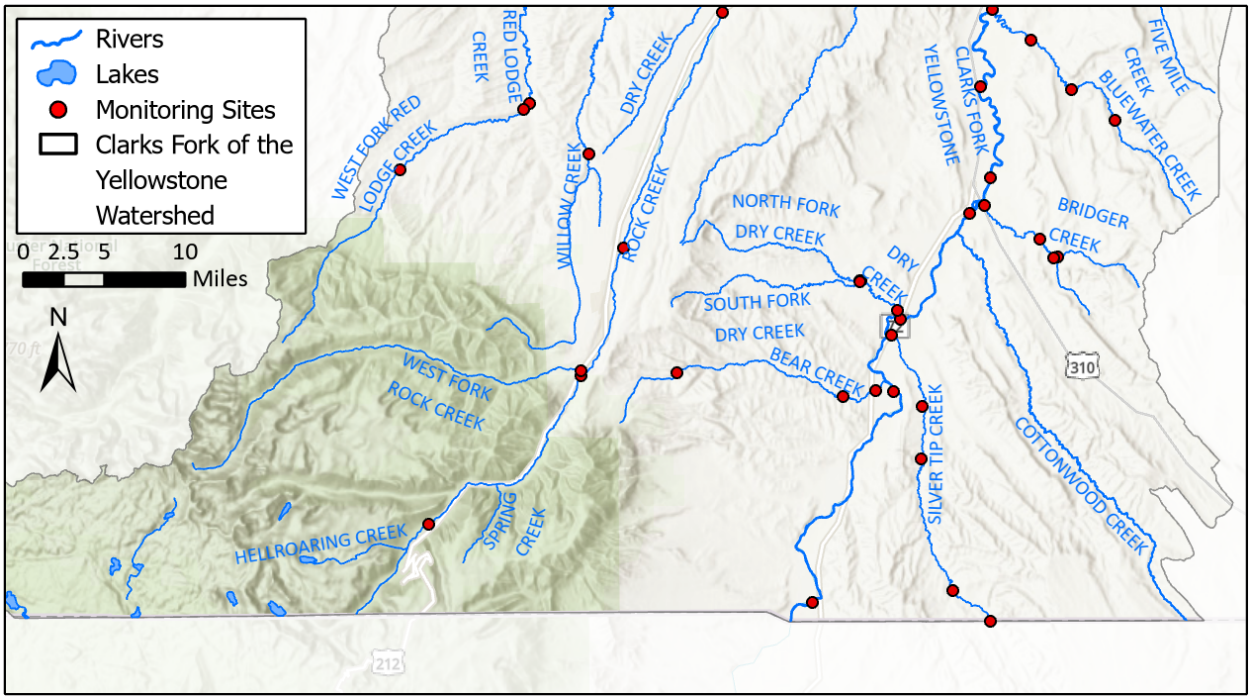

Figure 3. Monitoring site locations in the south section of the watershed.

2.4 Monitoring Timeframe and Schedule

Sampling timeframes were selected to characterize hydrograph-water quality conditions, to meet assessment method requirements, and to aid source assessment. Flow measurements will occur at all sites during each sampling event. *In situ* measurements will occur at all sites during each monitoring event.

2.4.1 Nutrient and Biological Timeframe

Nutrient water column sampling will occur five times at all sites to capture runoff flows (June sampling) and baseflows (July, August, September, and October sampling). Each sampling event will be at least two weeks apart (**Table 2**) due to requirements from Assessment Methodology for Determining Wadeable Stream Impairment Due to Excess Nitrogen and Phosphorus Levels (Suplee and Sada, 2016). Benthic algae, periphyton, and macroinvertebrate monitoring will occur in July and August.

2.4.2 Metals Timeframe

Metal water column sampling will occur five times at all sites to capture runoff flows (June sampling) and baseflows (July, August, September, and October sampling). Each sampling event will be at least seven days apart due to requirements from the Metals Assessment Method (Drygas, 2012).

2.4.3 *E. coli* Timeframe

E. coli sampling will occur once at 15 sites during baseflows in August. The sampling event is within the most protective seasonal period of April 1 to October 31, as specified in the *E. coli* water quality standards (ARM 17.30.623 for B-1 and B-2 waters). *E. coli* standards specify that a minimum of five samples be collected during separate 24-hour periods during any consecutive 30-day period (ARM 17.30.620); data for assessment purposes will adhere to this requirement.

2.4.4 Continuous DO Timeframe

Continuous DO sampling will occur between July and August for at least five consecutive days at 25 sites. This timeframe falls within the growing season recommended in Assessment Methodology for Determining Wadeable Stream Impairment Due to Excess Nitrogen and Phosphorus Levels (Suplee and Sada, 2016).

Table 2. Monitoring Schedule

Date of Sampling Event	Rationale for Timing/Frequency	Parameters
Runoff Flow (Late June)	To collect runoff flow samples	TSS, TDS, Nutrients, DOC, Total Recoverable Metals, ULL Mercury, Hardness, *In Situ* Measurements, and Flow
Summer Baseflow (July)	To collect baseflow samples during the growing season	TSS, TDS, Nutrients, DOC, Total Recoverable Metals, ULL Mercury, Hardness, *In Situ* Measurements, Continuous Data, Chl *a*, AFDW, Periphyton, Macroinvertebrates, and Flow
Summer Baseflow (August)	To collect baseflow samples during the growing season	TSS, TDS, Nutrients, DOC, Total Recoverable Metals, ULL Mercury, Hardness, *In Situ* Measurements, Continuous Data, Chl *a*, AFDW, Periphyton, Macroinvertebrates, *E. coli*, and Flow
Summer Baseflow (September)	To collect baseflow samples during the growing season	TSS, TDS, Nutrients, DOC, Total Recoverable Metals, ULL Mercury, Hardness, *In Situ* Measurements, and Flow
Fall Baseflow (October)	To collect baseflow sample during cooler weather	TSS, TDS, Nutrients, DOC, Total Recoverable Metals, ULL Mercury, Hardness, *In Situ* Measurements, and Flow

2.5 PARAMETERS

Table 3. Water Quality Parameters to be Collected in 2023 during each Site Visit.

Parameter or Data Type	Collection Approach	Justification for Collecting
Nutrients (total persulfate nitrogen [TN], total phosphorus [TP], NO_{2+3}, NH_{3+4}, and SRP)	Measured via water samples and analyzed by a lab.	DEQ's nutrient assessment method is based on best available science for TN and TP. NO_{2+3}, NH_{3+4}, and soluble reactive phosphorus (SRP) help determine pollutant sources, pathways, and biological availability.
Common Cations and Hardness (Ca and Mg)	Measured via water samples and analyzed by a lab.	Common cations generally reflect natural geology and buffer capacity. Calcium and Magnesium are used to calculate hardness. Hardness is necessary to calculate several metals' water quality standards which are hardness dependent.
Sulfate and Chloride	Measured via water samples and analyzed by a lab.	Commonly may be indicators of sources of pollutants.

Parameter or Data Type	Collection Approach	Justification for Collecting
Total Suspended Solids (TSS)	Measured via water samples and analyzed by a lab.	TSS is used to help understand nonpoint source erosion and sources of pollutants.
Total Dissolved Solids (TDS)	Measured via water samples and analyzed by a lab.	TDS may be used as an indicator of pollutants and salinity.
Dissolved Metals (Al)	Measured via water samples and analyzed by a lab.	Dissolved aluminum values will be used for assessment purposes due to the water quality standard for aluminum representing the dissolved fraction.
Total Recoverable Metals (As, Cd, Cr, Cu, Fe, Pb, Se, Ag, and Zn)	Measured via water samples and analyzed by a lab.	Total recoverable metals include dissolved and particulate metals in ambient water. Results are compared to Montana's water quality standards and are used for assessment.
Ultra-Low Level Mercury (ULL Mercury)	Measured via water samples and analyzed by a lab.	Ultra-low level mercury results are compared to Montana's numeric water quality standards and are used for assessment.
Dissolved Organic Carbon (DOC)	Measured via water samples and analyzed by a lab.	DOC may increase or decrease the bioavailability of certain metals.
Benzene, Toluene, Ethylbenzene, Xylene (BTEX)	Measured via water samples and analyzed by a lab.	BTEX is used as an indicator of impacts by oil and gas activities.
Extractable Petroleum Hydrocarbons (EPH)	Measured via water samples and analyzed by a lab.	EPH is used as an indicator of impacts by oil and gas activities.
Volatile Petroleum Hydrocarbons (VPH)	Measured via water samples and analyzed by a lab.	VPH is used as an indicator of impacts by oil and gas activities.
Chlorophyll *a* (Chl *a*) **and Ash Free Dry Weight** (AFDW)	Measured via benthic algae samples and analyzed by a lab.	Algae growth may increase due to the bioavailability of nitrogen and phosphorus. Results are compared to water quality thresholds and are used in assessment.
Macroinvertebrates	Measured via specimen samples and analyzed by a lab.	Macroinvertebrates communities may shift due to excess nutrients and algae growth.
Periphyton	Measured via specimen samples and analyzed by a lab.	Periphyton communities may shift due to excess nutrients and algae growth.
E. coli	Measured via water samples and analyzed by DEQ staff.	*E. coli* includes total coliform and *E. coli* in ambient water. Results are compared to water quality standards and are used in assessment.

3.0 PROJECT TEAM AND RESPONSIBILITIES

The Water Quality Monitoring and Assessment Section will conduct this project in 2023. **Table 4** provides project team roles and responsibilities.

Table 4. Project Team Roles and Responsibilities

Individuals	Affiliation	Roles	Responsibilities
Abbie Ebert	DEQ	Project Lead	Develops project and oversees field sampling efforts. Coordinates with lab on bottle orders. Main contact for seasonal staff.
Lisa Anderson	DEQ	Flow Monitoring Lead	Prepares acoustic doppler current profiler (ADCP) and other equipment for flow monitoring. Oversees flow sampling events.
Darrin Kron	DEQ	Section Supervisor	Oversees project development.
Elise Thiel	DEQ	Equipment Technician	Oversees equipment and supplies preparation. Coordinates sample delivery with field personnel and project lead.
Seasonal Staff	DEQ	Field Personnel	Prepare equipment and supplies for each field sampling trip, collect field data, and accurately record field information on appropriate field forms.
Deanna Tarum	DEQ	Database manager	Enter data into the MT e-WQX database.
Erin Louden	DEQ	Quality Assurance (QA) Manager	Reviews and approves the SAP.

4.0 FIELD PROCEDURES

This section cites or describes each field procedure that will be applied while collecting data during this project and references the field forms that will be used to record data and sample collection activities.

4.1 ORDER OF OPERATIONS

Prior to each sampling event, the project manager, equipment technician, and field personnel will prepare equipment and field supplies required for that trip. Appropriate monthly maintenance and calibrations on the field meter will occur prior to sampling. Field vehicles will be packed with all necessary equipment and supplies. **Appendix C** provides a field equipment and supply list.

After equipment and supplies have been packed, field crews will navigate to the sites as described by the SAP and additional information provided by the project manager. Upon arrival at the site, the field crew will perform the activities that are most sensitive to disturbance first:

- Clean Hands/Dirty Hands ULL Mercury
- Filtered Samples
- Unfiltered Samples
- *In situ* Measurements (field meter)
- Biological Samples (Benthic Algae, Periphyton, and Macroinvertebrates)
- Flow Measurement
- Photos
- Wader and equipment decontamination

Before leaving the site, field personnel will ensure all items are packed into the vehicle and all information is recorded correctly on the bottle labels and site visit form (SVF).

When field crews return from the field, they will unpack field vehicles and place equipment and supplies in the proper place. Samples shall be placed in a DEQ storage fridge or freezer until delivery to the lab. Field samples will be hand delivered to Energy Laboratory in Helena, MT.

4.2 FIELD FORMS AND SAMPLE LABELS

DEQ's field form and sample label system (Makarowski, 2020) will be followed for this project. All data collection and field activities conducted during a site visit will be recorded on a SVF. The SVF will serve as a chain of custody form for any samples that are collected for analysis by an analytical laboratory. A unique site visit code (SVC) will be affixed to each individual SVF, and each field form and routine sample produced during the site visit will be labeled with that same SVC. Separate SVFs and SVCs will be used for additional sets of samples collected during the site visit (i.e., duplicate and blank samples).

All field forms should be printed on water resistant all-weather paper and filled out using pencil (preferable) or permanent fine-line marker. The field forms used during this project are included in **Appendix B** and include:

- Site Visit Form
- Total Discharge Form (McWilliams, 2020b)
- Aquatic Plant Tracking Form (DEQ, 2021a)
- Aquatic Plant Visual Assessment Form (DEQ, 2021a)
- Continuous Datalogger Form (McWilliams and Nixon, 2020)

Prior to collecting samples at each site, all sample containers will be labeled, at a minimum, with the SVC, waterbody name, date, and personnel performing the sampling, as well as any other information requested on the label (filtration, transect number, method type). Labels will be filled out with pencil or permanent fine-point marker, affixed to the sample container and covered completely with clear plastic tape to protect the label from being damaged during storage.

All field forms must be reviewed by the field crew prior to departure from each site to verify completeness and accuracy. Field forms will be reviewed by the project manager prior to sample delivery and submitted to the database specialist for entry.

4.3 DATA COLLECTION PROCEDURES

This section describes the field sampling methods for the Clarks Fork Yellowstone Watershed Project. Sections include decontamination procedures, water sampling, instantaneous measurements, benthic algal collection, diatom collection, macroinvertebrate collection, flow measurements, and photo collection.

4.3.1 Decontamination Procedures

Field personnel will visit sites from upstream to downstream when possible in accordance with the Aquatic Invasive Species Decontamination Standard Operating Procedures (SOP) (McWilliams and Esquivel, 2020). At tributary sites or if sites are visited downstream to upstream, field gear (i.e., waders) must be decontaminated following the procedures in Section 10.2.2 – Decontaminating in the Field of McWilliam and Esquivel (2020).

A telescopic pole may be used when accessing the water is either difficult or unsafe for field personnel to approach the proper depth for water chemistry collection. The pole will be decontaminated between sites using hydrochloric acid and deionized water rinsing following the Field Equipment Decontamination SOP (McCarthy, 2014).

4.3.2 Water Sampling

Water chemistry samples will be collected via the Sample Collection for Chemistry Analysis: Water, Sediment, and Biological Tissue SOP (Makarowski, 2019a) following sections: 10.2.1 Unfiltered Grab Samples, 10.2.2 Filtered Grab Samples, 10.2.3 Clean Hands/Dirty Hands Method, 10.25 Extension (Telescopic) Pole Sampler.

Benzene, Toluene, Ethylbenzene, Xylene (BTEX), Extractable Petroleum Hydrocarbons (EPH), and Volatile Petroleum Hydrocarbons (VPH) will be collected at four sites on Silvertip Creek. Sampling will be collected via the Sample Collection for Chemistry Analysis: Water, Sediment, and Biological Tissue SOP (Makarowski, 2019a) following section 10.2.1 Unfiltered Grab Samples.

4.3.3 Benthic Algal Sampling

Benthic algae sampling will occur once at sites listed in **Table 5** during the 2023 field season in either July or August. Algae will be monitored to supplement nutrient sampling results and used to inform nutrient assessment decisions. This can help determine how nutrient levels are impacting the beneficial uses in the watershed.

Field crews may not collect algae if habitat conditions prohibit algae growth (i.e., sediment substrate and turbidity impacting light availability).

Benthic Chlorophyll-*a* (chl *a*) and AFDW will be determined at 27 sampling locations (**Table 5**). Eleven samples will be collected along a medium-river sampling frame within the wadeable zone (**Figure 4**) following the DEQ SOP, Sample Collection and Laboratory Analysis of Chlorophyll-*a* (DEQ, 2021a).

Table 5. Benthic Algae Sampling Locations

Site Name/Location	Station ID	AUID	Latitude	Longitude
Bear Creek u/s of Hwy 308 crossing	Y05BEARC03	MT43D002_020	45.156545	-109.18365
Bear Creek near mouth	Y05BEARC01	MT43D002_020	45.145045	-109.00603
Bluewater Creek just above private ranch	Y05BLUWC03	MT43D003_032	45.31483	-108.79202
Bluewater Creek d/s of hatchery, above Orchard Ditch	Y05BLUWC45	MT43D003_032	45.33406	-108.83085
Bluewater Creek at Bluewater Rd crossing	Y05BLUWC25	MT43D002_031	45.365177	-108.86703
Bluewater Creek near mouth	Y05BLUWC01	MT43D002_031	45.384609	-108.90204
Clarks Fork Yellowstone River off Bear Creek Lane	Y05CFYLR60	MT43D001_012	45.144655	-108.99005
Clarks Fork Yellowstone River at CF Yellowstone FAS above Hwy 310	Y05CFYLR28	MT43D001_012	45.25631	-108.92178
Clarks Fork Yellowstone River d/s of Bridger Creek at Peters Rd	Y05CFYLR38	MT43D001_011	45.278793	-108.9035
Clarks Fork Yellowstone River at E Pryor Rd	Y05CFYLR01	MT43D001_011	45.464303	-108.84145
Clarks Fork Yellowstone River d/s Rock Creek, d/s of Glenwood ditch	Y05CFYLR14	MT43D001_011	45.543055	-108.82703
Clarks Fork Yellowstone River at Thiel Rd, near mouth	Y05CFYLR07	MT43D001_011	45.648417	-108.71689
Red Lodge Creek at Election Rd crossing	Y05RDLGC75	MT43D002_050	45.391355	-109.32056
Red Lodge Creek u/s Cooney Reservoir	Y05RDLGC48	MT43D002_050	45.436341	-109.25102
Red Lodge Creek d/s Cooney Reservoir	Y05RDLGC45	MT43D002_060	45.449755	-109.19728
Red Lodge Creek at Lone Tree Rd crossing	Y05RDLGC75	MT43D002_060	45.4680442	-109.09008
Rock Creek d/s of Wyoming Creek	Y05ROCKC90	MT43D002_132	45.0608943	-109.40494
Rock Creek u/s of West Fork Rock Creek	Y05ROCKC70	MT43D002_132	45.154669	-109.26871
Rock Creek Horsethief Station FAS	Y05ROCKC60	MT43D002_131	45.234428	-109.23128
Rock Creek Hwy 212 crossing d/s of Roberts	Y05ROCKC20	MT43D002_131	45.382693	-109.14241
Rock Creek u/s of Red Lodge Creek	Y05ROCKC30	MT43D002_131	45.471312	-109.07365
Rock Creek at Hwy 212 crossing	Y05ROCKC02	MT43D002_120	45.475085	-108.99794
Rock Creek near mouth	Y05ROCKC08	MT43D002_120	45.526591	-108.82493
West Red Lodge Creek Luther Roscoe Rd Crossing	Y05RDLWC10	MT43D002_080	45.284069	-109.43018
West Red Lodge Creek 2nd May Grade Rd bridge	Y05RDLWC20	MT43D002_080	45.32175	-109.31978
Willow Creek at Taylor Hill Rd crossing	Y05WILOC45	MT43D002_070	45.293497	-109.26185
Willow Creek near mouth	Y05WILOC90	MT43D002_070	45.425618	-109.23112

