

Utah Water Watch

USU Water Quality Extension

Partnering with Utah Division of Water Quality

Tier 2 Manual

Supplement to the UWW Program Manual

Guidance and Protocols

To be used in conjunction with Utah Division of Water Quality Standard Operating Procedures.

Draft Document – April 2018







Table of Contents:

Program Overview.....	4
Tier 2 Volunteers.....	4
Tier 2 Training.....	4
Watershed Management in Utah.....	5
Overview of Monitoring and Procedures.....	6
What Is a Standard Operating Procedure.....	6
What Is a Sample Analysis Plan.....	7
Monitoring Best Management Practices Effectiveness....	7
UWW Tier 2 Monitoring.....	7
What We Monitor and Why?.....	7
Tier 2 Projects.....	9
UWW Quality Assurance / Quality Control.....	11

Appendix:

Equipment Checklist	14
Multiprobe Use and Calibration	16
Water Chemistry Sample Collection	21
Flow Measurements	24
E. coli IDEXX Collection	28
E. coli IDEXX Analysis	30
Macroinvertebrate Collection	32
Photo Point Monitoring	36
Helpful Resources	38

Program Overview

The Tier 2 program is Utah Water Watch’s advanced monitoring program. Volunteers participating in Tier 2 are trained in state water monitoring protocols to provide assistance and data that may be used for assessment and decision making purposes. Utah Water Watch works closely with the Utah Division of Water Quality (UDWQ) to determine the methodologies and procedures Tier 2 volunteers should understand and learn during the training. Once a volunteer is trained, they may participate in a wide range of monitoring activities as needed. These activities are not necessarily limited to the methods taught in the training. Volunteers work with a variety of partners, including the UDWQ to collect data.

Utah Water Watch primarily works with nonpoint source water quality issues. The distinction between point and nonpoint source pollution for simplicity, can be broadly defined as, “any water pollutant coming from a non-discernable source.” Due to its diffuse nature, nonpoint source pollution is controlled and reduced by the implementation of best management practices (BMPs): BMPs are projects and practices designed to improve and/or maintain water quality. These may be executed on a large scale through an entire watershed, or locally on a small landowner basis. In order to determine the success of a BMP, monitoring stream health and water quality before and after implementation is necessary. Because Utah is a large state and resources are limited, the Utah Division of Water Quality, watershed coordinators, and other partners look to volunteers to assist with the collection of data.

Tier 2 Volunteers

Volunteers participating in Tier 2 are required to have some background or understanding of monitoring and water quality. This includes either professional or Tier 1 volunteer experience. Tier 2 volunteers are interested in taking an extra step to learn more monitoring skills, which may lead them to working directly with watershed managers to help collect data. Many volunteers also continue to monitor their assigned Tier 1 location(s).

The Utah Water Watch Tier 2 program connects local watershed scientists and partners with trained volunteers. Monitoring is often conducted on an “as-needed” basis. Tier 2 volunteers are available statewide for monitoring needs.

Tier 2 Training

Each Tier 2 volunteer attends a six-hour training. This training is geared towards people who already have some background in watersheds, water quality or environmental monitoring. Tier 1 volunteers are also encouraged to participate.



Volunteers receive training in the following state-approved methods:

- collection, handling, and processing of water chemistry samples
- collection and analysis of *E. coli* samples
- use of calibrated probes to measure in-stream chemical and physical parameters
- measurement of stream velocity and discharge
- collection and preservation of aquatic macroinvertebrates
- photo point monitoring

Volunteers are also trained in collection and identification of harmful algal blooms: a growing problem in some of our lakes, ponds, and reservoirs.

Watershed Management in Utah

Water pollution and water bodies in general, do not adhere to political and private property boundaries. For this reason, water quality managers use natural, hydrological boundaries instead. Watershed management approaches are utilized across the world because the watershed is the logical planning area for management of water resources.

The Utah Division of Water Quality’s watershed management approach uses four key elements: stewardship, monitoring and assessment, coordination, and watershed planning.

Stewardship is encouraged by working closely with the stakeholders; those who have a stake or interest in protection of their area, including all Utah residents. Working directly with and educating stakeholders often provides effective and lasting solutions to environmental protection and restoration efforts.

In Utah, and across the United States, water is managed and regulated according to how it will be used. These uses are what water managers refer to as “beneficial uses.”



