SUN RIVER WATERSHED GROUP
2019 Volunteer Water Quality Monitoring Project
Sampling and Analysis Plan

April 4, 2019

Prepared by:
Tracy Wendt
Sun River Watershed Group
PO Box 7312, Great Falls, MT 59405

Approved by:

____ ____________________

Katie Makarowski (Montana DEQ VM Lab Analysis Program Manager Date

____ ____________________

Michelle Hauer (Montana DEQ QA Officer) Date

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

The Sun River Watershed Group (SRWG) is a nonprofit organization that promotes community-based, collaborative efforts to protect and restore the resources of the Sun River watershed and the way of life of its communities. SRWG's goal to restore and protect the health of the Sun River Watershed includes improving water quality by reducing sediment, nutrients, and temperature. For over 20 years, SRWG has collected water quality and flow data and, with partners, has produced multiple reports and analyses for the purpose of understanding the causes of poor water quality in the Sun and its tributaries and the effects Best Management Practices (BMPS) and projects implemented have on the reduction and mitigation of these issues.

In December 2004, the 'Water Quality Restoration Plan and Total Maximum Daily Loads for the Sun River Planning Area' (TMDL) (DEQ 2004) was finalized for the Sun River watershed. The TMDL listed impairments to the Sun River and several other waterbodies within the watershed and identified measures needed to bring the water quality of these listed waters into compliance with the applicable standards. [Note: Since the TMDL was completed, Montana has adopted Numeric Nutrient Standards (DEQ 12A) which are not consistent with the TMDL targets in the 2004 document. SRWG is working to understand an appropriate way to address this and adjust targets.]

SRWG and DEQ developed a Sun River Watershed Restoration Plan in 2013 and SRWG is currently developing a 10-year Strategic Plan (anticipated completion in June 2019). These two plans identify goals, objectives and tasks for SRWG to address water quality and other issues affecting the Sun River Watershed for the benefit of fish, wildlife, and communities. The long-term dataset collected through this volunteer water quality monitoring program is key to providing data to inform SRWG actions towards these goals. These data can be used to understand the impacts of current land and water management practices, identify general sources of impairments, assess efficacy of past projects and BMPs implemented, prioritize future work, and provide a baseline for future data comparisons.

1.2 PROJECT AREA OVERVIEW

The Sun River watershed is a sub-basin of the Missouri-Sun-Smith basin, located in north-central Montana (HUC 10030104). From its headwaters in the Rocky Mountains, the Sun River flows east for approximately 97.4 miles to the town of Great Falls where it empties into the Missouri River. The Sun River between the Gibson Reservoir and its confluence with the Missouri is heavily influenced by agricultural uses. Flows are altered for irrigation and water quality is impacted by roads, ranches, and farming activity.

Impairments of the Sun River and tributaries are described in The Sun River Quality Assurance Project Plan (QAPP), developed in 2012. The following is summarized from the 2012 Sun River 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 from Muddy Creek to 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 and total phosphorus inputs, other flow regime alterations, sedimentation/siltation, and total suspended solids. Tributaries to the Sun River and other watershed waterbodies are also designated for impairments, including: Muddy Creek (headwaters to mouth), Ford Creek (mouth to 2 miles upstream), Gibson Reservoir, Willow Creek Reservoir, and Freezeout Lake.

The Montana State University Extension Water Quality department (MSUEWQ) compiled a report in 2009 summarizing Sun River Water Quality Data. Some highlights from that report include:

- Between 2004 and 2009, salinity decreased overall. The Sun River at Augusta was relatively free of salinity (reflected in conductivity), though levels increased downstream and was nearly three times higher at the confluence with the Missouri. All three tributaries monitored under this project are measurable sources of salinity, however salinity measures typically below thresholds established in the 2004 TMDL except where tributary flows are sources primarily from seepage and groundwater rather than irrigation return flows.

- Total nitrogen (TN) decreased consistently between 2004 and 2009 however individual TN concentration in many samples still exceed the 2004 TMDL target. TN appears to be heavily influenced by tributary inflows.
- Nitrate+nitrite (N) increases between Augusta and Great Falls. Between 2004 and 2009, N concentration increased, with Muddy Creek, Mill Coulee, and Big Coulee appearing to be significant sources.
- Total Phosphorus (P) concentrations also increased during the study period, including a significant increase between Sun River at Augusta and Sun River near Vaughn/Great Falls.
- Total suspended solids (TSS) increased significantly in the Sun River between Augusta and Great Falls during the study period. Concentrations of TSS in Mill Coulee appeared to decrease while concentrations in Big Coulee appeared to increase.

For 2018, DEQ identified the following water quality impairments and probable causes for the Sun River Watershed (http://svc.mt.gov/deq/dst/#/app/cwaic):

- Sun River, Gibson Dam to Muddy Creek: Not fully supporting aquatic life
  - Alteration in stream-side or littoral vegetative covers due to impacts from hydrostructure flow regulation-modification, channelization
  - Flow regime modification due to channelization, impacts from hydrostructure flow regulation-modification
  - Sedimentation-siltation due to grazing in riparian or shoreline zones, agriculture
  - Temperature due to impacts from hydrostructure flow regulation-modification, channelization
- Sun River, Muddy Creek to mouth (Missouri River): Not Fully Supporting agriculture, aquatic life, and primary contact recreation
  - Flow regime modification due to crop production (irrigated)
  - Total nitrogen due to agriculture, rangeland grazing, crop production (irrigated)
  - Total phosphorus due to crop production (irrigated), rangeland grazing, agriculture
  - Sedimentation-siltation due to crop production (irrigated), rangeland grazing, channelization
  - Total Suspended Solids (TSS) due to channelization, crop production (irrigated), rangeland grazing

The MSUEWQ 2009 report clearly identified tributaries as major contributors of water quality impairments and noted impairment concentrations generally increase with downgradient. The DEQ 2018 Montana Clean Water Act Information Center also shows an increase in impairments downgradient. For this reason, SRWG continues to monitor sites near Augusta (upstream) and at the confluence with the Missouri (downstream), as well as on multiple tributaries before they each converge with the Sun River.

As in past years, the volunteer water quality monitoring sites for 2019 will include (also see map below):

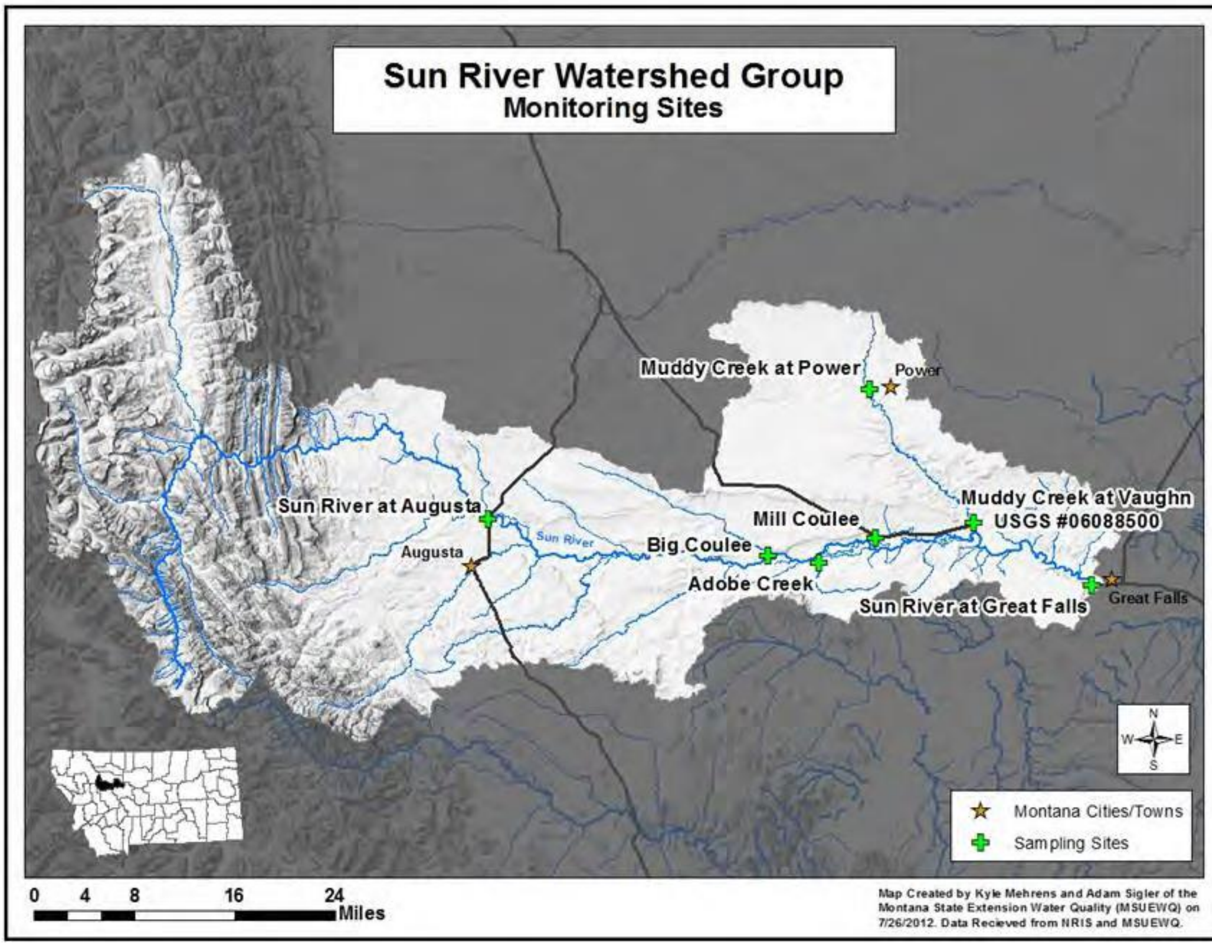
SUN RIVER

- Augusta
- Ulm Bridge
- Great Falls

TRIBUTARIES (measured in tributary prior to flowing into the Sun River)

- Big Coulee
- Adobe Creek
- Mill Coulee North
- Muddy Creek

Figure 1. Map of Sun River Volunteer Water Quality Sampling Locations



1.3 Project Goals and Objectives

The goal of this project is to add to the existing long-term Sun River water quality monitoring data set for the purposes of: 1) measuring progress towards goals stated in the 2004 TMDL and the 2013 Sun River Watershed Restoration Plan; 2) identifying contributions to impairments; 3) assessing efficacy of past projects; and, 4) prioritizing future work.

Table 1. Project Goals, Questions, Objectives and Analyses

Goal	Question	Objective	Data Analysis
Measure progress towards goals set in the 2004 TMDL and 2013 Watershed Restoration Plan.	Is the water quality in the Sun River waterbodies improving and trending towards the standards and goals set in the TMDL and Watershed Restoration Plans?	Collect nutrient samples at seven sites across the watershed	Compare overall 2019 data to past years' data for trends
	Are improvement (or lack of improvement) trends similar across the watershed?		Compare 2019 data to past years' data for each site, then compare sites to one another (2019 annual data as well as trends over time).

<table>
<tr><th>Goal</th><th>Question</th><th>Objective</th><th>Data Analysis</th></tr>
<tr><td rowspan="3">Identify contributions to impairments.</td><td>What parts of the watershed contribute the most impairments?</td><td>Collect nutrient samples at seven sites across the watershed including upstream and downstream reaches on the Sun and at tributaries before they converge with the Sun River.</td><td>Compare data from site to site.</td></tr>
<tr><td>How are water quality parameters affected by land uses or management strategies?</td><td>Collect nutrient samples at seven sites across the watershed.</td><td>Compare data from site to site, noting if land uses or management strategies vary from site to site</td></tr>
<tr><td>How are water quality parameters affected by irrigation practices?</td><td>Collect nutrient samples throughout the watershed before, during, and after irrigation season.</td><td>Compare data from site to site, noting if irrigation practices near sites vary; compare temporal data looking for variance before, during, and after irrigation.</td></tr>
<tr><td rowspan="2">Assess efficacy of past projects.</td><td>Which projects or BMPs implemented are having the most positive effects on water quality?</td><td rowspan="2">Collect nutrient samples at seven sites across the watershed before, during, and after irrigation season.</td><td>Compare data trends at monitoring locations to locations of BMPs and projects, comparing trends prior to and after project implementation. Compare these trends before, during, and after irrigation season.</td></tr>
<tr><td>Are additional monitoring sites needed to answer this question adequately?</td><td>If no discernable difference exists in the data (prior question), revisit the sites and decide if something else is interfering with the results, consider adding a station closer to the project area – especially if site photos indicate an improvement in bank conditions near the project.</td></tr>
<tr><td rowspan="2">Prioritize future work.</td><td>What areas/reaches would benefit most from future projects?</td><td colspan="2" rowspan="2">Review data analysis from the prior questions. Identify reaches and strategies based on trends and prioritize projects that data and trends indicate are likely to be most successful and have the most impact.</td></tr>
<tr><td>Which past strategies and BMPs should be used again on future projects?</td></tr>
</table>

2.0 PROJECT TEAM AND RESPONSIBILITIES

Table 2. Project Team Roles and Responsibilities

Role	Person(s)	Contact phone, email
Develop Sampling and Analysis Plan (SAP)	Tracy Wendt, SRWG	(406) 214-2868
Oversee monitoring personnel	Tracy Wendt	
Training monitoring personnel	N/A	

Role	Person(s)	Contact phone, email
Review field forms	Rai Hahn and Tracy	
Lab coordination (e.g., bottle orders, shipping notifications, lab EDDs)	Rai Hahn	
Ship or deliver samples to lab	Rai Hahn	
Review data quality	Rai / Tracy	
Upload data into MT-eWQX database	Tracy Wendt	
Write final report	Tracy Wendt	

3.0 SAMPLING DESIGN

3.1 MONITORING LOCATIONS

One of the values of the SRWG long-term water quality data set is that data have been collected at the same sites for many years. In 2019, SRWG will continue to monitor water quality at the same sites identified in the past, while keeping in mind that additional sites may be required in future years to answer research questions. Sites have been chosen for their proximity to agricultural activity, as agricultural practices have been identified as a key influence on water quality in the Sun River. Sites are located in tributaries prior to entering the Sun River so each individual tributary's contribution to mainstem water quality can be assessed. Sites are located in the main Sun River at its downstream extent and upstream where agricultural activities are much lighter to help tease out the cumulative impacts agricultural activities are having on water quality. Landowner access has been granted at each site.

See Figure 1 on Page 4 for monitoring location map.

Table 3. Monitoring Locations*

Site ID 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 Name	Site Description	Latitude	Longitude	Parameters to Collect	Rationale for Site Selection
SUN-SUNR50 (see site ID note)	Sun River near Augusta	47.547861	- 112.366250	Total Suspended Solids (TSS) Nitrate-Nitrate 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-SUNR51	Sun River below Muddy Creek.	47.547258	- 111.531208		Below confluence of Muddy Creek
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 which may change due to unforeseen access or other issues.

3.2 MONITORING SCHEDULE

Water quality is monitored prior to, during, and after the irrigation season. Monitoring will begin in April prior to the irrigation season, continue through the season, and end in October once irrigation ditches have been shut off. This helps identify the impacts of changing flows, potentially due to water management for agriculture. In general, samples are collected once a month at the same time of day, except when conditions prohibit access. In that instance, data will be collected as close to desired date and time as possible.

Table 4. Monitoring Schedule

Date	Parameters	Rationale for Timing
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 at end of irrigation season
October	Nitrate-nitrite N, TPN, Total P, and TSS	During low flows after irrigation season

3.3 Sample Collection Protocols

Samples will be collected according to SRWG's SOP document (see Appendix F), Table 4 – Sample Collection and Analysis Methods, and the protocol described in this section.

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. At this time, photo's will be stored on SRWG coordinator's computer. All this data will be transferred to SRWG web site fall 2018 when all water quality data is compiled. 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, 2018 would be labeled:
    20180815_SUN-ADBEC01_A
A duplicate at the same place and time as above:
    20180815_SUN-ADBEC01_B
A blank at the same place and time as above:
    20180815_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 F.

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.

3.4 Field Forms

A Site Visit Form 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. A copy of the field form is included in Appendix B.

3.5 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						
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
Nitrate-Nitrite as N	EPA 353.2	A4500-NO3 F	10			

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

4.1 QA/QC Overview

To inform water quality studies, data needs to accurately represent conditions in the watershed. Projects require proper sample collection, handling, processing, and data quality assessment to produce high quality, credible data that can be used to answer scientific questions or guide resource management decisions.

Quality Assurance (QA) is the overall management of a sampling program. It ensures the monitoring process is adequate for the project to meet its objectives with a stated level of confidence, from specifying which methods will be used to collect data to how the data will be managed and analyzed. 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 include collecting field duplicate samples and field blank samples.

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 data users to assess 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 C.

4.2 Data Quality Indicators

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

Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space.

Spatial representation

Sampling sites were chose to capture variability in land use, flow, and other watershed characteristics that may be influencing water quality. Sites include key tributaries and represent the Sun River Watershed from Gibson Dam to the mouth.

Temporal representation

Sampling occurs at approximately the same time of day and same time each month to provide a consistent representation of watershed conditions. The sampling period was chosen to ensure water management practices and seasonal fluctuations are captured. Sampling occurs before seasonal peak flows, during peak flows but before irrigation season, during peak flow and irrigation season, mid-irrigation season, at seasonal low-flow during irrigation, and after irrigation season is complete and seasonal flows are still typically low.

Comparability

Comparability is the degree to which methods, data, or decisions 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 analytes, analytical methods, and required 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 that you *planned to collect* compared to the amount of data that you *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 for the projected 49 sampling events. 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.

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. One blank will be included per site per visit.

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. 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.

SRWG intends to take field duplicates for approximately 10% of the total routine samples.

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

$$\text{Relative Percent Different (RPD)} = ((D1 - D2) / ((D1 + D2)/2)) \times 100$$

where:
D1 = routine sample result value
D2 = duplicate sample result value

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. Field blank samples are used to determine the integrity of the monitoring personnels' handling of samples, the condition of the sample containers supplied by the laboratory, and the accuracy of the laboratory methods.

SRWG intends to prepare and submit one blank per site per field visit for each parameter.

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.

4.3 Training and Qualifications

All volunteers will be trained in all field methods, including field meters, sample collection and handling, prior to the initial sampling event. 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.

Data will be collected by volunteer Rai Hahn. Rai has been trained in field data collection and has over 20 years of experience collecting water quality data. Rai will be training the Sun River Watershed Coordinator, Tracy Wendt, as a backup for future sampling. Tracy has collected water quality and flow data in other positions and has been properly trained in general sampling techniques.

5.0 DATA MANAGEMENT, RECORD KEEPING & REPORTING

The person(s) responsible for data management, record keeping, data quality review and data upload will perform the following activities:

- Review field forms for completeness and accuracy, especially Site Visit and Chain of Custody forms.

- Draft a brief synopsis of any SAP derivations that occurred.
- Store and backup all data generated during this project, including field forms, laboratory reports obtained from the laboratories, electronic copies of field photographs, and written field notes.
- Review data quality and flag result values (Appendix E), as needed, prior to uploading into the database(s). Upload all laboratory data into MT e-WQX database (if DEQ funding or support is provided).
- Maintain records of volunteer hours, travel and other budget tracking, as needed.

5.1 DEQ'S MT-EWQX DATABASE AND DATA QUALITY REVIEW

Laboratory analytical reports and Electronic Data Deliverable (EDD) spreadsheets will be supplied by the analytical laboratory to the volunteer monitoring project administrator. If DEQ funding is received via DEQ's Volunteer Monitoring Lab Analysis Support Program or other funding mechanism, all data must be entered by the project administrator into DEQ's MT e-WQX database. Instructions for uploading data to MT-eWQX can be found at http://deq.mt.gov/water/surfacewater/SubmitData.

Prior to entering data into the MT e-WQX database, the project administrator 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 D**.
3. Assign appropriate data qualifiers provided in **Appendix E** to data, as needed, in both hardcopy and electronic form.

5.2 OTHER DATA MANAGEMENT APPROACHES

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.

6.0 DATA ANALYSIS

6.1 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 (2008-2017) average for each month, sampling location, and analyte by calculating the RPD between the 2018 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 has recently undergone a personnel transition 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 will be investigating options and will be seeking outside assistance to look at other approaches to data analysis than those outlined above. 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.

6.2 Data Communication

Annual data summaries will be prepared for SRWG annual meetings and semi-annual meetings of the water quality working group by the SRWG coordinator. In addition to reporting for these SRWG meetings, electronic copies of raw data and data summaries will be sent to DEQ and maintained on SRWG's website at http://www.sunriverwatershed.org/. 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.

As part of SRWG's 10-Year Strategic Plan, we are also developing community education tools that will include a brochure and potentially other methods of communicating the results of this project with the public. SRWG is also planning a watershed tour and workshop for the summer of 2019 that will feature water quality issues, projects and BMPs implemented to improve water quality, and discussion of land and water stewardship activities that private landowners can implement on their own land to promote better water quality. Data and analysis collected through this project will inform that event.

7.0 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

Sun River Watershed Group 10-Year Strategic Plan (draft). Currently in development. Draft is available from Tracy Wendt at sunriverwatershed@gmail.com. Upon finalization and once the SRWG website is redesigned, the Plan will be available at www.sunriverwatershed.org.

APPENDIX A - PROJECT BUDGET

Projected Budget for Laboratory Analysis and Shipping

Parameter	Price per Parameter	Number of Sites	Number of visits per site	Number of routine samples (number of sites x number of visits per site)	Number of field blanks (often one per sampling event)	Number of field duplicates (often ~10% of the total number of routine samples)	Total number of samples (routine + duplicates + blanks)	Total Cost (Total number of samples x cost per parameter)
Total Suspended Solids (TSS)	$8	7	7	49	7	5	61	$488
Total Persulfate Nitrogen (TPN)	$15	7	7	49	7	5	61	$915
Total Phosphorus as P	$10	7	7	49	7	5	61	$610
Nitrate-Nitrite as N	$8	7	7	49	7	5	16	$488
Shipping	$12		7					$84
TOTAL								**$2,585**

APPENDIX B – FIELD FORMS

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

APPENDIX C – 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 % = $((D1 – D2)/((D1 + D2)/2)) \times 100$ 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 D – 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 E – 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 F – 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	615.1
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 ____________

ENERGY LABORATORIES
Trust our People. Trust our Data.

Chain of Custody & Analytical Request Record

www.energylab.com

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, PWS ID, Permit, etc.	
Sampler Name	Sampler Phone
Sample Origin State	EPA/State Compliance ☐Yes ☐No

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

Matrix Codes
A - Air
W - Water
S - Soils / Solids
V - Vegetation
B - Bioassay
O - Other
DW - Drinking Water

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

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

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 (cash/check 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

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

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.

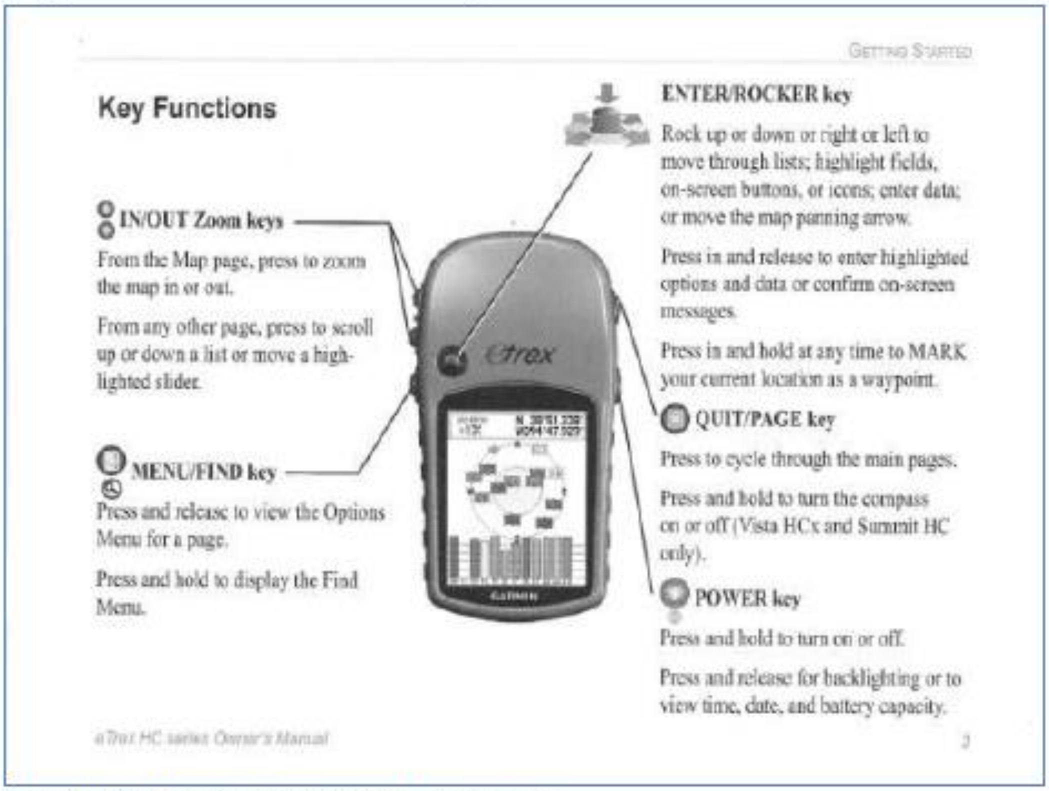
Directions: From I-15, take Exit 290 to highway 200 west. Parking is ~ 0.25 west of interchange on 200. Historic WQ data was collected at railroad bridge just north of highway 200. Park east of Muddy Creek bridge on highway 200, use Exxon gas station as landmark (photo 1). USGS gauge can be seen on right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

GPS Coordinates: 47.561056 lat
111.538306 lon

Verifying Site Locations with GPS

<u>Lat/Long and Elevation</u>

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


GETTING STARTED

Key Functions

IN/OUT Zoom keys

From the Map page, press to zoom the map in or out.

From any other page, press to scroll up or down a list or move a highlighted slider.

MENU/FIND key

Press and release to view the Options Menu for a page.

Press and hold to display the Find Menu.

ENTER/ROCKER key

Rock up or down or right or left to move through lists; highlight fields, on-screen buttons, or icons; enter data; or move the map panning arrow.

Press in and release to enter highlighted options and data or confirm on-screen messages.

Press in and hold at any time to MARK your current location as a waypoint.

QUIT/PAGE key

Press to cycle through the main pages.

Press and hold to turn the compass on or off (Vista HCx and Summit HC only).

POWER key

Press and hold to turn on or off.

Press and release for backlighting or to view time, date, and battery capacity.

eTrex HC series Owner's Manual 3

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.

<u>GPS Datum and Verification</u>

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

<u>Way point</u>

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)

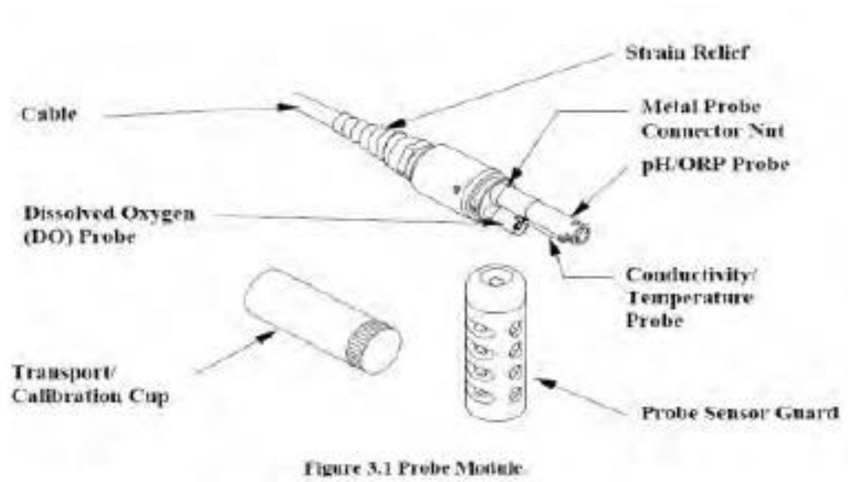


Figure 1: Probe Module from the YSI 556 Manual

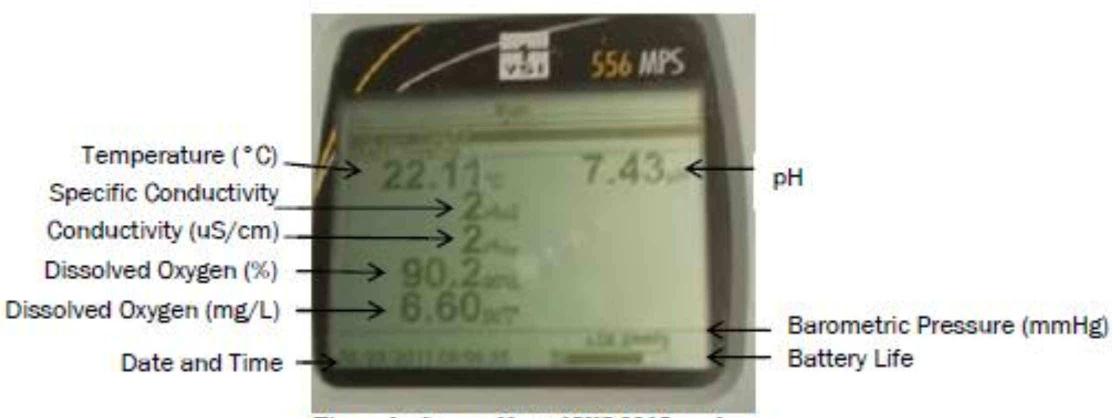


Figure 2: Screen Shot of YSI 556 Interface

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

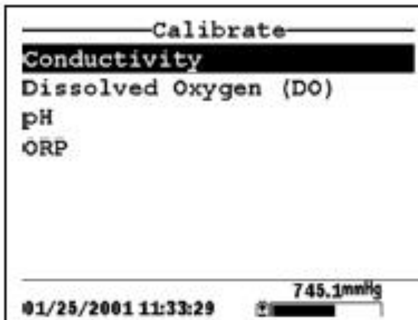


Figure 3. Calibrate Menu Screen

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.
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.


Picture 1


Picture 2

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

Picture 3

DISSOLVED OXYGEN CALIBRATION in % SATURATION

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:

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

Staff Gauge Reading: ______________

Location:

Stream Field Measurements

Temp (°C) __________ pH ____________

SC (µS/cm^c) __________ 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