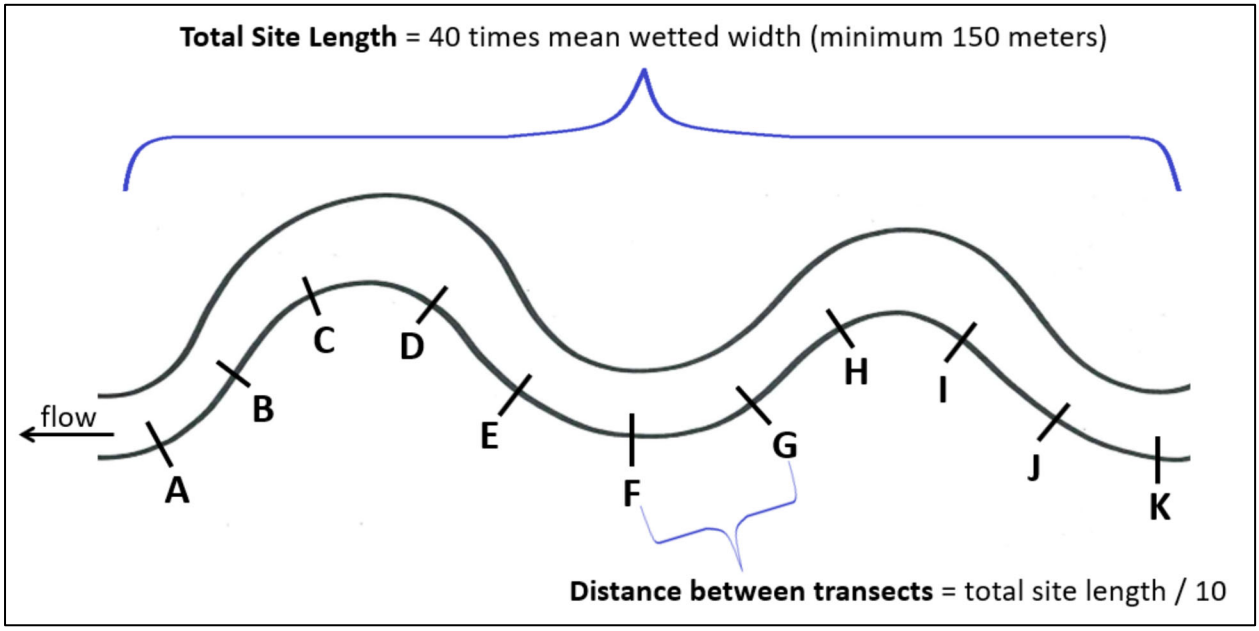

Figure 4. Diagram of Chl *a* Sampling Frame for Medium Sized Rivers

4.3.4 Macroinvertebrate Sampling

Macroinvertebrate sampling will occur once during the 2023 field season in either July or August. Macroinvertebrates will be monitored to supplement nutrient sampling results and used to inform nutrient assessment decisions. This can help determine how nutrient levels are impacting the beneficial uses in the watershed.

Macroinvertebrate Hilsenhoff Biotic Index (HBI) scores will be determined at 30 sampling locations (**Table 6**). Eleven samples will be collected along a medium-river sampling frame within the wadeable zone (**Figure 4**) following the DEQ SOP, Sample Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Communities (DEQ, 2012).

Table 6. Macroinvertebrate Sampling Locations

Site Name/Location	Station ID	AUID	Latitude	Longitude
Bear Creek u/s of Hwy 308 crossing	Y05BEARC03	MT43D002_020	45.156545	-109.18365
Bear Creek near mouth	Y05BEARC01	MT43D002_020	45.145045	-109.00603
Bluewater Creek just above private ranch	Y05BLUWC03	MT43D003_032	45.31483	-108.79202
Bluewater Creek d/s of hatchery, above Orchard Ditch	Y05BLUWC45	MT43D003_032	45.33406	-108.83085
Bluewater Creek at Bluewater Rd crossing	Y05BLUWC25	MT43D002_031	45.365177	-108.86703
Bluewater Creek near mouth	Y05BLUWC01	MT43D002_031	45.384609	-108.90204
Clarks Fork Yellowstone River off Bear Creek Lane	Y05CFYLR60	MT43D001_012	45.144655	-108.99005
Clarks Fork Yellowstone River at CF Yellowstone FAS above Hwy 310	Y05CFYLR28	MT43D001_012	45.25631	-108.92178
Clarks Fork Yellowstone River d/s of Bridger Creek at Peters Rd	Y05CFYLR38	MT43D001_011	45.278793	-108.9035

Site Name/Location	Station ID	AUID	Latitude	Longitude
Clarks Fork Yellowstone River at E Pryor Rd	Y05CFYLR01	MT43D001_011	45.464303	-108.84145
Clarks Fork Yellowstone River d/s Rock Creek, d/s of Glenwood ditch	Y05CFYLR14	MT43D001_011	45.543055	-108.82703
Clarks Fork Yellowstone River at Thiel Rd, near mouth	Y05CFYLR07	MT43D001_011	45.648417	-108.71689
Red Lodge Creek at Election Rd crossing	Y05RDLGC75	MT43D002_050	45.391355	-109.32056
Red Lodge Creek u/s Cooney Reservoir	Y05RDLGC48	MT43D002_050	45.436341	-109.25102
Red Lodge Creek d/s Cooney Reservoir	Y05RDLGC45	MT43D002_060	45.449755	-109.19728
Red Lodge Creek at Lone Tree Rd crossing		MT43D002_060	45.4680442	-109.090076
Rock Creek d/s of Wyoming Creek	Y05ROCKC90	MT43D002_132	45.0608943	-109.40494
Rock Creek u/s of West Fork Rock Creek	Y05ROCKC70	MT43D002_132	45.154669	-109.268707
Rock Creek Horsethief Station FAS	Y05ROCKC60	MT43D002_131	45.234428	-109.23128
Rock Creek Hwy 212 crossing d/s of Roberts	Y05ROCKC20	MT43D002_131	45.382693	-109.14241
Rock Creek u/s of Red Lodge Creek	Y05ROCKC70	MT43D002_131	45.471312	-109.073646
Rock Creek at Hwy 212 crossing	Y05ROCKC02	MT43D002_120	45.475085	-108.99794
Rock Creek near mouth	Y05ROCKC08	MT43D002_120	45.526591	-108.82493
Silvertip Creek near WY boarder	Y05SILVC95	MT43D002_100	45.00012	-108.90302
Silvertip Creek 0.25 mi u/s Cub Creek off Silvertip Rd	Y05SILVC22	MT43D002_100	45.134926	-108.96401
Silvertip Creek 1.5 mi u/s mouth, off of Hergenrider Rd	Y05SILVC01	MT43D002_100	45.179784	-108.99211
West Red Lodge Creek Luther Roscoe Rd Crossing	Y05RDLWC10	MT43D002_080	45.284069	-109.43018
West Red Lodge Creek 2nd May Grade Rd bridge	Y05RDLWC20	MT43D002_080	45.32175	-109.31978
Willow Creek at Taylor Hill Rd crossing	Y05WILOC45	MT43D002_070	45.293497	-109.26185
Willow Creek near mouth	Y05WILOC90	MT43D002_070	45.425618	-109.23112

4.3.5 Periphyton Sampling

Periphyton sampling will occur once during the 2023 field season in either July or August. Periphyton will be monitored to supplement nutrient sampling results and used to inform nutrient assessment decisions. This can help determine how nutrient levels are impacting the beneficial uses in the watershed.

Periphyton metrics will be determined at 15 sampling locations (**Table 7**). Eleven samples will be collected along a medium-river sampling frame within the wadeable zone (**Figure 4**) following the DEQ Periphyton SOP (DEQ, 2011).

Table 7. Periphyton Sampling Locations

Site Name/Location	Station ID	AUID	Latitude	Longitude
Bear Creek u/s of Hwy 308 crossing	Y05BEARC03	MT43D002_020	45.156545	-109.18365
Bear Creek near mouth	Y05BEARC01	MT43D002_020	45.145045	-109.00603
Bluewater Creek just above private ranch	Y05BLUWC03	MT43D003_032	45.31483	-108.79202
Bluewater Creek d/s of hatchery, above Orchard Ditch	Y05BLUWC45	MT43D003_032	45.33406	-108.83085
Bluewater Creek at Bluewater Rd crossing	Y05BLUWC25	MT43D002_031	45.365177	-108.86703
Bluewater Creek near mouth	Y05BLUWC01	MT43D002_031	45.384609	-108.90204
Clarks Fork Yellowstone River off Bear Creek Lane	Y05CFYLR60	MT43D001_012	45.144655	-108.99005
Clarks Fork Yellowstone River at CF Yellowstone FAS above Hwy 310	Y05CFYLR28	MT43D001_012	45.25631	-108.92178
Clarks Fork Yellowstone River d/s of Bridger Creek at Peters Rd	Y05CFYLR38	MT43D001_011	45.278793	-108.9035
Clarks Fork Yellowstone River at E Pryor Rd	Y05CFYLR01	MT43D001_011	45.464303	-108.84145
Clarks Fork Yellowstone River d/s Rock Creek, d/s of Glenwood ditch	Y05CFYLR14	MT43D001_011	45.543055	-108.82703
Clarks Fork Yellowstone River at Thiel Rd, near mouth	Y05CFYLR07	MT43D001_011	45.648417	-108.71689
Silvertip Creek near WY boarder	Y05SILVC95	MT43D002_100	45.00012	-108.90302
Silvertip Creek 0.25 mi u/s Cub Creek off Silvertip Rd	Y05SILVC22	MT43D002_100	45.134926	-108.96401
Silvertip Creek 1.5 mi u/s mouth, off of Hergenrider Rd	Y05SILVC01	MT43D002_100	45.179784	-108.99211

4.3.6 *E. coli* Sampling

E. coli sampling will occur once at 15 sites in August (**Table 8**). Samples will be collected following the *E. coli* SOP (Makarowski, 2019b). Five samples be collected at each site during separate 24-hour periods during any consecutive 30-day period to meet assessment requirements.

Table 8. *E. coli* Sampling Locations

Site Name/Location	Station ID	AUID	Latitude	Longitude
Clarks Fork Yellowstone River at Chance Rd crossing	Y05CFYLR73	MT43D001_012	45.01151	-109.06221
Clarks Fork Yellowstone River off Bear Creek Lane	Y05CFYLR60	MT43D001_012	45.144655	-108.99005
Clarks Fork Yellowstone River at CF Yellowstone FAS above Hwy 310	Y05CFYLR28	MT43D001_012	45.25631	-108.92178
Clarks Fork Yellowstone River d/s of Bridger Creek at Peters Rd	Y05CFYLR38	MT43D001_011	45.278793	-108.9035
Clarks Fork Yellowstone River at E River Rd crossing	Y05CYLR30	MT43D001_011	45.391633	-108.8951

Site Name/Location	Station ID	AUID	Latitude	Longitude
Clarks Fork Yellowstone River at E Pryor Rd	Y05CFYLR01	MT43D001_011	45.464303	-108.84145
Clarks Fork Yellowstone River d/s Rock Creek, d/s of Glenwood ditch	Y05CFYLR14	MT43D001_011	45.543055	-108.82703
Clarks Fork Yellowstone River at Thiel Rd, near mouth	Y05CFYLR07	MT43D001_011	45.648417	-108.71689
Rock Creek d/s of Wyoming Creek	Y05ROCKC90	MT43D002_132	45.0608943	-109.40494
Rock Creek u/s of West Fork Rock Creek	Y05ROCKC70	MT43D002_132	45.154669	-109.268707
Rock Creek Horsethief Station FAS	Y05ROCKC60	MT43D002_131	45.234428	-109.23128
Rock Creek Hwy 212 crossing d/s of Roberts	Y05ROCKC20	MT43D002_131	45.382693	-109.14241
Rock Creek u/s of Red Lodge Creek	Y05ROCKC30	MT43D002_131	45.471312	-109.073646
Rock Creek at Hwy 212 crossing	Y05ROCKC02	MT43D002_120	45.475085	-108.99794
Rock Creek near mouth	Y05ROCKC08	MT43D002_120	45.526591	-108.82493

4.3.7 Continuous Data Measurements

Continuous measurements of parameters (DO, pH, conductivity, turbidity, and temperature) will be collected by deploying MiniDOT DO sensors, salinity sensors, or YSI EXO2 sondes at 25 sites (**Table 9**). Continuous data loggers will be deployed in mid-July and retrieved in mid-August to capture data during the growing season. Sondes and sensors prior to deployment and post deployment procedures will be completed in the Helena field laboratory according to the Multiparameter Water Quality Sonde SOP (McWilliams and Nixon, 2020) and Small Water Quality Dataloggers SOP (McWilliams and Nixon, 2020). Continuous measurements will log data every 15 minutes. MiniDOT sensors will be fixed with a copper mesh to prevent biofouling. YSI EXO2 sondes will be equipped with wipers that clean the sensor surfaces every 15 minutes to prevent biofouling and need to be checked every 2 weeks to ensure their functionality and cleaned from fouling if needed.

Table 9. Continuous Data Sampling Locations

Site Name/Location	Station ID	AUID	Latitude	Longitude	Types of Sensors
Bear Creek near mouth	Y05BEARC01	MT43D002_020	45.145045	-109.00603	MiniDOT sensor
Bluewater Creek d/s of hatchery, above Orchard Ditch	Y05BLUWC45	MT43D003_032	45.33406	-108.83085	MiniDOT sensor
Bluewater Creek near mouth	Y05BLUWC01	MT43D002_031	45.384609	-108.90204	MiniDOT sensor
Clarks Fork Yellowstone River at Chance Rd crossing	Y05CFYLR73	MT43D001_012	45.01151	-109.06221	MiniDOT sensor
Clarks Fork Yellowstone River off Bear Creek Lane	Y05CFYLR60	MT43D001_012	45.144655	-108.99005	MiniDOT sensor
Clarks Fork Yellowstone River at CF Yellowstone FAS above Hwy 310	Y05CFYLR28	MT43D001_012	45.25631	-108.92178	MiniDOT sensor

Site Name/Location	Station ID	AUID	Latitude	Longitude	Types of Sensors
Clarks Fork Yellowstone River d/s of Bridger Creek at Peters Rd	Y05CFYLR38	MT43D001_011	45.278793	-108.9035	MiniDOT sensor
Clarks Fork Yellowstone River at E River Rd crossing	Y05CYLR30	MT43D001_011	45.391633	-108.8951	MiniDOT sensor
Clarks Fork Yellowstone River at E Pryor Rd	Y05CFYLR01	MT43D001_011	45.464303	-108.84145	MiniDOT sensor
Clarks Fork Yellowstone River d/s Rock Creek, d/s of Glenwood ditch	Y05CFYLR14	MT43D001_011	45.543055	-108.82703	MiniDOT sensor
Clarks Fork Yellowstone River at Thiel Rd, near mouth	Y05CFYLR07	MT43D001_011	45.648417	-108.71689	MiniDOT sensor
Red Lodge Creek u/s Cooney Reservoir	Y05RDLGC48	MT43D002_050	45.436341	-109.25102	MiniDOT sensor
Red Lodge Creek d/s Cooney Reservoir	Y05RDLGC45	MT43D002_060	45.449755	-109.19728	MiniDOT sensor
Red Lodge Creek at Lone Tree Rd crossing	Y05RDLGC05	MT43D002_060	45.4680442	-109.090076	MiniDOT sensor
Rock Creek u/s of West Fork Rock Creek	Y05ROCKC70	MT43D002_132	45.154669	-109.268707	MiniDOT sensor
Rock Creek Horsethief Station FAS	Y05ROCKC60	MT43D002_131	45.234428	-109.23128	MiniDOT sensor
Rock Creek u/s of Red Lodge Creek	Y05ROCKC30	MT43D002_131	45.471312	-109.073646	MiniDOT sensor
Rock Creek at Hwy 212 crossing	Y05ROCKC02	MT43D002_120	45.475085	-108.99794	MiniDOT sensor
Rock Creek near mouth	Y05ROCKC08	MT43D002_120	45.526591	-108.82493	MiniDOT sensor
Silvertip Creek near WY boarder	Y05SILVC95	MT43D002_100	45.00012	-108.90302	YSI EXO2 and Salinity sensor
Silvertip Creek 2.5 miles d/s WY boarder	Y05SILVC85	MT43D002_100	45.01894	-108.93716	YSI EXO2 and Salinity sensor
Silvertip Creek 0.25 mi u/s Cub Creek off Silvertip Rd	Y05SILVC22	MT43D002_100	45.134926	-108.96401	MiniDOT sensor and Salinity sensor
Silvertip Creek 1.5 mi u/s mouth, off of Hergenrider Rd	Y05SILVC01	MT43D002_100	45.179784	-108.99211	MiniDOT sensor
West Red Lodge Creek 2nd May Grade Rd bridge	Y05RDLWC20	MT43D002_080	45.32175	-109.31978	MiniDOT sensor

Site Name/Location	Station ID	AUID	Latitude	Longitude	Types of Sensors
Willow Creek near mouth	Y05WILOC90	MT43D002_070	45.425618	-109.23112	MiniDOT sensor

4.3.8 Instantaneous *in situ* Measurements

Water temperature, pH, specific conductivity, and DO will be collected at each site using a multiparameter sonde. DEQ field personnel will use a YSI Pro Plus multiparameter sonde during each monitoring event. Once the values have stabilized, measurements will be recorded on the SVF before leaving the site. All meter use, maintenance, and calibrations will follow the Instantaneous Field Meter SOP (McWilliams, 2020a). A field thermometer will be placed in a shaded area with sufficient air circulation and allowed to stabilize for approximately 15 minutes, then an air temperature measurement (°C) will be recorded on the SVF.

4.3.9 Flow Measurements

Flow will be measured on wadable streams by following procedures listed in Section 10 – Procedural Steps of the Total Discharge SOP (McWilliams, 2020b). If discharge is needed on unwadeable rivers and streams, an ADCP will be used to collect flow, or the project manager will download flow data from nearby USGS gages (**Table 8**).

Table 10. USGS Gauging Stations in Relation to Sampling Site Locations

Site Name and Description	Station ID	Gauging Station	Latitude	Longitude
Clarks Fork Yellowstone River at Chance Rd crossing	Y05CFYLR73	USGS 06207500 Clarks Fork Yellowstone River near Belfry, MT	45.0099111	-109.0653667
Clarks Fork Yellowstone River at E Pryor Rd	Y05CLFYR01	USGS 06208500 Clarks Fork Yellowstone River at Edgar MT	45.4657139	-108.8441056
Red Lodge Creek upstream of Cooney Reservoir	Y05RDLGC48	USGS 06211000 Red Lodge Creek above Cooney Reservoir near Boyd, MT	45.4378500	-109.2533111
Willow Creek near mouth	Y05WILOC90	USGS 06211500 Willow Creek near Boyd, MT	45.4221472	-109.2305306

4.3.10 Photos

Field personnel will take photos at each site when visited. A minimum of three photos will be taken facing upstream, downstream, and across the waterbody. The photo number and pertinent transect information will be recorded for each photo on the back of the SVF.

4.4 Changes to the Field Sampling Plan

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this plan. Field personnel will clearly document any modifications made to the approved plan and will communicate these modifications, preferably before or as soon as possible after, with the project leader. If, for any reason, field staff feel that conditions are unsafe for collecting

samples (e.g., swift waters, weather or ice conditions, flooding, other site hazards) they are not to collect the samples. Field personnel will make reasonable effort to reschedule any missed sampling events in consultation with the project leader, or to replace samples that are lost or broken during the sampling event. If field personnel suspect that an instrument is malfunctioning or giving inaccurate readings, they will add a comment to the SVF explaining the issue and will communicate the issue to the project leader and equipment technician. Project leaders will acknowledge modifications in year-end project reports.

4.5 Field Health and Safety Procedures

Field personnel will carry first aid kits with them during each sampling trip. Field personnel will wear personal protective equipment as appropriate, including but not limited to nitrile gloves, eye protection, wading belts, and personal floatation devices. First aid and CPR training is recommended for all field personnel. Chemical safety precautions will be taken in accordance with chemical safety data sheets. Field personnel will adhere to DEQ's Fieldwork and Emergency Response System (Kron *et al*., 2020). Field personnel will be required to adhere to all safety precautions related to driving, including following traffic regulations, avoiding driving while tired, and selecting appropriate vehicles for anticipated driving conditions. Safety measures will be taken when working in and around water, including wearing wading belts and using approved alternate sampling techniques during excessive flow conditions.

5.0 Sample Handling and Laboratory Analysis

This section contains information pertaining to sample handling, chain of custody, and laboratory analysis.

5.1 Sample Handling and Delivery

In the field, samples will be stored according to the preservation requirements shown in **Table 11**. Care will be taken to maintain appropriate temperatures (e.g., adequate air circulation or ice supply), and coolers will be drained frequently to avoid contamination from melted ice. Storage time between sample collection and delivery to the lab will be minimized and samples will be received by the lab within the holding times specified in **Table 11**.

Samples will preferably be delivered by hand to Energy Laboratory in Helena, MT. If samples must be shipped, the method of delivery (USPS, FedEx, or UPS) will be indicated on the SVF and packing instructions provided by the lab will be followed. Upon delivery of samples at the laboratory, DEQ will keep the original SVFs with chain of custody signatures in place and the laboratory will keep a photocopy.

5.2 Chain of Custody

A record of chain of custody will be maintained for each sample collected during this project so that physical possession is tracked at all points from sample collection through laboratory analysis. The chain of custody section of each SVF will be used to record signatures, dates, and times when samples are relinquished and received during transfers among people including laboratory staff. If samples are shipped, custody seals will be used on the shipping container to ensure that custody is maintained and that samples are not tampered with while in transit.

5.3 LABORATORY ANALYTICAL REQUIREMENTS

Table 11 shows the laboratory analytical requirements for each analyte included in this project. For this project samples will be analyzed by Energy Laboratory in Helena, MT.

Table 11. Monitoring Parameter Suite, Sample Handling, Analysis & Preservation

Parameter	**Required Method**	**Required Reporting Limit** (µg/L unless noted otherwise)	**Holding Time** (days unless noted otherwise)	**Container**	**Preservative**
Water Sample – Physical Parameters and Miscellaneous					
Total Suspended Solids (TSS)	A2540 D	4000	7	1000 ml HDPE	None, then place on ice (≤6°C)
Total Dissolved Solids	A2540 C	4000	7	1000 ml HDPE	None, then place on ice (≤6°C)
Dissolved Organic Carbon (DOC)	A5310 B	500	28	125 ml amber glass	H_3PO_4; field filter 0.45 µm; ≤6° on ice
Chloride	EPA 300.0	50	28	500 ml HDPE	None, then place on ice (≤6°C)
Sulfate	EPA 300.0	50			
Water Sample – Nutrients					
Total Persulfate Nitrogen (TN)	A4500-N C	40	28	250 ml HDPE	≤6°C on ice
Total Phosphorus as P	EPA 365.1	3	28	250 ml HDPE	H_2SO_4; ≤6°C on ice
Nitrate-Nitrite as N	EPA 353.2	10			
Total Ammonia as N	EPA 350.1	50			
Dissolved Orthophosphate (SRP)	EPA 365.1	1	45*	250 ml HDPE	Field filter 0.45 µm; freeze
Water Sample – Total Recoverable Metals, Common Ions, and Hardness					
Total Recoverable Metals Digestion	EPA 200.2	N/A	180	250 ml HDPE	HNO_3; ≤6°C on ice
Aluminum	EPA 200.7	30			
Arsenic	EPA 200.8	1			
Boron	EPA 200.7	6			
Barium	EPA 200.7	0.2			
Cadmium	EPA 200.8	0.03			
Calcium	EPA 200.7	1000			

Parameter	**Required Method**	**Required Reporting Limit** (µg/L unless noted otherwise)	**Holding Time** (days unless noted otherwise)	**Container**	**Preservative**
Chromium	EPA 200.8	1			
Copper	EPA 200.8	1			
Iron	EPA 200.7	20			
Lead	EPA 200.8	0.3			
Magnesium	EPA 200.7	1000			
Selenium	EPA 200.8	1			
Silver	EPA 200.8	0.2			
Sodium	EPA 200.7	1000			
Zinc	EPA 200.7	8			
Mercury, Ultra-low level	EPA 245.7	0.005	90	125 ml Glass	HCl; ≤6°C on ice
Hardness	A2340 B (Calculated)	1000	-	-	-
Water Sample – Dissolved Metals					
Aluminum	EPA 200.7	9	180	250 ml HDPE	Field filter only 180 ml through a 0.45 µm; HNO_3; ≤6°C on ice
Selenium	EPA 200.8	1			
Iron	EPA 200.7	20			
Water Sample – Volatile Organics					
Extractable Petroleum Hydrocarbons (EPH)	MADEP, May 2004	5 - 300	14	2 1000 ml Glass	H_2SO_4; ≤6°C on ice
Volatile Petroleum Hydrocarbons (VPH), includes Benzene, Toluene, Ethylbenzene, Xylene (BTEX)	MADEP, May 2004	1	14	3 VOA vials – no headspace	HCl; ≤6°C on ice
Water Sample – Chlorophyll *a* and AFDW					
Benthic chlorophyll *a*	A 10200 H	Variable	45	Petri dishes or centrifuge tubes (template method); centrifuge tubes (core method); zip-loc bags (hoop)	Process sample according to method, then freeze, and keep in the dark

Parameter	**Required Method**	**Required Reporting Limit** (µg/L unless noted otherwise)	**Holding Time** (days unless noted otherwise)	**Container**	**Preservative**
Ash Free Dry Weight (AFDW)	A 10300 C (5)	Variable	45	-	-
Biological – Macroinvertebrates and Periphyton					
Benthic Macroinvertebrates	Taxonomic ID, O/E Analysis and HBI	-	-	1 Liter HPDE Bottle	95% Ethanal
Periphyton (species present)	Taxonomic ID	-	-	Centrifuge Tube	Formalin
Water Sample – E. coli					
Escherichia coli (E. coli)	A9223 B	1 MPN/100 ml	6 hrs	100 ml HDPE	Place on ice (≤10°C)

* SRP samples must be frozen to extend the holding time to 45 days when sample delivery will exceed the 2-day holding time allowed for unfrozen samples.

6.0 Quality Assurance and Quality Control (QA/QC)

This section describes the QA/QC elements applicable to this project.

6.1 Training and Qualifications

Before sampling commences, all field personnel conducting monitoring for this project will receive training from experienced professionals. Each participant will be provided with a copy of this SAP, applicable SOPs, and field forms, will be required to review them, and must keep these copies with them in the field during all sampling events for reference. Whenever feasible, an experienced professional will accompany inexperienced staff during sampling events until each field personnel demonstrates proficiency. If mistakes are identified throughout the sampling period, efforts will be made to provide supplemental training and clarify guidance documents to prevent further issues, and these corrective actions will be revisited during a "Lessons Learned" review period.

6.2 Instrument Calibration and Maintenance

Instantaneous field meters will be used during each sampling event. Field staff will complete maintenance and calibrations monthly and follow DEQ's SOP for Instantaneous Water Quality Field Meters (McWilliams 2020a). YSI EXO2 and MiniDOT calibration prior to deployment and post deployment procedures will be completed in the Helena field laboratory according to the Multiparameter Water Quality Sonde SOP (McWilliams and Nixon, 2020) and Small Water Quality Dataloggers SOP (McWilliams and Nixon, 2020).

6.3 DATA QUALITY INDICATORS

Data quality indicators (DQIs) are attributes of samples that allow data users to assess data quality. DQI requirements for this project will follow **Section 1.8.3** in the Quality Assurance Project Plan for Water Quality Planning Bureau (WQPB) Environmental Data Operations (DEQ, 2022).

6.3.1 Field Duplicates

Field duplicates are two samples of ambient water (i.e., a routine sample and a duplicate or replicate sample) collected from a waterbody as close as possible to the same time and place by the same person and carried through identical sampling and analytical procedures. Field duplicate samples are labeled, collected, handled and stored in the same way as the routine samples and are sent to the laboratory at the same time.

Field duplicates will be submitted to the analytical lab for each water sample parameter monitored for this project at a rate of at least 10% of the total number of routine samples collected per batch of samples delivered to the laboratory (**Table 12**). Duplicates may be collected at any of the monitoring locations in **Appendix A**. Analytical requirements for field duplicates are shown in **Table 11**.

Table 12. Number of Duplicates per Trip

Number of Duplicates per Analyte Types and Sampling Trips					
	June	July	August	September	October
Nutrients, DOC, TDS, and TSS	6	6	6	6	5
TR and Dissolved Metals	6	6	6	6	5
ULL Mercury	2	2	2	2	2
Sulfate and Chloride	1	1	1	1	1

6.3.2 Field Blanks

Field blanks are samples of analyte-free, laboratory-grade deionized water poured into a sample container in the field using the same method, container, and preservation as routine samples, and shipped to the lab along with other field (i.e., routine and duplicate) samples. All labeling, rinsing, preservation, and storage requirements applied for routine and duplicate samples are applied to field blanks; the only difference is that the water is deionized water rather than ambient stream water.

One set of field blanks (one blank per analyte) will be submitted with each batch of samples delivered to the laboratory. Field blanks must be prepared while in the field. Field blanks will be prepared at or near the end of each sampling event and submitted to the laboratory alongside the other routine and duplicate samples from that trip. Analytical requirements for blanks are shown in **Table 11**.

6.3.3 Trip Blanks

Trip blanks are provided by the laboratory for certain parameters that are especially sensitive to exposure to the atmosphere such as ultra-low level mercury. Trip blanks are samples of analyte-free, laboratory-grade deionized water prepared by analytical laboratory staff, carried through the sampling

event and stored alongside other samples but not opened, and resubmitted to the laboratory alongside other samples. One ultra-low level mercury trip blank will be submitted with each batch of samples delivered to the laboratory.

6.3.4 Result Qualifiers

Result qualifiers approved for use in this project are specified in the most current MT-eWQX EDD Guidance available on the WQPB's WQX webpage: https://deq.mt.gov/water/Programs/sw.

6.4 Laboratory Quality Control

Analytical laboratories shall prepare and analyze the samples in accordance with the chain of custody forms and the methods specified in the analytical requirement table in Section 5 **(Table 11)**. Laboratory SOPs must be controlled under a Laboratory Quality Assurance Program (LQAP) with sufficient rigor for the lab facility to hold a current certification under the State of Montana/U.S. Environmental Protection Agency *(*EPA) Region 8 drinking water certification and/or National Environmental Laboratory Accreditation Conference (NELAC) program. Results from laboratory QC samples (e.g., instrument blanks, method blanks, laboratory control samples, sample matrix spikes) are submitted with the laboratory data report.

7.0 Data Management and Record Keeping

This section describes the process for managing data and maintaining records associated with this monitoring project.

7.1 Data Review and Validation

All data produced by this project will be managed via the WQPB data management and QC system prior to release to project staff for data use and decision making. The WQPB data flow process is summarized in DEQ's Field Data Collection Activities SOP (Makarowski, 2020b) and entails receipt of Electronic Data Deliverables (EDDs) from laboratories, merging analytical results with station information and field parameters for each site visit to create a complete data package, QC review of the entire data package, validating and uploading data into DEQ's EQuIS Water Quality Exchange database (MT-eWQX), and archiving data and records.

The database manager or data technician will verify station information and assign station IDs. EDDs received from the analytical laboratories will undergo QC review by data management staff and will be shared with project leaders for additional quality review in a timely manner to ensure that the analytical results are meeting requirements specified in the project quality assurance project plan and SAP. All SVFs, and other field forms will undergo a QC review by field personnel prior to departure from each site to verify completeness and accuracy. Forms undergo further quality review throughout the data flow process.

The data management and quality assurance team will produce a QA Oversight & Evaluation report to summarize result qualifiers and other QC issues that may affect the usability of analytical results received from the laboratory. The project manager will document any notable deviations from this SAP and will highlight any QC issues identified during the project, as well as corrective actions, in a year-end review document for the project.

7.2 Data Management

All site information, field measurements and analytical results from laboratories for this project will be uploaded into DEQ's EQuIS Water Quality Exchange database (MT-eWQX). Data uploaded to MT-eWQX is submitted to EPA's National WQX Warehouse and accessible via the Water Quality Portal. All data submitted to DEQ for this project from analytical laboratories and others must adhere to the most current EDD and submittal requirements published in the MT-eWQX EDD Guidance available on the WQPB's WQX webpage: https://deq.mt.gov/water/Programs/sw.

All raw electronic files, including EDDs, data logger files, and other, will be retained indefinitely on DEQ's server within the WQPB field season data archive and on the annual WQPB field season archive DVDs. Site Visit Forms (SVF) and other field forms used to document field activities, measurements and site information will be scanned and retained indefinitely in the WQPB data archive and field season archive DVDs. All field photos will be named consistently using WQPB's naming convention (Makarowski, 2020) and archived in electronic project files as well as on the field season archive DVDs.

8.0 Data Analysis and Reporting

This section describes the intended data analyses to be performed using data produced by this project.

8.1 Data Analysis

Data from this project and data uploaded into MT-eWQX by volunteer monitoring groups will be reviewed and analyzed to inform future project planning, site selection, and inform gaps in data collection. Data from 2023 will be compared against water quality standards and thresholds to inform the project lead and stakeholders about current water quality conditions.

Project data for the entire project and all readily available data will be considered for water quality assessment to update the 303(d) list of impaired waters for the Water Quality Integrated Report (2026 cycle anticipated). Further information on assessment approach can be found in Section 3.3.2 of the Project Plan (DEQ, 2022). Additionally, the data will be used to support source assessment and TMDL development. Further information on the TMDL development strategy can be found in Section 4.0 of the Project Plan (DEQ, 2022).

8.2 Reporting

The results from 2023 analysis will be shared with internal DEQ programs for continued project development. The project lead will provide project result updates to stakeholders and external groups. Presentations, handouts, and reports may be used to convey this information. Assessment outcomes will be documented in DEQ's Water Quality Assessment, Reporting and Documentation System (WARD) and will be made available to the public via DEQ's Clean Water Act Information Center (cwaic.mt.gov).

9.0 REFERENCES

Drygas, J. 2012. The Montana Department of Environmental Quality Metals Assessment Method. Helena, MT: Montana Dept. of Environmental Quality.

Environmental Protection Agency (EPA). 2002. Guidance for Quality Assurance Project Plans. EPA QA/G-5. Washington DC: Environmental Protection Agency Office of Environmental Information.

Kron, Darrin, Elizabeth McWilliams, and Stephen Carpenedo. 2020. Standard Operating Procedure for Fieldwork Communication and Emergency Response System. WQDMASFM-02, Version 1.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

Makarowski, K. 2020a. Beneficial Use Assessment Method for Montana's Surface Waters. Helena, MT: Montana Department of Environmental Quality. Document WQPBWQM-001, Version 4.0.

Makarowski, K. 2020b. Standard Operating Procedure: Field Data Collection Activities. WQDWQPBFM-01, Version 1. Helena, MT: Montana Department of Environmental Quality Water Quality Planning Bureau.

Makarowski, K. 2019a. Standard Operating Procedure for Sample Collection for Chemistry Analysis: Water, Sediment, and Biological Tissue. WQDWQPBFM-02, Version 1.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

Makarowski, K. 2019b. Standard Operating Procedure for Sample Collection, Handling, and Analysis of *Escherichia coli*. WQPBWQM-014, Version 2.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

McCarthy, M. 2014. Standard Operating Procedure: Field Equipment Decontamination. Document WQPBWQM-028. Helena, MT: Montana Department of Environmental Quality Water Quality Planning Bureau.

McWilliams, E. and R. Esquivel. 2017. Standard Operating Procedure: Aquatic Invasive Species Decontamination. WQDWQPBFM-05, Version 1.0. Helena, MT: Montana Department of Environmental Quality Water Quality Planning Bureau.

McWilliams, Elizabeth. 2020a. Standard Operating Procedure for Instantaneous Water Quality Field Meters. WQDWQPBFM-06, Version 1.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

McWilliams, Elizabeth. 2020b. Standard Operating Procedure for Total Discharge. WQDWQPBFM-03, Version 1.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

McWilliams, Elizabeth, and Alan Nixon. 2020. Standard Operating Procedure for Small Water Quality Dataloggers. WQDWQPBFM-07, Version 1.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

Montana DEQ. 2022. Clarks Fork Yellowstone Watershed Water Quality Project Plan. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

Montana Department of Environmental Quality (DEQ). 2022. Quality Assurance Project Plan for Water Quality Planning Bureau Environmental Data Operations. WQDWQPBQAP-01, Version 1.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

Montana DEQ. 2012. Periphyton Standard Operation Procedure. WQPBWQM-010, Version 1.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

Montana DEQ. 2021. Sample Collection and Laboratory Analysis of Chlorophyll-*a* Standard Operation Procedure. WQPBWQM-011, Version 8.0. Helena, MT: Montana Department of Environmental Quality, Water Quality Planning Bureau.

Suplee, M.W., and R. Sad, 2016. Assessment Methodology for Determining Wadeable Stream Impairment Due to Excess Nitrogen and Phosphorus Levels. Helena, MT: Montana Dept. of Environmental Quality.

APPENDIX A – MONITORING LOCATIONS

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D002_020	Bear Creek	Y05BEARC03	u/s of Hwy 308 crossing	-109.18365	45.156545	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Upstream of abandoned mines and the town of Bearcreek, represents upstream extent of AU
MT43D002_020	Bear Creek	Y05BEARC15	0.6 mi above Belfry	-109.034513	45.1415	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Transition in land use practices
MT43D002_020	Bear Creek	Y05BEARC01	near mouth	-109.00603	45.145045	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River
MT43D003_032	Bluewater Creek	Y05BLUWC03	just above private ranch	-108.79202	45.31483	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Represents upstream extent of AU
MT43D003_032	Bluewater Creek	Y05BLUWC45	d/s of hatchery, above Orchard Ditch	-108.83085	45.33406	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Periphyton,	Downstream extent of AU

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
						Macroinvertebrates, *in situ* Measurements, and Flow	
MT43D002_031	Bluewater Creek	Y05BLUWC25	at Bluewater Rd crossing	-108.86703	45.365177	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Transition in land use practices
MT43D002_031	Bluewater Creek	Y05BLUWC01	near mouth	-108.90204	45.384609	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River
MT43D002_170	Bridger Creek	Y05BRIDC50	u/s of S Fk Bridger Creek	-108.84322	45.229341	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Upstream of tributary confluence, represents upstream extent of AU
MT43D002_170	Bridger Creek	Y05BRIDC30	off Pryor Mtn Rd	-108.85917	45.240577	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Downstream of tributary confluence
MT43D002_170	Bridger Creek	Y05BRIDC02	at Hwy 310 crossing	-108.90902	45.26159	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D002_180	Bridger Creek South Fork	Y05BRSFC03	near mouth	-108.84692	45.228702	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Downstream extent of AU, tributary contribution
MT43D001_012	Clarks Fork Yellowstone River	Y05CFYLR73	at Chance Rd crossing	-109.06221	45.01151	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, Delta DO, *in situ* Measurements, and Flow	Site at operational USGS gage at upstream extent of AU, near WY boarder
MT43D001_012	Clarks Fork Yellowstone River	Y05CFYLR60	off Bear Creek Lane	-108.99005	45.144655	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Upstream of tributary confluence
MT43D001_012	Clarks Fork Yellowstone River	Y05CFYLR55	at Hwy 72 crossing	-108.98418	45.189802	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, *in situ* Measurements, and Flow	Downstream of multiple tributary confluences
MT43D001_012	Clarks Fork Yellowstone River	Y05CFYLR28	at CF Yellowstone FAS above Hwy 310	-108.92178	45.25631	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream extent of AU

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D001_011	Clarks Fork Yellowstone River	Y05CFYLR38	d/s of Bridger Creek at Peters Rd	-108.9035	45.278793	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Upper extent of AU
MT43D001_011	Clarks Fork Yellowstone River	Y05CFYLR32	d/s of Bridger, at Sand Creek Rd	-108.91241	45.3359	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, *in situ* Measurements, and Flow	Downstream of point source discharger
MT43D001_011	Clarks Fork Yellowstone River	Y05CFYLR30	at E River Rd crossing	-108.8951	45.391633	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, *in situ* Measurements, and Flow	Downstream of tributary confluence
MT43D001_011	Clarks Fork Yellowstone River	Y05CFYLR25	u/s of Elbow Creek	-108.86611	45.43341	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, *in situ* Measurements, and Flow	Upstream of tributary confluence
MT43D001_011	Clarks Fork Yellowstone River	Y05CLFYR01	at E Pryor Rd	-108.84145	45.464303	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream of tributary confluence
MT43D001_011	Clarks Fork Yellowstone River	Y05CFYLR14	d/s Rock Creek, d/s of Glenwood ditch	-108.82703	45.543055	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream of tributary confluence

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D001_011	Clarks Fork Yellowstone River	Y05CFYLR10	d/s of Cottonwood Creek near River Rd	-108.80713	45.57808	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, *in situ* Measurements, and Flow	Downstream of tributary confluence
MT43D001_011	Clarks Fork Yellowstone River	Y05CFYLR07	at Thiel Rd, near mouth	-108.71689	45.648417	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, ULL Mercury, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Periphyton, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream extent of AU
MT43D002_140	Cottonwood Creek	Y05COTWC25	0.3 mi u/s Little Cottonwood Creek	-108.769937	45.527042	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Represents upstream extent of AU
MT43D002_140	Cottonwood Creek	Y05COTWC03	at McDowell Lane	-108.82153	45.555793	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River
MT43D002_190	Dry Creek	Y05DRYC98	d/s N and S Fork Confluence	-109.01917	45.214294	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Upper extent of AU
MT43D002_190	Dry Creek	Y05DRYC15	off Hwy 72, 0.4 mi from mouth	-108.98648	45.195545	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River
	East Red Lodge Creek	Y05RDLEC02	near mouth	-109.31471	45.32531	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals,	Contribution to Red Lodge Creek

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
						TSS, DOC, *in situ* Measurements, and Flow	
MT43D002_010	Elbow Creek	Y05ELBWC30	at Lower Elbow Cr Rd crossing	-108.957269	45.455349	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Transition in land use practices
MT43D002_010	Elbow Creek	Y05ELBWC04	near mouth	-108.86473	45.447121	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River
	North Fork Dry Creek	Y05DRYNF01	near mouth	-109.02008	45.214193	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Contribution to Dry Creek
MT43D002_050	Red Lodge Creek	Y05RDLGC75	at Election Rd crossing	-109.32056	45.391355	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Accessible site on limited access assessment unit
MT43D002_050	Red Lodge Creek	Y05RDLGC48	u/s Cooney Reservoir	-109.25102	45.436341	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream extent of AU
MT43D002_060	Red Lodge Creek	Y05RDLGC45	d/s Cooney Reservoir	-109.19728	45.449755	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Upper extent of AU

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D002_060	Red Lodge Creek	Y05RDLGC05	at Lone Tree Rd crossing	-109.090076	45.468044	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Contribution to Rock Creek.
MT43D002_132	Rock Creek	Y05ROCKC90	d/s of Wyoming Creek	-109.40494	45.060894	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, E. coli, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream of tributary confluence
MT43D002_132	Rock Creek	Y05ROCKC70	u/s of West Fork Rock Creek	-109.268707	45.154669	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream extent of AU
MT43D002_131	Rock Creek	Y05ROCKC60	Horsethief Station FAS	-109.23128	45.234428	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream of point source discharger
MT43D002_131	Rock Creek	Y05ROCKC20	Hwy 212 crossing d/s of Roberts	-109.14241	45.382693	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, E. coli, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Middle extent of AU
MT43D002_131	Rock Creek	Y05ROCKC30	u/s of Red Lodge Creek	-109.073646	45.471312	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream extent of AU

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D002_120	Rock Creek	Y05ROCKC02	at Hwy 212 crossing	-108.99794	45.475085	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Upper extent of AU
MT43D002_120	Rock Creek	Y05ROCKC08	near mouth	-108.82493	45.526591	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, E. coli, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River
MT43D002_100	Silvertip Creek	Y05SILVC95	near WY border	-108.90302	45.00012	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chloride, Sulfate, Delta DO, Macroinvertebrates, Periphyton, *in situ* Measurements, and Flow	Upper extent of AU
MT43D002_100	Silvertip Creek	Y05SILVC85	2.5 miles d/s WY border	-108.93716	45.01894	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chloride, Sulfate, Continuous Measurements, *in situ* Measurements, and Flow	Downstream of oil and gas sources.
MT43D002_100	Silvertip Creek	Y05SILVC45	on BLM property	-108.96514	45.10233	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chloride, Sulfate, *in situ* Measurements, and Flow	Between oil and gas sources and transition in land use practices.

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D002_100	Silvertip Creek	Y05SILVC22	0.25 mi u/s Cub Creek off Silvertip Rd	-108.96401	45.134926	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chloride, Sulfate, Continous measurements, Macroinvertebrates, Periphyton, *in situ* Measurements, and Flow	Transition in land use practices
MT43D002_100	Silvertip Creek	Y05SILVC01	1.5 mi u/s mouth, off of Hergenrider Rd	-108.99211	45.179784	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chloride, Sulfate, Delta DO, Macroinvertebrates, Periphyton, *in situ* Measurements, and Flow	Downstream extent of AU
	South Fork Dry Creek	Y05DRYSF01	near mouth	-109.01972	45.213621	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Tributary contribution
MT43D002_040	Spring Creek	Y05SPRGC02	at River Rd near mouth	-108.71543	45.647854	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Contribution to the Clarks Fork Yellowstone River
	West Fork Rock Creek	Y05ROCWF02	near mouth	-109.26899	45.15773	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, *in situ* Measurements, and Flow	Contribution to Rock Creek
MT43D002_080	West Red Lodge Creek	Y05RDLWC10	Luther Roscoe Rd Crossing	-109.43018	45.284069	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Accessible site on limited access assessment unit

AUID	Site Name	Station ID	Site Description	Longitude	Latitude	Parameters to Collect	Rationale for Site Selection
MT43D002_080	West Red Lodge Creek	Y05RDLWC20	2nd May Grade Rd bridge	-109.31978	45.32175	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream extent of AU
MT43D002_070	Willow Creek	Y05WILOC45	at Taylor Hill Rd crossing	-109.26185	45.293497	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Represents upstream extent of AU
MT43D002_070	Willow Creek	Y05WILOC90	near mouth	-109.23112	45.425618	Nutrients, TR Metals, Common Ions, Hardness, Dissolved Metals, TSS, TDS, DOC, Delta DO, Chl a, AFDW, Macroinvertebrates, *in situ* Measurements, and Flow	Downstream extent of AU

*These are proposed sampling locations which may change due to unforeseen access or other issues.

APPENDIX B – FIELD FORMS

Place Site Visit Label Here

Site Visit Form

Project ID:_CFYR-2023_______

Date: ____________ **Time:** ___________ **Personnel:** ______________________________

Waterbody: ______________________________ Location: ______________________________

Station ID: ____________ HUC: ____________ County: ____________ AUID: ____________

Latitude: ______________ Longitude: ______________ Elevation: __________ ft m

☐Field Duplicate to __________ ☐Field Blank ☐Trip Blank ☐ Field Equipment Blank

Samples Collected		**Sample ID**	**Sample Collection Information/Preservation**
Water	☐		☐**GRAB** ☐EWI ☐BACT
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Analysis:			0.45µ Filtered | HNO_3 H_2SO_4 H_3PO_4 HCL | Ice Frozen
Benthic Chl-a	☐		Sample Method: C=Core H=Hoop T=Template N=None
☐ Composite at Lab ☐ AFDW ☐ Visual Est. <50 mg/m2			Sample Location: R=Right C=Center L=Left
Transect: A___-___ B___-___ C___-___ D___-___ E___-___			F___-___ G___-___ H___-___ I___-___ J___-___ K___-___
Algae	☐		☐ PERI-1-MOD ☐ PERI-1 ☐ OTHER:
Macroinvertebrates	☐		☐ MAC-R-500 ☐ OTHER: # of Jars:

Field Measurements	Time: ____(24 hr)	**Field Assessments**
Water Temp: °C °F	Air Temp: °C °F	☐ Photos ☐ Data Logger ☐ Aquatic Plant Tracking
Bar. Pressure: mm/Hg	SC: uS/cm	☐ AQPVA ☐ Total Discharge ☐ SAM (Sediment Assess)
pH: DO: mg/L	Turbidity: NTU	☐ EMAP ☐ Bacteria ☐ NRCS (Riparian Assess)
Turbidity: ☐Clear ☐Slight ☐Turbid ☐Opaque		☐ BEHI ☐ Greenline ☐ HAM (Habitat Assess)
		☐ SUM ☐ Wetland ☐ Other:
Flow: ft3/sec (☐Dry Bed ☐Stranded Pools)		☐Only Transect F Total Site Length________m
☐Meter ☐Meter-Auto ☐Float ☐Gage ☐Visual Est.		Transect Length______m Average Wetted Width________m

Photos	#

Chemistry Lab Information		
Lab Samples Submitted to: Energy Lab	Account #:	Term Contract Number: STC SPB 19-0156T-ELI -221004
Invoice Contact: Darrin Kron – DEQ/WQ / PO Box 200901 / Helena, MT 59620-0901 / 406-444-4765		
Contact Name & Phone: Darrin Kron – DEQ – 406-444-4765		EDD ☒ Format: MT-eWQX Compatible
1) Relinquished By & Date/Time:	1) Shipped By: ☐USPS ☐Hand ☐FedEx/UPS	1) Received By & Date/Time:
2) Relinquished By & Date/Time:	2) Shipped By: ☐USPS ☐Hand ☐FedEx/UPS	2) Received By & Date/Time:

Lab Use Only - Delivery Temperature: Wet Ice__________°C Dry Ice__________°C Rev. 3/22/22

Place Site Visit Label Here

Site Visit Form Continued

Data Loggers	☐Temperature	☐YSI	☐MiniDOT	☐EC	☐TruTrack	☐AquaRod	☐Weather Station
	☐Deployed	☐Cleaned/Checked	☐Retrieved				

Field Meter Calibration		
pH Meter:	Manufacturer & Model:	Date of Last Calibration:
	Comments:	
Multiparameter Meter:	Manufacturer & Model:	
	Date of SC Calibration:	☐DO calibrated at site visit
	Comments:	

Site Visit Comments
Data Logger Notes:
Time data logger removed:
Time data logger returned:
☐Data logger cleaned
☐Data logger downloaded
☐Data logger re-launched

APPENDIX C – EQUIPMENT AND SUPPLIES

- Project SAP
- SOPs
- Forms
- Labels
- Project ID stickers
- Site Visit Codes (SVCs)
- Clip Board(s)
- Mechanical Pencils and fine tip Sharpies
- Tape for labels
- InReach
- GPS with loaded sites
- Camera
- Road Atlas
- Sample Containers (i.e. bottle sets, 1 L bottles, centrifuge tub, ziplock bag, petri dishes)
- Large cooler(s) for collecting up to 40 sets
- Small dry ice cooler (for frozen SRP samples)
- Dry Ice (at least 20 lbs)
- Mercury Cooler
- Mercury Sampling Kit
- Bags for mercury sampling
- Syringes
- Filters
- DI water (6 to 9 L)
- Extension (telescopic) pole sampler and HCL for decontamination (if needed)
- Flow meter, rod, pins, tape (for tributary sampling)
- ADCP equipment (for Clarks Fork Yellowstone River and Rock Creek sampling)
- Benthic algae sampling kit
- Macroinvertebrate sampling kit (include D-net)
- Formalin
- Parafilm
- Quanti-Trays/2000
- Colilert
- Tray Sealer
- Incubators
- UV light
- Nitrile gloves
- YSI handheld meter
    - Ensure that the proper weekly and month calibrations and maintenance have occurred before sampling.
- YSI EXO2 with sensors

- MiniDOTs
- Deployment Equipment
- AIS Decon supplies
    - Jug with spigot marked with “Decon Tap Water”
    - Virkon® Aquatic disinfectant powder
    - Powder scoop (provided with Virkon® Aquatic)
    - Protective gloves
    - Eye/face protection
    - Container with gamma sealed lid marked with “2% Virkon”
    - Stiff-bristled brush (1 per person)
    - Pressurized sprayer Pole Sampler with HCL vials