These beneficial uses include drinking water, recreation, habitat for aquatic organisms, and agricultural use for irrigation and stock watering.

Monitoring and assessment is used in streams and lakes to ensure their designated beneficial uses are supported.

In Utah, coordination through watershed partners, stakeholders, and local watershed coordinators is important to complete the goals. These groups collaborate to support or participate in watershed actions and develop watershed plans, including characterization of the watershed, prioritization of environmental concerns, implementation plans of best management practices, and funding



opportunities, etc. Check out www.utahcleanwater.org or contact the UWW Project Coordinator to find out if there is an active watershed group in your area.

Best Management Practices

Best management practices (BMPs) are land management strategies and activities that aim to reduce or prevent pollution of surface and groundwater. BMPs are usually simple, low tech and generally beneficial to many of the involved stakeholders, and are divided by dominant land uses into agriculture, urban and forestry practices. BMPs aid in preservation of Utah’s various beneficial uses.

BMPs are used on private, state, and federal lands. Some examples include, grazing management on rangelands, protection of riparian areas, animal waste management, stormwater protection, creation of wetlands to capture pollutants; among many others.

Overview of Monitoring and Procedures

What is a Standard Operating Procedure?

Monitoring by the Utah Division of Water Quality (UDWQ) adheres to a Quality Assurance and Quality Control (QA/QC) Program. This ensures that environmental data that is collected is of high quality regardless of the group or individual collecting the data, and can thus be used for decision-making. Collaborative programs such as Utah Water Watch must also follow the same QA/QC to ensure the data is of high quality.

As part of the state QA/QC, each monitoring method has a Standard Operating Procedure (SOP) followed by all monitors.

SOPs developed by the UDWQ are detailed instructions on the collection, handling, processing and analysis of data. An SOP is generated for any routine procedure and ensures the data is standardized and comparable. In turn, strict adherence to an SOP reduces personal bias and increases the data’s overall accuracy.

Data collected in the Tier 2 program follows these SOPs. Volunteers’ understanding of these detailed SOPs is necessary to ensure that data collected under the Tier 2 program is comparable to data collected by the Utah Division of Water Quality. We have provided simplified instructions in the appendix, but request you review the more detailed SOPs available at the Utah Division of Water Quality webpage: <https://deq.utah.gov/Compliance/monitoring/water/qaqc.htm>.

Upper Sevier River Watershed SAP

Table 1-1. Project Organization.

Title/Responsibility	Name	Email	Phone #	Role
Upper Sevier River Watershed Coordinator	Wally Dodds	wdodds@utah.gov	(435) 676-8190	Project Manager
DWQ Watershed Coordinator	Scott Daly	sdaly@utah.gov	(801) 536-4333	Data Analysis/ Interpretation
DWQ Cooperative Monitoring Coordinator	Calah Worthen	calahworthen@utah.gov	(801)536-4376	Cooperative Monitoring Coordinator
DWQ Biologic Monitoring Coordinator	Ben Holcomb			Data Collection/Data Analysis/ Interpretation
DWQ Monitoring Section	Jim Hams		(801) 536-4360	
DWR Regional Aquatic Biologist	Stan Beckstrom		(435)865-6100	Fish Population monitoring
USU Extension Agent	Kevin Heaton		(435)676-1117	Pasture monitoring
Utah Water Watch Coordinator	Ellen Bailey	Ellen.bailey@Usu.edu		Volunteer Monitors



What is a Sample Analysis Plan?

A Sample Analysis Plan describes monitoring objectives, methodologies, data collection frequency, person(s) collecting the data, and any specific information pertaining to sample processing. Plans also include contact information, analysis and coordination procedures, and a map of sample locations. A Sample Analysis Plan (SAP) is required for all monitoring activity overseen by the DWQ. Volunteer roles will also be specified within the project SAP.

Monitoring Best Management Practice Effectiveness

Project managers are often required to demonstrate the effectiveness of their projects. Utah Water Watch is dedicated to assisting with monitoring for BMP effectiveness and, by extension, show improvements attributable to projects. In order to do this, monitoring and project objectives must be clear. Volunteers may assist with a variety of monitoring to meet specific needs.

To have meaningful data, it is imperative that data is collected before and after the BMP is implemented. Without the before data, it is difficult to determine what may have changed.

With any monitoring project, it is important to distinguish which changes can be attributed to natural variability and how pollutants respond within these natural fluctuations. This variability influences the timing and frequency of monitoring plans. (You can learn more about natural variability on our website or in the Introduction to the Utah Water Watch manual.)

UWW Tier 2 Monitoring

The methods you will learn in Tier 2 are those frequently used in monitoring plans. These methods, however, are not inclusive of all possible monitoring methods. Other common monitoring may include riparian, stream bank, and stream bed assessments. The broad goal in Tier 2 training is introduction to some of the monitoring methodologies and the rationale behind improvement projects. You may be asked to assist with other measurements, but will receive “on the job” training. If necessary, additional training will be provided by Utah Water Watch, Utah Division of Water Quality, or other cooperators.

What We Monitor and Why

Field Conditions - Use of a multiprobe

Multiprobes are used to measure multiple parameters such as temperature, dissolved oxygen, conductivity and pH (in addition, some units can measure turbidity, chlorophyll or nitrates). These measurements are often taken in conjunction with a chemistry sample.



Image 1 Collecting field data using a multiprobe.

Multiprobes provide excellent information by providing an immediate number; they are also relatively inexpensive and easy to maintain. However, these measurements only provide instantaneous data, unable to provide data illustrating temporal variability. To combat this, continuous monitors are left out for days or years to capture changes that occur throughout the day and between seasons. Continuous monitors require regular maintenance on a weekly or biweekly basis.

There are a number of different types of multi-probes available for use; all work under the same basic principles. To ensure proper functioning and accurate measurements it is vital all probes are calibrated daily. Probes contained on the multiprobe must all fall within the pass/fail range of their respective parameters as directed by the Standard Operating Procedures (SOPs). These SOPs can be found at the end of these instructions. With Utah Water Watch, we will generally be using the **SmarTroll** and **Oakton PCSTestr**. While the setup and controls of the probes will be different, the basic methods are the same.

All probes need to be **calibrated within 24 hours or less prior to sampling**. We recommend that you calibrate at home or the lab before you leave to monitor. All solutions should be within the expiration date.

Water Chemistry

Agencies and professionals collect water samples when they are interested on the presence and level of nutrients, metals or other chemicals in the water (i.e. nitrate, phosphate, ammonia, dissolved nutrients, metals - zinc, copper, lead, iron). These tests may be used to track the presence of contaminants, understand the biology and chemistry of water, or determine amounts and concentrations. Water samples are collected in a standardized way to reduce the risk of contamination. Metals and nutrients require preservative to suspend their activity and sometimes require filtration to capture the dissolved forms.

State guidelines on proper sample collection and processing ensure consistency between different monitors. When collecting samples, it is important to be familiar with the project specific procedures which may be found in the Sample Analysis Plan (SAP). The SAP will include detailed

information about the sample locations, parameters to test for, special requirements, and holding time required to return the samples to the lab.

The samples should be representative of the stream by collecting in the thalweg (deepest flow or main flow) and collected following the SOP.

Stream Flow and Discharge

Flow measurements tell us the amount of water that is flowing past a specific point in a stream



Image 2 UWW volunteers learning to take stream flow measurements on the Provo River.

at a given time. Irrigation withdrawals, precipitation, season, stream shape and local groundwater conditions are some factors that influence flow. Flow is typically recorded in cubic feet per second (cfs) or cubic meters per second (cms). Flow measurements are performed for natural rivers and streams, engineered water bodies (outfalls, ditches, canals), and other surface water bodies.

Stream flow measurements in water quality monitoring programs are used to determine pollutant loads, characterize water quality conditions and the effect of hydrologic conditions on aquatic life.

While the tools used to measure water flow vary, the general principle remains the same. Familiarity with different procedures associated with the use of a wading rod (e.g. Marsh-McBirney or MagnaRod) or flow probe (e.g. Global Water Flow Probe) will be beneficial when trying new methods. Flow is often measured while wading; when unsafe, it may be done from bridges, especially in deep or high-flow areas.

To determine flow in a stream you must know the stream’s average velocity (feet per second) and the cross sectional area (square feet). These are multiplied, which gives you flow in cubic feet per second - velocity*width*depth or (ft/sec * ft * ft = ft³/sec or cfs).

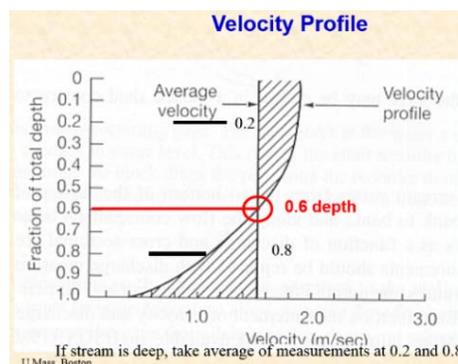


Figure 3 Graph showing depth vs. velocity to depict the reasoning for taking a measurement at 60% depth.

Velocity and depth vary across the stream, so you will take a series of measurements, depending on the size of the stream.

Average velocity in a wadeable stream is measured at 60 percent of the total depth. This is measured from the water surface. This is illustrated in figure 3.

E. coli IDEXX sampling

Escherichia coli (commonly known as *E. coli*) is a single species in the fecal coliform group. It is a bacterium that is found in the intestines of humans and other warm blooded animals. *E. coli* does not occur naturally in soil and vegetation.



Figure 4 Analyzing IDEXX *E. coli* tray

The presence of *E. coli* in water is an indication of recent contamination from sewage or animal wastes, which may have many disease-causing organisms. Although most strains of *E. coli* are harmless, *E. coli* O157:H7 is a cause of foodborne and waterborne illness. Although there are several ways to quantify *E. coli* concentrations, the most commonly used in Utah is the IDEXX method.

The IDEXX method gives an accurate quantification of the *E. coli* present in a 100mL sample using a Most Probable Number (MPN) model. Samples incubate at 35°C for 24 hours and the presence of coliform turns the wells yellow, while *E. coli* is counted in cells that are **yellow and fluorescent** under UV light. The combination of large and small wells increases the accuracy of the MPN calculation. **Note: It is important to remember that in order for a cell to count as containing *E. coli*, it must be both yellow and fluorescent.**

Photo point Monitoring

Photo point monitoring provides an easy and inexpensive way to monitor and track changes of a stream, lake and surrounding land. Photos may be used to document effectiveness of new management practices. Locations should be strategically placed to capture the monitoring objective (e.g. improvements in riparian area, stream banks, surrounding uplands).

Photo point monitoring is utilized by many agencies to document changes in stream shape, riparian habitat, or other land use improvements. Photos are taken on a regular basis (once a month, quarterly, yearly etc.) from the same position and field of view. Using site marking and good documentation, photos can be taken by multiple people and remain consistent. While it is a simple method, it can be extremely useful data, especially for small projects or when little data is available.

Macroinvertebrate Collection



Figure 5 Mayfly from Coal Creek

Benthic macroinvertebrates (BMI) are a useful indicator of stream health. BMI are relatively quick, inexpensive, and can indicate the presence (or absence) of pollutants in a water body. They have predictable community composition under natural conditions and provide a snapshot of long term conditions. Some BMI are especially useful for targeted sampling due to their high sensitivity to environmental changes and pollutants. For quantification, models compare the taxa observed at the site to the taxa expected in the absence of human-caused stress.

A reach for BMI sampling should be long enough to present a representative picture of the streams macroinvertebrate community. A reach, typically 40 times the width of the stream, should be dominated by riffle habitat- as riffles host a higher diversity of macroinvertebrates. If riffle habitat is unavailable, the next best habitat is selected.

Benthic macroinvertebrate collection consists of subsamples from 8 targeted locations. The sampler moves through a reach of river collecting subsamples with a D-net using a 500µm sieve bucket to sort the macroinvertebrates from sediment and other debris. This technique is designed to be rapid so that each subsample takes no more than 3 minutes to collect. This, however, takes some practice to become familiar with the method and stream habitats. See the instructions and SOP in the Appendix for details.

Tier 2 Projects

There are a variety of projects for volunteers to participate in. Some of these require schedule coordination with watershed coordinators and partners. Monitoring runs generally occur during the week. Additionally, there are projects that volunteers do on their own.

There are always new projects being implemented, so check with the UWW Program Coordinators for projects in your region.

Some projects we highlight include:

- Work directly with watershed coordinators and partners in Southeast Colorado Watershed, Lower Colorado Watershed, West Colorado Watershed, