Sun River Watershed Group
2017 Volunteer Monitoring Project
Sampling and Analysis Plan

Revised: April 25, 2017
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1.0 INTRODUCTION

1.1 Project Area Overview

The Sun River watershed is a sub-basin of the Missouri-Sun-Smith submajor basin, located in north-central Montana. From its headwaters in the Rocky Mountains, the Sun River flows east for approximately 97.4 miles until it reaches the town of Great Falls, Montana, where it empties into the Missouri River. Along the way, countless springs and numerous tributaries feed the Sun River. The Sun River watershed, and the quality of the water it carries, has been significantly impacted by human activity, for better and for worse. Sun River QAPP dated September 19, 2012 also contains useful data for this SAP.

The following are excerpts from the 2012 QAPP. Several sections of the watershed were included on the state's 2010 303(d) list. The Sun River has an "impaired" designation, unable to support designated uses from Gibson Dam to Muddy Creek and also from Muddy Creek to the mouth at its confluence with the Missouri River. Causes of impairment from Gibson Dam to Muddy Creek include alteration in stream-side or littoral vegetative covers, other flow regime alterations, sedimentation/siltation, and water temperature. From Muddy Creek to the Missouri, causes include total nitrogen, total phosphorus, other flow regime alterations, sedimentation/siltation, and total suspended solids. Other sections with impairment designations include Muddy Creek (headwaters to mouth), Ford Creek (from mouth to 2 miles upstream), Gibson Reservoir, Willow Creek Reservoir and Freezeout Lake. More detailed information regarding 303(d) listings within the watershed can be found on Montana Department of Environmental Quality's (DEQ's) Clean Water Act Information Center website (http://cwaic.mt.gov/).

In December 2004, a document called the "Water Quality Restoration Plan and Total Maximum Daily Loads for the Sun River Planning Area" (WQRP) (DEQ 2004) was finalized for the Sun River watershed. The WQRP addressed these and other impairments on the Sun River, as well as impairments on several other waterbodies within the watershed. The TMDL acknowledges the fact that conditions on all of the tributaries within the watershed "plays an important role in supporting beneficial uses" (pg 3 of the WQRP).

Previous monitoring summary by MSU 2009 report included:

- For the period of monitoring (2004-2009), overall salinity appears to have decreased slightly. Sun River at Augusta is relatively free of salinity, as reflected in conductivity measurements. Salinity increases downgradient, nearly tripling before the Sun River reaches Great Falls. It appears that each of the tributaries monitored is a measurable source of salinity. In a large majority of the cases of measurement, salinity (reflected in conductivity) is below the thresholds established in the TMDL. Exceptions occur when flows in tributaries are sourced primarily from seepage and ground water discharge, and are not augmented by either irrigation spillages or direct return flows.
- Total nitrogen appears to have decreased consistently during the period of record, although inspection of individual values identifies many occasions when the TN concentration exceeds the TMDL target. Efforts should be focused on identifying the sources/causes of elevated TN and initiating land resource management plans to give attention to reducing TN concentrations. TN appears to be heavily influenced by tributary inflows.
- Nitrate+nitrite-N clearly increases between Augusta and Great Falls. The period of record suggests a trend of increasing nitrate+nitrite-N concentration between 2004 and 2009. Muddy Creek, Mill Coulee, and Big Coulee all appear to be sources of significant contribution. As with total nitrogen, efforts should be focused on identifying the sources/causes of elevated nitrogen and initiating land resource management plans to give attention to reducing nitrogen contributions.
- As with nitrogen, there appears to be a developing trend of increasing total phosphorus concentrations over time – in addition to a measurable and significant increase in total phosphorus between Sun River at Augusta and Sun River near Vaughn-Great Falls. The same recommendation applies with respect to total phosphorus as to nitrogen.
- Clearly total suspended sediment (TSS) increases significantly in Sun River between Augusta and Great Falls. There also appears to be a trend of increasing TSS during the period of record. While

concentrations of TSS in Mill Coulee appear to have decreased during the 2004-2009 period, concentrations of TSS in Big Coulee appear to have increased during this same time period.

1.2 Project Goals and Objectives

The goal of this sampling project is to add to the existing Sun River water quality monitoring dataset that will subsequently be used to assess trends in water quality and track progress towards reaching the goals of the Sun River TMDL plan, the Sun River Watershed Restoration Plan (WRP) (2004), and to determine the effects of the improvement projects since those plans were developed. Relevant goals from the WRP include: 1) Freezout Lake reduction of salinity and selenium; 2) Sun River from Gibson Dam to Vaughn improvements of riparian vegetation, sedimentation levels, and water temperature; 3) Sun River from Vaughn to mouth improvements of nitrogen levels, phosphorus levels, sedimentation levels, and total suspended sediment levels; 4) Muddy Creek from headwaters to mouth improvements of nitrogen levels, phosphorus levels, sedimentation levels, and total suspended sediment levels.

The field data collected by SRWG will be considered along with all other readily available data obtained from federal, state and local agencies, other interested water quality organizations, and individuals in evaluating progress towards meeting water quality standards in the Sun River. A desirable outcome of continued monitoring is in identifying, evaluating and remediating the sources/contributing factors to nitrogen, phosphorus, and sediment loads in Muddy Creek, Mill Coulee, Big Coulee, and Adobe Creek. Data collected between 2004 and 2009 provides clear evidence of contributions to impairment from these tributaries. It is important to maintain monitoring stations to track changes in tributary impairment.

Continued monitoring provides data to evaluate whether projects have impacted sources/contributing factors to nitrogen, phosphorus, and sediment loads. This data and evaluation will assist in determining sources/contributing factors as well as the efficacy of various project approaches.

Table 1 – Project Goals, Research Questions and Objectives

Goal	Question	Objective	Data analysis/Product
To evaluate whether water quality impairments noted in the Sun River TMDL are making improvement.	Have Nitrate+Nitrite, Total Nitrogen, Total Phosphorus, and Suspended Sediment Concentrations been reduced in the Sun River and selected tributaries?	Maintain data set of Nitrate+Nitrite levels over time.	Analyze trends over time and compare to TMDL goals.
		Maintain data set of Total Nitrogen levels over time.	Analyze trends over time and compare to TMDL goals.
		Maintain data set of Total Phosphorus levels over time.	Analyze trends over time and compare to TMDL goals.
		Maintain data set of Suspended Sediment Concentrations over time.	Analyze trends over time and compare to TMDL goals.
To determine if large scale best management practices (BMP); irrigation water management (IWM) and livestock management; projects are working.	Have tributaries where water quality improvement projects have taken place show associated improvements in water quality?	Collect nutrient and TDS samples at 6 sites both during and following irrigation season.	Compare concentrations to existing data. Analyze trends over time and compare to TMDL goals.
		Take photos of stream during each sampling event.	Visually estimate impact of BMP projects

1.3 Project Budget

The total project budget for sample analysis and shipping is $2,380. See Appendix A.

2.0 Sampling Process

2.1 Study Design

The project will sample on the Sun River from its upper reach near Augusta to the lower reach at Great Falls near the confluence with the Missouri River, as well as major tributaries that enter the Sun River. Sampling from the selected sites enables us to collect water quality data upstream and downstream of agriculture and human activities. Samples will be collected prior to, during, and after peak flow events. Monitoring at differing flow levels is important in the Sun River drainage because the farming and irrigation practices that contribute to some impairments vary throughout the season and at different flow levels. Sampling under this study design is ongoing and will be continued with funding support. Additional sampling in 2017 will be performed monthly starting in April and continuing through October. Access to private land has been granted.

The Fairfield science teacher Rai Hahn, who has monitored water quality in the Sun River for more than 10 years, will sample all locations during the sampling events. The watershed coordinator will maintain contact with volunteers to schedule sampling dates and with the laboratory to acquire the appropriate bottles. After sampling, Mr. Hahn will perform a data quality assessment for the samples by visually inspecting the sample bottles for physical integrity, and will ship them to the laboratory for analysis.

The sampling sites and parameters are appropriate because the TMDL indicated that agriculture contributions from the tributaries were the largest contributor to sediment and nutrients loads. Best Management Practices efforts have reduced these contributions but monitoring is necessary to quantify improvement toward meeting water quality standards and to determine whether projects are meeting desired outcomes.

Sampling Locations

Sites were identified and sampled in previous sampling efforts. Previously used sites were chosen to allow for comparability between new and previously obtained sampling results. Comparability was desired in order to facilitate trend analysis.

Table 2 - Sampling Locations*

Note- Site ID is incorrect in this table and 2017-2019 sampling location tables. See SAPs prior/ preceding these years for correct site IDs.

Site	Site Description	Latitude	Longitude	Analytes	Rationale for Site Selection
SUN-SUNR50 see Site ID note	Sun River near Augusta	47.547861	-112.366250	Total Suspended Solids (TSS), Nitrate-Nitrite as N (NO2+3), Total Phosphorus (TP), and Total Persulfate Nitrogen (TPN).	Near headwaters
SUN-SUNR56 see Site ID note	Sun River at Great Falls	47.492028	-111.334361		At confluence
SUN-DUCKC01	Big Coulee near Simms	47.516972	-111.887306		Confluence with Sun
SUN-ADBEC01	Adobe Creek near Ft Shaw	47.510583	-111.800611		Confluence with Sun
SUN-MILCU01	Mill Coulee near Sun River	47.540611	-111.705806		Confluence with Sun
SUN-MUDYC57	Muddy Creek at Vaughn	47.561056	-111.538306		Confluence with Sun

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

Sampling Map

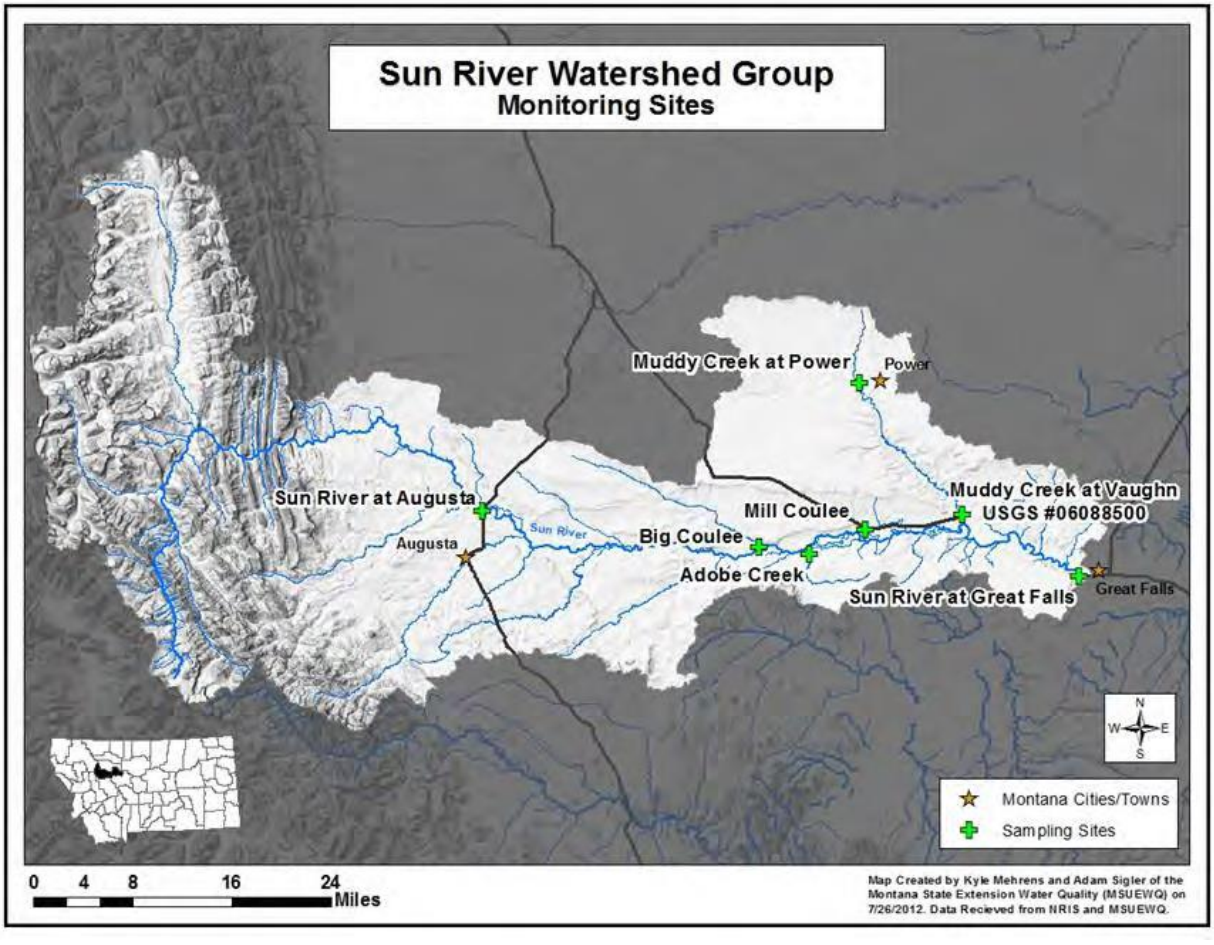

Figure 1 - Map of Sampling Locations

Sampling Timing

The 2017 data collection effort has included monthly sampling starting in April. Funding will be used to continue monthly sampling in the period of April-October.

Table 3 - Sample Collection Timeframe of Lab parameters

Date	Analytes	Reason for Date Selection
April	Nitrate-nitrite N, TPN, Total P, and TSS.	Prior to high flow and irrigation
May	Nitrate-nitrite N, TPN, Total P, and TSS.	During high flows and prior to irrigation
June	Nitrate-nitrite N, TPN, Total P, and TSS.	During high flows and start of irrigation
July	Nitrate-nitrite N, TPN, Total P, and TSS.	During irrigation season
August	Nitrate-nitrite N, TPN, Total P, and TSS.	During irrigation season
September	Nitrate-nitrite N, TPN, Total P, and TSS.	During low flows and at end of irrigation
October	Nitrate-nitrite N, TPN, Total P, and TSS.	During low flows and after irrigation

2.2 Sampling Methods

Table 4 - Sample Collection and Analysis Methods

	Preferred Method	Alternative Method	Preservations	Hold Time	Justification
Field Parameters:					
pH	YSI 556 multi-meter	Oakton Tester	N/A	N/A	Collected when samples are collected.
Temperature	YSI 556 multi-meter	Oakton Tester	N/A	N/A	Collected when samples are collected.
Specific Conductance (SC)	YSI 556 multi-meter	Oakton Tester	N/A	N/A	Cheap and easy surrogate for salinity.
Discharge (Q)	USGS gage data	Field Observation of gage w/ rating curve	N/A	N/A	Necessary to calculate loads; affects sediment, salinity, and all WQ parameters.
Turbidity	Hach	---	N/A	N/A	Erosion is a concern, meter already acquired, hands-on opportunity for SRSC students.
Photos	Digital Camera	---	N/A	N/A	Tracking riparian conditions; cheap and easy.
Lab Parameters:					
Total Suspended Sediment	ASTM D3977-97	---	≤ 6C	7 days	Erosion is a long-term concern in watershed.
Nitrogen (Total Persulfate)	A4500-N C	A4500-N B	≤ 6C	28 days	Muddy Creek exceeds standards.
Nitrate + Nitrite as N	EPA 353.2	A4500-NO3 F	H_2SO_4, ≤ 6C	28 days	Muddy Creek exceeds standards.
Phosphorus (total)	EPA 365.1	A4500-P F	H_2SO_4, ≤ 6C	28 days	Some tributaries exceed standards.

Sampling Methods

SRWG is responsible for water quality parameter sampling efforts, and will conduct sampling according to the SRWG SOP document, located in Appendix E. A Site Visit Form (see Appendix E) will be completed for each site visit and will include all field data collected and an inventory of samples collected for analysis at the contracted laboratory. Field parameters outlined in Appendix E and indicated on the Site Visit Form will be collected at each sampling event. Site locations will be corroborated using the GPS coordinates, driving directions and photographs provided in the SOP document. A GPS reading will be taken and recorded on the field visit form, using the NAD 1983 State Plane Montana datum, in decimal degrees to at least the fourth decimal. Photographs will be taken at pre-established photo-point locations using a digital camera. Field parameter data will be collected with a YSI 556, calibrated on the day of the sampling event, according to manufacturer instructions. Site Visit Forms will be checked for completeness before leaving the sample site by Rai Hahn.

Flow (Discharge) Measurement

USGS uses automated gauges to collect flow data at Sun River at Augusta (SUN-SUNR50), Muddy Creek at Vaughn (SUN-MUDYC57), and Sun River at Great Falls (SUN-SUNR56). USGS maintains and calibrates these gauges in accordance with their own procedures and standards. DNRC creates rating curves for the gauges at the Big Coulee (SUN-DUCKC01) and Mill Coulee (SUN-MILCU01) sites via monthly visits May through October. Fort Shaw Irrigation District also creates rating curves for the Adobe Creek (SUN-ADBEC01) site using this method.

Water Sample Collection and Handling Procedure

Grab samples will be collected for delivery to the DEQ-contracted lab (Energy Lab) for chemistry analysis using acid washed, polyethylene bottles provided by the testing laboratory. Tables 3 and 4 detail the sample collection schedule, lab parameters, and justifications for sample collection. Table 5 details the analytical methods and handling procedures for each parameter.

Bottles must be rinsed three times with stream water prior to sample collection in a well-mixed portion of each stream. During sampling, the sample bottle opening should face upstream and should be drawn

through the water column once, carefully avoiding disturbance of bottom sediments. Samples will be preserved in the field and stored on ice until shipment to the lab well in advance of the hold times listed above.

Quality control (QC) samples consisting of one blank and one duplicate will be collected each sample run and for each analyte. A field blank is prepared by transporting laboratory-grade deionized (DI) water to the field (provided by the laboratory) and pouring it into sample containers provided by the lab. The blank will be prepared at the same time that the samples are collected from the stream. A duplicate sample is a second, co-located stream sample collected at the same time in the same way that the regular stream sample is collected. Duplicate and blank samples are labeled according to the labeling protocol below, which does not identify which sample is which to the lab. Blank and duplicate samples are preserved and handled and delivered to the lab in the same manner that regular samples are handled.

Sample labels should be filled out with Company (SRWG), the date, the time, and the sample ID. The sample ID is very important and includes the year, the month, the day, the site ID and a letter indicating they type of sample (regular, duplicate, or blank).

Sample ID = [Year, Month, Day]_[Site ID]_[Sample-Type Letter]
A = Regular Sample
B = Duplicate Sample
C = Blank Sample

Sample ID Examples:
A regular sample collected at the Adobe Creek site on August 15th, 2017 would be labeled:
20170815_SUN-ADBEC01_A
A duplicate at the same place and time as above:
20170815_SUN-ADBEC01_B
A blank at the same place and time as above:
20170815_SUN-ADBEC01_C

Immediately following grab-sample collection, samples should be preserved with acids (as needed according to the tables in the Sampling and Laboratory Methods sections) and stored in a cooler on ice. The DEQ-contracted analytical lab's chain of custody (COC) forms will be used to document and track all samples collected during the project. COCs will be completed for each set of samples submitted to the laboratory. A sample COC can be found in Appendix E.

2.3 Field Forms

A Site Visit Form (see Appendix E) will be completed for each site visit and will include all field data collected and an inventory of samples collected for analysis at the contracted laboratory.

2.4 Laboratory Methods and Sample Handling Procedures

Table 5 – Monitoring Parameter Suite, Sample Handling, Analysis & Preservation

Parameter	Preferred Method	Alternate Method	Required Reporting Limit ug/L	Holding Time Days	Bottle	Preservative
Water Sample - Common Ions, Physical Parameters, Miscellaneous						
Total Suspended Solids (TSS)	A2540 D	ASTM D3977-97	4000	7	500 ml HDPE	≤6°C
Water Sample - Nutrients						

Parameter	Preferred Method	Alternate Method	Required Reporting Limit ug/L	Holding Time Days	Bottle	Preservative
Total Persulfate Nitrogen (TPN)	A4500-N C	A4500-N B	40	28	250ml HDPE	≤6°C
Total Phosphorus as P	EPA 365.1	A4500-P F	3		250ml HDPE	H_2SO_4 , ≤6°C or Freeze
Nitrate-Nitrite as N	EPA 353.2	A4500-NO3 F	10			

3.0 Quality Assurance/Quality Control

Data needs to accurately represent the conditions in the watershed in order to be useful providing trend data for water quality within the watershed. Proper sample handling, processing, and assessment of data to ensure quality is required and should be examined thoroughly. Data quality objectives (DQOs) state the required quality of data for the intended use and data quality indicators (DQIs) are the specific criteria that data are assessed by to determine quality. These indicators are assessed by collecting quality control (QC) samples and then performing quality assurance (QA) checks on those samples. QC samples are the blank and duplicate samples collected in the field for evaluation of quality indicators. Once the results are processed for the QC samples, QA is the process of assessing the data through use of indicators to determine data quality.

3.1 Quality Assurance and Quality Control Overview

To inform water quality studies, data needs to accurately represent conditions in the watershed. Most projects require some degree of proper sample handling, processing, and data quality assessment, particularly when scientific or resource management questions are being investigated.

Quality Assurance (QA) is the overall management of a sampling program. It ensures the monitoring process, from the methods used to how data will be managed and analyzed, is adequate for the project to meet its objectives with a stated level of confidence. QA activities include developing a sampling and analysis plan, making sure that volunteers or staff is properly trained, and following standard operating procedures.

Quality control (QC) includes technical actions taken to detect and control errors. QC consists of developing measures and protocols to ensure sample collection and analyses are consistent and correct. If there is a problem, good QC will help to identify the problem. It also helps determine whether volunteer work is being performed correctly. QC activities may include collecting replicate samples for chemical analyses and the use of field blanks.

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify the purpose of the study, define the most appropriate type of information to collect, determine the most appropriate conditions from which to collect that information, and specify tolerable levels of potential decision errors. Essentially, DQOs prompt monitoring project managers to determine what level of data quality is necessary to achieve the objectives of the project.

Data quality indicators (DQIs) are attributes of samples that allow for assessment of data quality. Because there are large sources of variability in streams and rivers, DQIs are used to evaluate the sources of variability and error and thereby increasing confidence in our data.

A list of Data Quality Assurance and Quality Control terms and definitions is included in **Appendix B**.

Provisions are in place to ensure sensitivity of data collected to differences in stream water quality and comparability of data collected to other datasets. These provisions include the collection of grab samples and field QC for submission to a certified laboratory and assessment of QC data relative to data quality indicators.

In order to ensure the highest degree of data completeness possible, volunteers need to fill out data sheets completely and review them before leaving a site. Rai Hahn of Sun River Science Club will review datasheets for completeness and will follow-up with his student volunteers if any fields are illegible, inaccurate, or incomplete.

The study design has taken into account sample collection number and timing to ensure quality of data collected throughout the study site and the comparability of data collected to other sample events. These provisions include the collection of field QC samples and laboratory QC methods in accordance with EPA sampling methods. Data that does not meet quality criteria will be qualified appropriately in reporting and during the MT EQuIS submission process.

Lab quality objectives and QA/QC are described in further detail in the appendices.

3.2 Data Quality Indicators

This section describes for each data quality indicator (representativeness, comparability, completeness, sensitivity, precision and accuracy) how the sampling and analysis plan and study design aims to achieve data quality. Data quality indicator criteria are specified, where appropriate.

Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. This project follows a judgmental sampling design in which spatial and temporal considerations were used to help ensure representativeness.

Spatial representation

The project's sampling design helps achieve spatial representativeness whereas sampling sites were chosen to capture variability in land use, flow or other watershed characteristics that may be influencing water quality; monitoring site locations were selected based on use in previous sampling studies; sampling sites include key tributaries; and monitoring sites were selected along the entire length of the stream from headwaters to mouth.

Temporal representation

The project sampling design helps achieve temporal representativeness by collecting samples on a monthly basis and with temporal consistency.

Comparability

Comparability is the degree to which different methods, data sets, and/or decisions agree or are similar. Comparability allows data users to determine the applicability of data to certain projects or decisions. For example, Montana DEQ may incorporate water chemistry data collected by volunteers if the methods, analytes and reporting limits are comparable to those that DEQ uses.

Comparability expresses the confidence with which one data set can be compared to another. To achieve a comparable result, both the field collection method and the analytical method must be comparable. This is achieved through the use of Standard Operating Procedures (SOPs – DEQ or USGS) for field collection and the *use* of the same analytical methods published by the EPA, APHA - Standard Methods, or USGS in the laboratory. This sampling project utilizes sampling methods, analysis methods, and sample locations from previous years and studies in order to encourage comparability.

Completeness

Completeness is a measure, expressed as a percentage, of the amount of data *planned for collection* compared to the amount *actually collected*. Prior to leaving a sampling site the Stream Team volunteers will be required to fill out a data sheet, which will be reviewed and signed by the field leader on site; this will reduce the occurrence of empty data fields. The overall project goal is 90% completeness. Because of the limited funding for laboratory analysis, collection of additional samples in the event of breakage of sample bottles en route to the laboratory is not planned.

Any loss of data due to site access issues, spillage, QC failures, or laboratory mistakes may result in no decisions being made due to insufficient data and a possible return trip to remote sites, or lessen the decision-making certainty. The project's sampling design helps achieve completeness though the following provisions: all field forms will be reviewed for completeness prior to departure from the site; any sampling events that must be cancelled for any reason will be rescheduled; lab reports will be reviewed upon receipt to ensure that results for each sample submitted are received).

Sensitivity

Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. Related to detection limits, sensitivity refers to the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. The more sensitive a method is, the better able it is to detect lower concentrations of a variable. For analytical methods, sensitivity is expressed as the method detection limit (MDL).

Laboratory Sensitivity:
Laboratories determine their method detection limits (MDLs) annually, and routinely check each method's ability to achieve this level of sensitivity using negative controls (e.g., method blanks, continuing calibration Blanks, and laboratory reagent blanks). Sensitivity quality controls for all laboratory methods will follow the frequency and criteria specified in the analytical method or as described in the analytical laboratory's Laboratory Quality Assurance Plan (LQAP).

Corrective Action:
If the analytical method controls fail the specified limit, check with the laboratory to see how they addressed the non-conformance and qualify data as necessary.

Precision, Bias and Accuracy for Water Samples

Bias is the degree of systematic error present in the assessment or analysis process. When bias is present, the sampling result value will differ from the accepted, or true, value of the parameter being assessed. Bias can occur either at sample collection or during measurement. Accuracy is the extent of agreement between an observed value (sampling result) and the accepted, or true, value of the parameter being measured. High accuracy can be defined as a combination of high precision and low bias. Precision measures the level of agreement or variability among a set of repeated measurements, obtained under similar conditions.

Evaluation of precision and accuracy for the water sampling portion of this project will consist of collecting and evaluating the results of field duplicates and field blank samples.

Precision: Field Duplicates
Field duplicates will be collected during this project and used to determine field and laboratory precision. Field duplicates consist of two sets of sample containers filled with the same water from the same sampling site. Duplicates will be collected two times per sampling season at different sites each time. All duplicate samples will be collected at the same location. Field duplicate samples will be collected, handled and stored in the same way as the routine samples for laboratory shipment. Duplicates are used to determine field and laboratory precision.

Field duplicates will be used to evaluate data precision by calculating their relative percent difference (RPD):

RPD as % = ((D1 – D2)/((D1 + D2)/2)) x 100

where:
D1 is first replicate result
D2 is second replicate result

Precision for field QC samples will be assessed by ensuring that relative percent difference (RPD) between duplicates is less than 25%. If the RPD of field duplicates is greater than 25%, all data results from the duplicate pair's parent sample that are less than 5 times the concentration in the duplicate sample will be flagged with a "J".

Precision: Laboratory Duplicates
Energy Laboratories uses EPA approved and validated methods. Energy Laboratory's standard operating procedures all require a method validation process including precision and accuracy performance evaluations and method detection limit studies. Internal laboratory spikes and duplicates are all part of Energy Laboratories quality assurance program; laboratory QA/QC results generated from this program are provided with the analytical results. The criteria used is 20% RPD for duplicate results greater than five times the MDL.

Accuracy: Field Blanks
Field blanks consist of laboratory-grade deionized (DI) water, transported to the field, and poured into a prepared sample container. Blanks are prepared in the field at the same time as the routine samples, and will be preserved, handled and analyzed in the same way as the routine samples. Blanks will be prepared twice per sampling session, at different sampling sites each time. Field blank samples are used to determine the integrity of the volunteer monitors' handling of samples, the condition of the sample containers supplied by the laboratory, and the accuracy of the laboratory methods.

Accuracy for field QC samples will be assessed by ensuring that blank samples return values less than the lower reporting limit (shown in **Section 3**). If a blank sample returns a result greater than the threshold, all data for that parameter from that batch of samples will be qualified with a "B" flag. The exception is that data with a value greater than 10 times the detected value in the blank does not need to be qualified.

Accuracy: Laboratory
Accuracy of individual measurements will be assessed by reviewing the analytical method controls (i.e. Laboratory Control Sample, Continuing Calibration Verification, Laboratory Fortified Blank, Standard Reference Material) and the analytical batch controls (i.e. Matrix Spike and Matrix Spike Duplicate). The criteria used for this assessment will be the limits that Energy laboratory has developed through control charting of each method's performance or based on individual method requirements.

Other
All samples will be checked to verify that they were processed within their specified holding times. Sample results whose holding time was exceeded prior to being processed will be qualified with an "H" flag.

Because of the limited funding for laboratory analysis, collection of additional samples in the event of data results that do not meet data quality objectives is not planned. If problems are linked to field crew sampling error, the data is either rejected or qualified, depending on the degree of the problem, and supplemental training will be provided prior to the next sampling event, as possible.

3.3 Training

All volunteers will be trained in all field methods, including field meters, sample collection and handling, prior to the initial sampling event. All volunteers have demonstrated adequate training as of 2017. Volunteers will demonstrate understanding of and proficiency in field methods to volunteer monitoring

program manager(s) prior to sampling. Volunteers will be required to bring a copy of this SAP as well as any supplemental documentation of detailed field methods and/or standard operating procedures.

3.4 Data Management, Record Keeping & Reporting

The Project Manager is responsible for data management and record keeping, including the following activities that occur during or after the sampling is completed:

- Draft a brief synopsis of any SAP methodology derivations that occurred.
- Store and backup all data generated during this project, including field forms, laboratory reports obtained from the laboratories, electronic copied of field photographs, and written field notes.
- Review field forms for completeness and accuracy, especially Site Visit and Chain of Custody forms.
- Enter all laboratory data into MT e-WQX database.
- Maintain records of hours worked by volunteers for purposes of budget tracking.

Copies of laboratory analytical reports and Electronic Data Deliverable (EDD) spreadsheets will be provided by the DEQ contract analytical lab to both the Project Manager and to DEQ. All data will be entered by the Project Manager, or other specified party, into MT e-WQX database. Prior to entering data into the MT e-WQX database, the Project Manager will review the laboratory data in the following manner:

1. Ensure lab results are within required reporting limits (including the laboratory QA/QC samples); if results are outside the reporting limits, the Project Manager will check with the laboratory to see how they addressed the non-conformance and qualify data as necessary.
2. Complete the QC Checklist included in **Appendix C**.
3. Assign appropriate data qualifiers provided in **Appendix D** to data, as needed, in both hardcopy and electronic form.

3.5 Project Team Responsibilities

Table 6 – Project Team Roles and Responsibilities

Person	Role	Contact Information	Responsibilities	Training (optional)
Rai Hahn	Volunteer	hahn@3rivers.net (406) 217-3943	Ensuring field forms are complete and accurate, filling out COC form, shipping samples.	Watercourse training
Travis Wilson	Project Leader	(209) 986-7012	Communicating with lab and DEQ, performing data QA and identifying data qualifiers, overall data management tasks per section 3.4, writing and submitting the final report to DEQ	Big Sky Watershed Corps technical skills training

3.6 Data Routing

Data will be uploaded into the Montana Department of Environmental Quality (DEQ) Montana EqUIS database (http://deq.mt.gov/Water/WQINFO/datamgmt/mtewqx) for eventual upload into EPA's STORET database (www.epa.gov/storet).

Spreadsheets with all field data collected by the volunteer will be emailed to Travis Wilson, who will review all laboratory and field data and conduct all QC procedures outlined in the Data Quality Control section of this document prior to data entry into the SRWG master spreadsheet. The spreadsheet will ultimately be publically accessible via the SRWG website. SRWG data will be housed in these spreadsheets and uploaded to EQuIS, with assistance from DEQ and/or Montana State University Extension Water Quality (MSUEWQ) personnel.

Table 7 – Data Routing Process

Task	Information/Data	Primary Responsibility	Secondary Responsibility
Reviewing for completeness	field forms	volunteer	project manager
Spreadsheets	field forms	volunteer	project manager
upload and backup	digital site photos	project manager	n/a
lab coordination	sample chain of custody forms, electronic data deliverables	project manager	n/a
data entry into EQuIS	lab results, field measurements, site information	project manager	n/a

4.0 ASSESSMENT RESULTS

4.1 Data Analysis

Upon receiving data from Energy Lab, the project leader will input the data into a spreadsheet to assess the quality of the data by performing initial QA/QC checks. These checks will include determining if there was potential for contamination by ensuring that field blanks show all "non-detects" and by calculating the RPD (see section 3.2) between field duplicates. Any data that does not pass initial data quality assessment will be flagged for further quality control investigation.

Once data passes the initial quality control, the project leader will compare the data values for each analyte, each sampling location, and each month to the corresponding data value for each analyte, sampling location, and month from the previous monitoring year by calculating the RPD between the values to determine the difference. The project leader will also compare each month's data to a 10-year (2007-2016) average for each month, sampling location, and analyte by calculating the RPD between the 2017 value and the 10-year average value (for example: compare site SUN-SUNR50's TSS value for June to the 10-year average of site SUN-SUNR50's June TSS data values). Sampling data will additionally be compared to the Sun River TMDL target values and State of Montana water quality standards for each water quality parameter (DEQ 2014).

The possible results of the assessment are as follows:

1. Sampling data reveals an increase in detected analyte levels relative to the previous year(s), requiring SRWG to evaluate change of land use upstream or if SRWG needs to reevaluate BMP projects. This evaluation will determine if a particular local land use change could be a contributing factor to the increase in the water quality parameter in question or if a SRWG supported land or stream project caused an increase in detected parameter levels despite employing best management practices. If this investigation finds that a land use change or BMP project caused the increase, SRWG will seek to remedy the situation using all available expert resources.

2. Sampling data reveals a decrease in detected levels requiring SRWG to evaluate if this is a trend that needs the SRWG to accomplish more BMP projects. BMP project tracking in water quality report will include where was the project located and what has been done differently, as well as how does WQ data demonstrate this change. SRWG will seek to perform this trend analysis and BMP project effectiveness determination using all available expert resources.

3. Sampling data reveals the Sun River and tributaries are meeting water quality targets. SRWG will request DEQ assistance to evaluate data and consider de-listing the Sun River from the impaired stream list.

The Sun River Watershed Group is currently undergoing a personnel transitional and is reassessing the water quality monitoring and data analysis goals for the Sun River drainage. In order to accomplish more

detailed and statistically driven analysis of data, the group is investigating options and will be seeking outside assistance to look at other approaches to data analysis than those outlined above. SRWG is revising many of its organizational planning documents and will work to develop data management and analyses to better align with these updated plans. At present, SRWG plans to continue water quality monitoring activities in order to continue adding to the long-running water quality dataset while seeking assistance with statistically driven trend analysis of existing and future Sun River watershed data.

See section 1.2 for discussion of individual parameters.

4.2 Data Communication

Annual data summaries will be prepared for SRWG annual meetings by Travis Wilson. In addition to reporting for the SRWG annual meeting, electronic copies of raw data and data summaries will be maintained on SRWG's website. In order to streamline this process, MSUEWQ has created an appendable Excel spreadsheet for each monitoring site that includes graphs of water quality parameters of interest using available historic data. The addition of the current year's water quality and discharge data, and some minor changes to the source data used to create the graphs is all that's needed to bring these files up-to-date.

5.0 References

Montana Department of Environmental Quality (DEQ). 2004. Water Quality Restoration Plan and Total Maximum Daily Loads for the Sun River Planning Area. Montana Dept. of Environmental Quality: Helena, MT. Available at http://deq.mt.gov/Portals/112/Water/WQPB/TMDL/PDF/Sun/M13-TMDL-01a.pdf.

Montana Department of Environmental Quality (DEQ). 2014. Department Circular DEQ 12-A: Montana Base Numeric Nutrient Standards. Montana Dept. of Environmental Quality: Helena, MT. Available at http://deq.mt.gov/Portals/112/Water/WQPB/Standards/NutrientWorkGroup/PDFs/NutrientRules/CircularDEQ12A_July2014_FINAL.pdf.

Sun River Watershed Group. 2004. Sun River Watershed Restoration Plan. Available at https://www.usbr.gov/watersmart/cwmp/docs/plans/Sun-River-Watershed.pdf

Appendix A - Project Budget

Projected Budget for Laboratory Analysis and Other Project Activities

Parameter or Activity	Cost per Analyte	# of Sites	# of visits per site	# of Routine Samples (= # sites x # visits per site)	# of Field Blanks (total for season = ~10% of total routine samples)	# of Field Duplicates (total per season = 1 per visit)	Total # samples (= # routine samples + # dups + # blanks)	Total Cost (= Total # samples x cost per parameter)
Total Suspended Solids (TSS)	$8	6	7	42	7	7	56	$448
Total Persulfate Nitrogen (TPN)	$15	6	7	42	7	7	56	$840
Total Phosphorus as P	$10	6	7	42	7	7	56	$560
Nitrate-Nitrite as N	$8	6	7	42	7	7	56	$448
Shipping sample coolers	$12		7	-	-	-	-	$84
							TOTAL	$2,380

Appendix B – QA/QC Terms and Definitions

Accuracy. A data quality indicator, accuracy is the extent of agreement between an observed value (sampling result) and the accepted, or true, value of the parameter being measured. High accuracy can be defined as a combination of high precision and low bias.

Analyte. Within a medium, such as water, an analyte is a property or substance to be measured. Examples of analytes would include pH, dissolved oxygen, bacteria, and heavy metals.

Bias. Often used as a data quality indicator, bias is the degree of systematic error present in the assessment or analysis process. When bias is present, the sampling result value will differ from the accepted, or true, value of the parameter being assessed.

Blind sample. A type of sample used for quality control purposes, a blind sample is a sample submitted to an analyst without their knowledge of its identity or composition. Blind samples are used to test the analyst's or laboratory's expertise in performing the sample analysis.

Comparability. A data quality indicator, comparability is the degree to which different methods, data sets, and/or decisions agree or are similar.

Completeness. A data quality indicator that is generally expressed as a percentage, completeness is the amount of valid data obtained compared to the amount of data planned.

Data users. The group(s) that will be applying the data results for some purpose. Data users can include the monitors themselves as well as government agencies, schools, universities, businesses, watershed organizations, and community groups.

Data quality indicators (DQIs). DQIs are attributes of samples that allow for assessment of data quality. These include precision, accuracy, bias, sensitivity, comparability, representativeness and completeness.

Data quality objectives (DQOs). Data quality objectives are quantitative and qualitative statements describing the degree of the data's acceptability or utility to the data user(s). They include data quality indicators (DQIs) such as accuracy, precision, representativeness, comparability, and completeness. DQOs specify the quality of the data needed in order to meet the monitoring project's goals. The planning process for ensuring environmental data are of the type, quality, and quantity needed for decision making is called the DQO process. Madison Stream Team Sampling and Analysis Plan Page 23

Detection limit. Applied to both methods and equipment, detection limits are the lowest concentration of a target analyte that a given method or piece of equipment can reliably ascertain and report as greater than zero.

Duplicate sample. Used for quality control purposes, duplicate samples are an additional sample taken at the same time from, and representative of, the same site that are carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the precision of a method, monitor, and/or analyst. More than two duplicate samples are referred to as replicate samples.

Environmental sample. An environmental sample is a specimen of any material collected from an environmental source, such as water or macroinvertebrates collected from a stream, lake, or estuary.

Field blank. Used for quality control purposes, a field blank is a "clean" sample (e.g., distilled water) that is otherwise treated the same as other samples taken from the field. Field blanks are submitted to the analyst along with all other samples and are used to detect any contaminants that may be introduced during sample collection, storage, analysis, and transport.

Instrument detection limit. The instrument detection limit is the lowest concentration of a given substance or analyte that can be reliably detected by analytical equipment or instruments (see detection limit).

Matrix. A matrix is a specific type of medium, such as surface water or sediment, in which the analyte of interest may be contained.

Measurement Range. The measurement range is the extent of reliable readings of an instrument or measuring device, as specified by the manufacturer.

Method detection limit (MDL). The MDL is the lowest concentration of a given substance or analyte that can be reliably detected by an analytical procedure (see detection limit).

Precision. A data quality indicator, precision measures the level of agreement or variability among a set of repeated measurements, obtained under similar conditions. Relative percent difference (RPD) is an example of a way to calculate precision by looking at the difference between results for two duplicate samples.

Protocols. Protocols are detailed, written, standardized procedures for field and/or laboratory operations.

Quality assurance (QA). QA is the process of ensuring quality in data collection including: developing a plan, using established procedures, documenting field activities, implementing planned activities, assessing and improving the data collection process and assessing data quality by evaluating field and lab quality control (QC) samples.

Quality assurance project plan (QAPP). A QAPP is a formal written document describing the detailed quality control procedures that will be used to achieve a specific project's data quality requirements. This is an overarching document that might cover a number of smaller projects a group is working on. A QAPP may have a number of sample analysis plans (SAPs) that operate underneath it.

Quality control (QC). QC samples are the blank, duplicate and spike samples that are collected in the field and/or created in the lab for analysis to ensure the integrity of samples and the quality of the data produced by the lab.

Relative percent difference (RPD). RPD is an alternative to standard deviation, expressed as a percentage and used to determine precision when only two measurement values are available. Calculated with the following formula: RPD as % = ((D1 – D2)/((D1 + D2)/2)) x 100 Where: D1 is first replicate result D2 is second replicate result

Replicate samples. See duplicate samples.

Representativeness. A data quality indicator, representativeness is the degree to which data accurately and precisely portray the actual or true environmental condition measured.

Sampling and Analysis Plan (SAP). A SAP is a document outlining objectives, data collection schedule, methods and data quality assurance measures for a project.

Sensitivity. Related to detection limits, sensitivity refers to the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. The more sensitive a method is, the better able it is to detect lower concentrations of a variable.

Spiked samples. Used for quality control purposes, a spiked sample is a sample to which a known concentration of the target analyte has been added. When analyzed, the difference between an environmental sample and the analyte's concentration in a spiked sample should be equivalent to the amount added to the spiked sample.

Standard operating procedures (SOPs). An SOP is a written document detailing the prescribed and established methods used for performing project operations, analyses, or actions.

Appendix C – Quality Control Checklist

Laboratory QC

___ Condition of samples upon receipt

___ Cooler/sample temperature within required range

___ Proper collection containers

___ All containers intact

___ Sufficient sample volume for analysis

___ Sample pH of acidified samples <2

___ All field documentation complete. If incomplete areas cannot be completed, document the issue.

___ Holding times met

___ Field duplicates collected at the proper frequency (specified in SAP)

___ Field blanks collected at the proper frequency (specified in SAP)

___ All sample IDs match those provided in the SAP. Field duplicates are clearly noted as such in lab results.

___ Analyses carried out as described in the SAP (e.g., analytical methods, photo documentation, field protocols)

___ Reporting detection limits met the project-required detection limit

___ All blanks were less than the project-required detection limit.

___ If any blanks exceeded the project-required detection limit, associated data is flagged.

___ Laboratory blanks/duplicates/matrix spikes/lab control samples were all within the required control limits defined within the SAP

___ Project DQOs and DQIs were met (as described in SAP)

___ Summary of results of OC analysis, issues encountered, and how issues were resolved addressed (corrective action)

___ Completed QC checklist before upload into DEQ's EQuIS (or other) database.

Appendix D – Data Qualifiers (Flags)

Result Qualifier	Result Qualifier Description
B	Detection in field and/or trip blank
D	Reporting limit (RL) increased due to sample matrix interference (sample dilution)
H	EPA Holding Time Exceeded
J	Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
R	Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
D	Not Detected: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
UJ	Not Detected/Estimated: The analyte was not detected at a level greater than or equal to the adjusted CRQL or the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

Appendix E – SRWG DOCUMENTS & STANDARD OPERATING PROCEDURES (SOP)

SRWG Gear Checklist

General

1. SAP/SOP
2. Volunteer Waivers
3. Landowner Consent Form
4. YSI multi parameter meter or handheld meters
5. Calibration solutions
6. Calibration logs
7. Solution discard bottle
8. pH solutions (7 and 10)
9. EC 1413 µS/cm Standard
10. Deionized water squirt bottle
11. Kim wipes
12. Tap water for YSI storage
13. Calibration Log for YSI
14. Clipboard
15. Site Visit Forms
16. Pencils and Extra lead
17. Fine tip permanent marker
18. Broad tip permanent marker
19. Calculator
20. Batteries (4 C for YSI, 2 AA for GPS)
21. Duct tape
22. Camera
23. First aid kit
24. Bear spray plus transport container
25. Garmin eTrex GPS Unit
26. Multi-tool or screwdriver
27. Life Jacket (pfd)
28. Backpack to carry gear

Collecting Samples for Lab Analysis

1. Cooler from lab
2. Chain of Custody form (COC)
3. One set of sample bottles for each site and for any blank and duplicate QC samples
4. Sample Preservative (sulfuric acid)
5. Laboratory grade deionized water for blank samples
6. Plastic gloves
7. Safety glasses
8. Chain of Custody Forms
9. Ice
10. Packing tape for labels

Field Activity Checklist

1. Calibrate YSI meter before going to the field
2. Deploy YSI meter
3. Begin filling out field visit form
4. Label sample containers
5. Collect water samples
6. Collect YSI meter measurements
7. Take staff gauge readings (where applicable)
8. Prepare samples for shipping
9. Fill out chain of custody
10. Check that all forms are complete
11. Check that all gear is accounted for

Sun River Watershed Group – Site Visit Form

Date: 8/19/2012 Time: 0722 Site Name: Sun River at Augusta Site ID: SR-287

Team Members: Rai Hahn, Torie Bunn, Alan Rollo, Joe Smith

Latitude 47.547857 Longitude 112.887314 GPS Verified? (YES) NO

Site Visit Comments:
brief light rain (20 min) last night 6pm.
lots of algae on rocks.

Staff Gauge Reading: N/A

Location:

Current Weather (circle one)

Cloud Cover:	<5%	(5-25%)	25-75%	75-100%
Precipitation	(None)	Light	Moderate	Heavy
Precip. Last 24 hrs:	None	(Light)	Moderate	Heavy

Stream Field Measurements

Temp (°C)	12.9	pH	8.21
SC (µS/cm²)	450	Salinity	0.5.1
Conductivity (µS/cm)	344		
D.O. (%)	98.0		
D.O. (mg/L)	11.6		

Method: (YSI) Other:

Turbidity (NTU) 18.2

Method: (Hach 2100P) Other:

Site Visit Photos:

jpeg # (on camera)	Description (upstream, across/south, etc.)
018	upstream (N)
019	downstream (S)
020	across (W)
021	Rai taking YSI reading

Water Chemistry Samples

Total # Grab Samples Collected: 6 (should match # checked boxes below)

SAMPLE ID: (YMD_SiteID_Sample Type Letter) ex: 20120815_AC-200_A	YELLOW CAP (H_2SO_4): (Nitrate) (Total P)	WHITE CAP (no preserv.): (Total N) (SSC)
REG: 20120819 SR-287 A	X	X
DUP: 20120819 SR-287 B	X	X
BLNK: 20120819 SR-287 C	X	X

Chemistry Sample Shipping Information:

Shipped by: Torie Bunn Date/Time: 8/20/12 9:15AM

Shipping Method (circle one): (FED EX) UPS

Form reviewed by:

Name Date

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Chain of Custody & Analytical Request Record

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Page _____ of _____

Account Information (Billing information)

Company Name		
Contact		
Phone		
Mailing Address		
City, State, Zip		
Email		
Receive Invoice ☐Hard Copy ☐Email	Receive Report ☐Hard Copy ☐Email	
Purchase Order	Quote	Bottle Order

Report Information (If different than Account information)

Company Name	
Contact	
Phone	
Mailing Address	
City, State, Zip	
Email	
Receive Report ☐Hard Copy ☐Email	
Special Report Formats: ☐ LEVEL IV ☐ NELAC ☐ EDD/EDT (contact laboratory) ☐ Other_____	

Comments

Project Information

Project Name, PWSID, Permit, etc.	
Sampler Name:	Sampler Phone:
Sample Origin State:	EPA/State Compliance ☐ Yes ☐ No

BILLING CLIENTS, please indicate sample type.
*If can has been processed or utilized, call before sending.
☐ Byproduct 11 (a)2 material ☐ Unprocessed ore (NOT ground or refined)*

Matrix Codes: A - Air; W - Water; S - Solid/Solids; V - Vegetation; B - Biosolids; O - Other; DW - Drinking Water

Analysis Requested

Sample Identification (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers	Matrix (See Codes Above)	See Attached	RUSH TAT	ELI LAB ID (Laboratory Use Only)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

All turnaround times are standard unless marked as RUSH.
Energy Laboratories MUST be contacted prior to RUSH sample submittal for charges and scheduling – See Instructions Page

Custody Record MUST be signed	Relinquished by (print)	Date/Time	Signature	Received by (print)	Date/Time	Signature
	Relinquished by (print)	Date/Time	Signature	Received by laboratory (print)	Date/Time	Signature

LABORATORY USE ONLY

Shipped By	Cooler ID(s)	Custody Seals: Y N C B	Intact: Y N	Receipt Temp: °C	Temp Blank: Y N	On Ice: Y N	Payment Type: CC Cash Check_____	Amount: $	Receipt Number (paid invoices only)

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All subcontracted data will be clearly notated on your analytical report.

Site Photos and Driving Directions

Sun River at Augusta (SR-287)

(1) Upstream at site

(2) Across at site

(3) Downstream at site

(4) View from parking on 287, facing south. Note 'War on Weeds' sign.

Directions: Approximately 4 miles north of the town of Augusta on highway 287. Cross over Sun River and park in pullout on northeast side of bridge. Sampling site is ~75 yards upstream of bridge on the north bank. Looking upstream, USGS gauge is located by old piling seen in photo 1.

GPS Coordinates: 47.47.547816 lat
112.366250 lon

Big Coulee (BC-SM)

(1) Upstream from bridge

(2) Across (west) at bridge

(3) Downstream from bridge

(4) View of sampling site on SE corner of bridge.

Directions: From Hwy 200 at Simms, take SR 565 (Simms Fairfield Road) north 1 mile to Simms Ashuelot Road on right. Follow Simms Ashuelot Road (zigzagging L, R, L, R) ~ 3 miles to site bridge. Access Big Coulee on the southeast corner of bridge, downstream (photo 4).

GPS Coordinates: 47.516972 lat
111.88736 lon

Adobe Creek (AC-200)

(1) Across at sampling site

(2) Upstream from road

(3) Downstream from site

Directions: Take highway 200 northeast from Fort Shaw for ~1 mile. Adobe Creek flows just west of driveway #13402. Park on west side of bridge and sample ~100 ft upstream/south side of road, past barbed wire fence. From road, gauge can be seen upstream (picture 2).

GPS Coordinates: 47.510583 lat
111.800611 lon

Mill Coulee (ML-200)

(1) Upstream from site

(2) Across (west) at site

(3) Downstream from site

(4) View of bridge from Hwy 200 facing W, note Ramble Inn on right.

Directions: On highway 200 between Ramble Inn Road and Dracult Hill Road, ~0.5 miles east of town of Sun River. Park on west side of bridge and sample downstream/south side of road. Gauge at site may be used or alternate gauge across highway 200, TBD. Ramble Inn hotel is on highway 200, across from site (picture 4).

GPS Coordinates: 47.540611 lat
111.705806 lon

Gauge readings elsewhere? TBD

Muddy Creek at Vaughn (MC-VN)

(1) Parking on Hwy 200, view to west. Note Exxon station on N side of road

(2) View to north of sampling from Hwy 200.

Directions: From I-15, take Exit 290 to highway 200 west. Parking is ~ 0.25 west of interchange on 200. Historic WQ data was collected at railroad bridge just north of highway 200. Park east of Muddy Creek bridge on highway 200, use Exxon gas station as landmark (photo 1). USGS gauge can be seen on right side of Muddy Creek (photo 2).

GPS Coordinates: 47.561056 lat
111.538306 lon

Sun River at Great Falls (SR-GF)

(1) Upstream from site

(2) Across (north) from site

(3) Downstream from site

(4) View of sampling access at end of 13th Ave SW.

Directions: Site is at the end of 13th Avenue SW in Great Falls. Park in Beacon Bar overflow parking and follow path at east side of fence down to site (photo 4). Sampling is upstream from railroad bridge on south side of river.

GPS Coordinates: 47.492028 lat
111.334361 lon

Verifying Site Locations with GPS

Lat/Long and Elevation

Using the Garmin E-Trex GPS to take a waypoint:

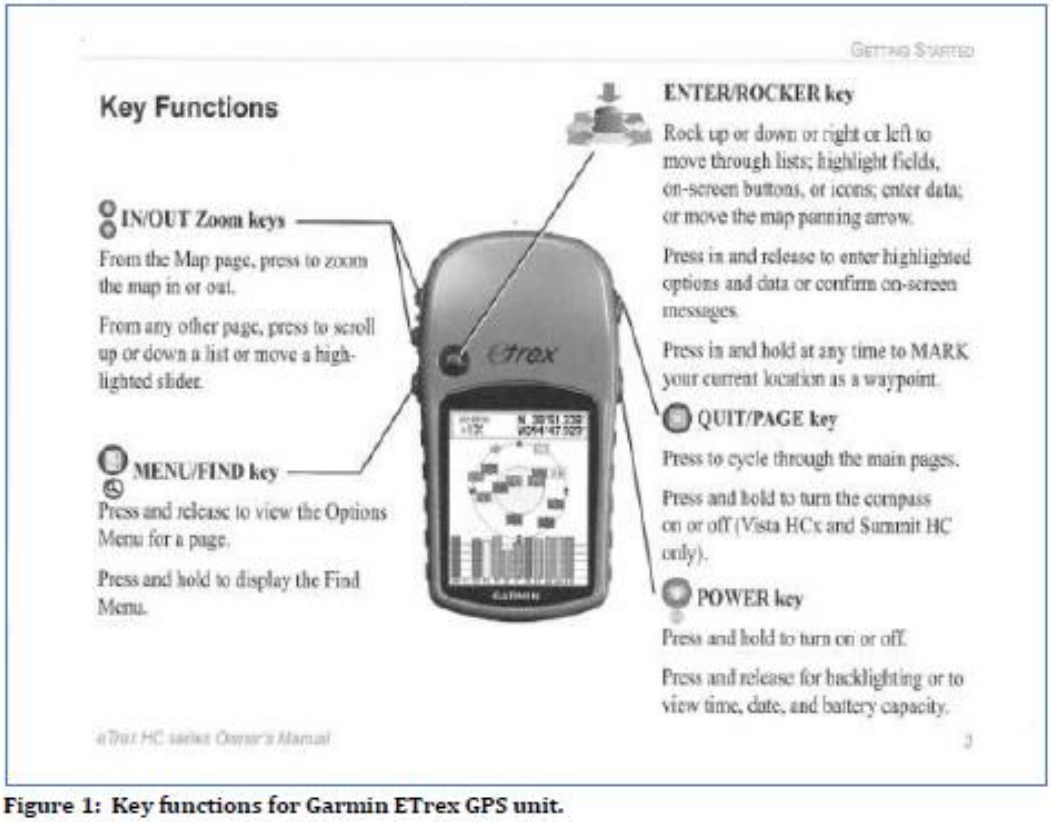


Figure 1: Key functions for Garmin ETrex GPS unit.

Use power key to turn device on. Press and hold the rocker key until the Mark Waypoint page appears. The waypoint name, and lat/long/elevation data can be found on this screen. To accept the waypoint with the data, highlight OK.

Latitude and Longitudes should be obtained in decimal degrees using a GPS unit reading NAD83. If a lat/long is obtained by another method, the datum and method must be recorded in the Site Visit Comments. Elevation should be recorded in feet.

GPS Datum and Verification

The GPS unit should be reading NAD83 and the point will be verified by the data entry person upon entry of data.

Way point

Record a waypoint for the site with the GPS unit and note the waypoint number on the form.

Sample Collection and Bottle Labeling

1. All samples (including quality control samples) should be labeled with a permanent marker before being filled and then covered with clear packing tape so that the labeled information does not smear. Labels should include:
    a. Company Name (Client): Sun River Watershed Group = SRWG
    b. Project = Sun River
    c. Date and time (military time)
    d. Sample ID (includes year, month, day, site ID, and letter indicating sample type)
        Sample ID = Year-Month-Day_SiteID_Sample Type Letter
            A = Regular Sample
            B = Duplicate Sample
            C = Blank Sample
2. Samples will be collected in a well-mixed portion of each stream.
3. Bottles and lids shall be rinsed three times with stream water prior to sampling. During sampling, the sample bottle opening should face upstream and should be drawn through the water column once, carefully avoiding disturbance of bottom sediments.
4. One set of quality control (QC) samples consisting of blanks and duplicates will be collected for approximately every 10 stream samples collected.
    a. A field blank is prepared by transporting laboratory-grade deionized (DI) water to the field and pouring it into sample containers provided by the lab. The blank will be prepared at the same time that the samples are collected from the stream. A duplicate sample is a second stream sample collected at the same time in the same way that the regular stream sample is collected.
    b. Duplicate and blank samples will be collected at the same location for each event but the site they are collected at will rotate through the sample sites for subsequent sample events.
5. Blank and duplicate samples are handled and delivered to the lab in the same manner that regular samples are handled.
6. Any preservative necessary should be added to samples in the field. Preservatives are included with the sample bottles in small vials with caps that correspond in color to the bottles they are intended to preserve. Sulfuric acid (H_2SO_4) (yellow vials and bottle caps) is typically added to samples for nutrient analysis and nitric acid (red vials and bottle caps) is added to samples for metal analysis. Add the entire vial contents to the corresponding sample bottle, replace the lid securely, and agitate gently.

Sample ID Examples:

A **regular sample** collected at the Adobe Creek site on August 15th, 2012 would be labeled:

20120815 AC-200 A

A **duplicate** at the same place and time as above:

20120815 AC-200 B

A **blank** at the same place and time as above:

20120815 AC-200 C

A regular sample collected at the Sun River at Augusta site on July 3rd, 2012 would be labeled:

20120703 SR-AG A

Packaging Samples for Shipment

1. Samples need to be kept on ice or in a refrigerator until shipping.
2. Samples should be shipped as quickly after collection as possible but need to be shipped on a Monday or Tuesday and not later than Wednesday. Next day delivery is ideal, but if outside temperatures aren't too high, two day delivery would work too. Samples need to be shipped so they do not arrive on a weekend.
3. Samples should be packaged immediately before shipping to avoid unnecessary loss of ice before shipping.
4. Organize all samples on a table, grouped by site, in the order they were collected.
5. Check that all sample labels are completely filled out.
6. Fill out the chain of custody for the testing laboratory. This includes listing all of the sample IDs and sampling times. See the completed example on the following page.
7. Place a large trash bag inside the cooler. This bag will hold all of the samples and be tied off at the end to prevent any liquids from leaking from the cooler.
8. Place sample bottles in the ziplock bags (they may have come from the lab in bags initially which can be used). Samples preserved with nitric acid (red caps) should be bagged together separately. This is because nitrogen in the form of acid was added to these bottles and we don't want them to contaminate the nutrient samples if they were to leak.
9. Fill a minimum of 2 gallon ziplock bags with ice purchased from a store or ice from your freezer (whichever is more convenient) to include with the samples. The volume of ice should be at least equal to that of the samples.
10. Place all of the samples and the bagged ice inside the trash bag, inside the cooler and tie off the top of the trash bag.
11. Tear off the pink sheet on the completed chain of custody to give to Rai. Place the other COC completed sheets inside a ziplock bag and tape it to the top of the cooler.
12. Close the cooler and tape it closed. Sign and stick the custody seal on the cooler. Peel the tracking sticker on the UPS prepaid sticker and place it on the pink sheet. Deliver the cooler to the shipping center immediately.
13. Timely delivery of samples is critical so the ice doesn't melt. Especially if temperatures are hot, samples need to reach the lab quickly to avoid overheating.

YSI Calibration & Care Instructions

(Adapted from a QAPP for the Gallatin Volunteer Monitoring Program written by Tammy Crone)

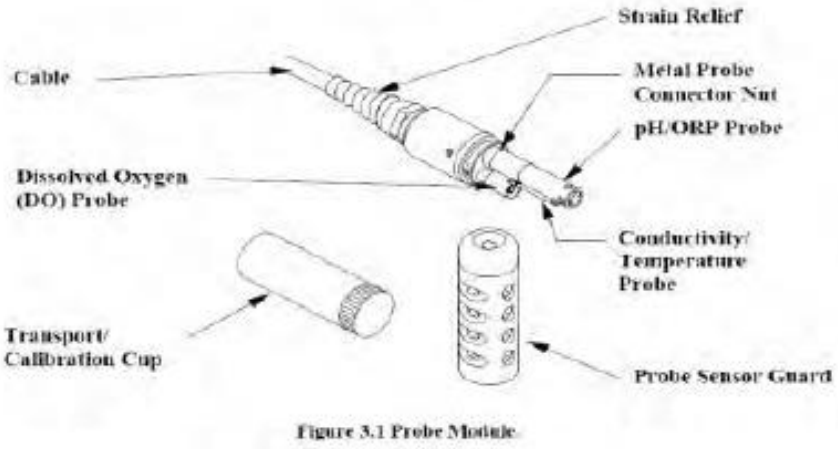


Figure 1: Probe Module from the YSI 556 Manual

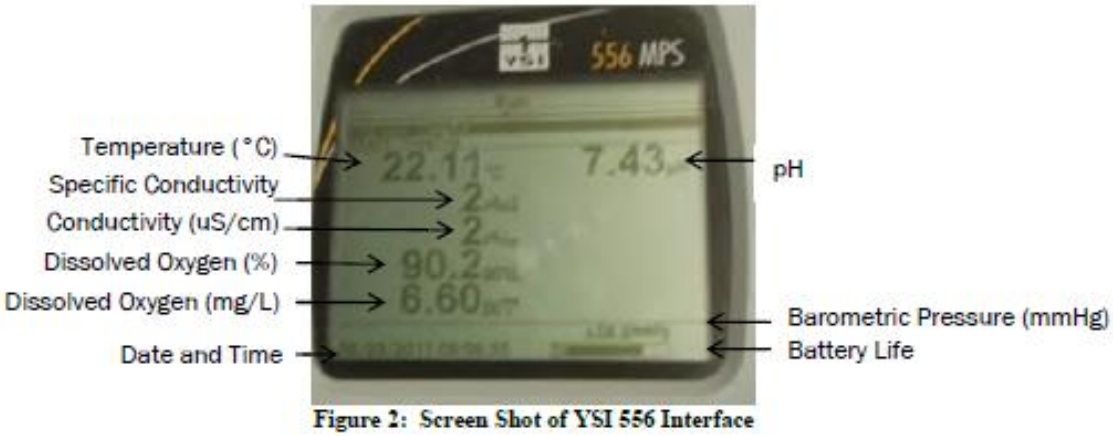


Figure 2: Screen Shot of YSI 556 Interface

YSI 556 CARE

- Before calibrating the YSI, check the condition of all of the probes
  - The pH glass bulb at the end of the probe should be clear. If it is starting to get cloudy or if you notice the pH taking a long time (> 5min) to calibrate then consider replacing the pH probe
  - Inspect the membrane on the dissolved oxygen probe. The membrane should be clear and not cloudy/dirty or scratched. There should not be bubbles under the membrane.
  - Check all probes to make sure they are free of sediment or buildup that may have accumulated since the last time it was used.

CALIBRATION TIPS & HINTS

- Calibration solutions should ideally be stored at room temperature and calibration should be performed at room temperature.
- The transport/calibration cup that comes with the probe serves as a calibration chamber for all calibrations and minimizes the volume of calibration solutions required.
- Ensure all sensors are immersed in the calibration solution. Many of the calibrations factor in readings from other sensors (e.g., temperature sensor). The top vent hole of the conductivity sensor must also be immersed during some calibrations.
- Make sure to loosen the seal of the transport/calibration cup prior to the DO calibration to allow pressure equilibration.
- For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the probe (Figure 1).
- Put some deionized (DI) water at ambient temperature to rinse the probe between calibration solutions.
- Have several clean, absorbent paper towels or Kim-wipes available to dry the probe between rinses and calibration solutions. Shake excess rinse water off the probe. Dry off the outside of the probe and sensor guard. (Making sure the probe module is dry reduces carry-over contamination of calibration solutions and increases the accuracy of the calibration.)

Figure 1. Bottles of solution for each calibration solution for rinsing.

PROBE INSPECTION

- Ensure the o-ring is installed in the o-ring groove of the transport/calibration cup and that the bottom cap is securely tightened. **NOTE:** Do not overtighten!
- Remove the probe sensor guard, if installed.
- Remove the o-ring, if installed, from the probe and inspect for defects. Replace with extra o-ring if defects found.

PROBE STORAGE

- Store the probe with about half an inch of tap water in the storage cup.

ACCESSING THE CALIBRATION SCREEN

1. Press the On/Off key to display the Run screen.

2. Press the Escape key to display the main menu screen (figure 2).
3. Use the arrow keys to highlight Calibrate (figure 3).
4. Press Enter key. Calibrate screen is displayed. Conductivity will automatically be highlighted on this screen.

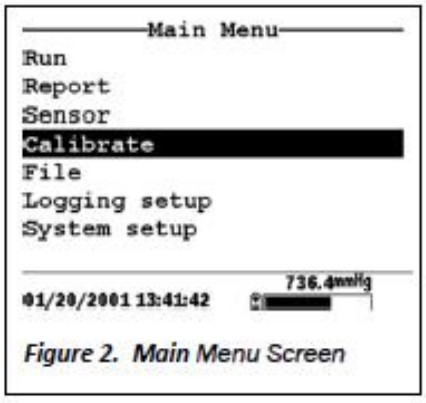


Figure 2. Main Menu Screen

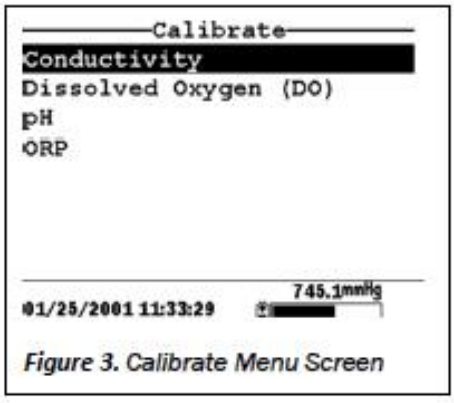


Figure 3. Calibrate Menu Screen

CONDUCTIVITY CALIBRATION

1. Go to Calibrate screen as described above.
2. Highlight Conductivity and press Enter. The Conductivity Calibration Screen is displayed.
3. Specific Conductance parameter will automatically be highlighted. Press Enter.
4. Remove the plastic transport/calibration cup (Picture 1).
5. Pre-rinse the conductivity sensor with a little bit of the 1413 standard conductivity calibration solution and discard into a waste jar.
6. Pour enough new 1413 standard into the transport/calibration cup to entirely cover all 3 sensors including the vent hole on the conductivity sensor (~55ml) (Picture 2, arrow) and secure the cup to the probe. Tap the probe gently to remove air bubbles.

Picture 1

Picture 2

7. Use the keypad to enter the calibration value of the standard being used. The 1413 uS/cm Standard Solution should be entered as: 1.413 (the 1.413 value may automatically be displayed)
8. Press Enter. The Cond Calibration Menu Screen will be displayed.

Note: *the YSI is set-up for "temperature compensation". Always use the value for the calibration standard at* ***25°C****.*

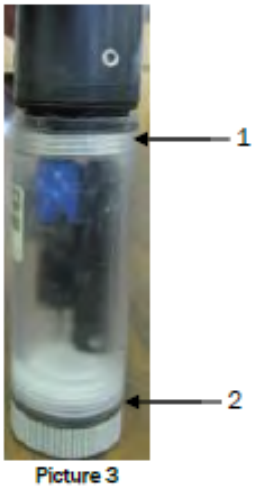
9. Allow at least one minute for instrument temperature to stabilize. The current values of enabled sensors will appear on the screen and will change with time as they stabilize.

10. Observe the reading under Specific Conductivity (uS/cm^{C}). When the reading shows no significant change for ~30 seconds, then record the "Temp of Standard" and record the Specific Conductivity (uS/cm^{C}) value on the calibration log sheet under "Reading Before Cal" then press Enter key.

If the meter displays a warning similar to "Value out of range, accept anyway?" Do NOT accept the value. Recalibrate and try again

11. Record the "Set to" values in the YSI Calibration Log (which should be 1413 uS/cm^{C})
12. Remember to record the "Expiration Date" of the solution too
13. Press Enter key again, screen will indicate calibration has been accepted.
14. Record the new Specific Conductivity (uS/cmC) value under "Reading After Cal" on the calibration log sheet
15. Press Enter key again, to return to the Conductivity Calibration Selection Screen.
16. Press Escape to return to the Calibrate Menu Screen.
17. Rinse the probe and sensors with DI water

DISSOLVED OXYGEN CALIBRATION in % SATURATION



Picture 3

1. In the Calibration Screen, use the arrow keys to highlight DO 2 mil PE (Blue).
2. Press Enter key. The DO % will automatically be highlighted.
3. Press Enter key again. The Enter Baro mmHG screen will be displayed. Enter the local barometric pressure, determined online or with the included benchtop barometer.
4. Record the Barometric Pressure on the calibration log sheet
5. Pour approximately 1/8 inch of water (Picture 3, arrow 2) in bottom of transport/calibration cup. * Do Not immerse any of the sensors in the water.
6. Screw the transport/calibration cup onto the probe using only 1 or 2 threads, so it is just hanging on (Picture 3, arrow 1).
7. Press Enter key. The DOsat Calibration Menu Screen will be displayed.
8. Allow 10 minutes for the DO probe to stabilize (and for the temperature to stabilize).
9. When the DO % reading is stable for 30 seconds, record the DO% and DO mg/L values in the calibration log.
10. Press Enter key to accept the reading.

If the meter displays a warning "Value out of range, accept anyway?" Do NOT accept the value, recalibrate and try again

11. Record the new DO% and DO mg/L values in the YSI Calibration Log
12. Press Enter key again. This returns you to the DO Calibration Menu Screen.
13. Press Escape key, to return to the Calibrate Menu Screen.

pH CALIBRATION

Picture 4

1. In the Calibration Screen, use the arrow keys to highlight pH.
2. Press Enter key. The pH Calibration Screen will be displayed.
3. Use arrow keys to highlight 2-point option to calibrate the pH sensor.
4. Press the Enter key, the pH Entry Screen will be displayed.
5. Enter value of pH standard being used - NOTE: Always calibrate in 7 buffer first.
7. Rinse the pH sensor with little bit of the 7.00 buffer and discard.
8. Pour ~35 ml 7.00 buffer into the transport/calibration cup (picture 4) and secure the cup to the probe. Tap the probe gently to remove air bubbles.
9. Use the keypad to enter the calibration value of the pH standard being used.
10. Press Enter. The pH Calibration Screen will be displayed.
11. Allow 1 minute for temperature to stabilize. Observe pH reading. If no significant change in 30 seconds, record the current pH value under "Reading Before Cal" and the temperature of the standard under "Temp of Standard"
12. Press Enter key. The screen will indicate calibration accepted.

***If the meter displays a warning similar to "Value out of range, accept anyway?"
Do NOT accept the value. Recalibrate and try again***

13. Record the "Set to" value on the Calibration Log and record the new pH reading under "Reading After Cal"
14. Pour used solution into a waste container and rinse the probes with DI water.
15. Press Enter key to return to pH Calibration Screen, continue with the second point of calibration for pH 10.00 (repeat steps 5-13).
16. Press Enter to return to the pH Calibration Screen. Press Escape twice to return to the data logging menu.
17. Rinse the probe and sensors with DI water.

Sun River Watershed Group – Site Visit Form

Date: _____ Time: _____ Site Name: _____ Site ID: _____

Team Members: _____

_____

Latitude __ __.__ __ __ __ __ __ Longitude __ __ __.__ __ __ __ __ __ GPS Verified? YES NO

Site Visit Comments:

Staff Gauge Reading: _____

Location:

Current Weather (circle one)

Cloud Cover:	<5%	5-25%	25-75%	75-100%
Precipitation:	None	Light	Moderate	Heavy
Precip. Last 24 hrs:	None	Light	Moderate	Heavy

Stream Field Measurements

Temp (°C) _____ pH _____

SC (µS/cm°) _____ Salinity _____

Conductivity (µS/cm) _____

D.O. (%) _____

D.O. (mg/L) _____

Method: YSI Other: _____

Turbidity (ntu) _____

Method: Hach 2100P Other: _____

Site Visit Photos:

jpeg # (on camera)	Description (upstream, across/south, etc.)

Water Chemistry Samples

Total # Grab Samples Collected: _____ (should match # checked boxes below)

SAMPLE ID: (YMD_SiteID_Sample Type Letter) ex: 20120815_AC-200_A	YELLOW CAP (H_2SO_4): Nitrate	Total P	WHITE CAP (no preserv.): Total N	SSC
REG:	☐		☐	
DUP:	☐		☐	
BLNK:	☐		☐	

Chemistry Sample Shipping Information:

Shipped by: _____ Date/Time: _____

Shipping Method (circle one): FED EX UPS

Form reviewed by:

_____ _____

Name Date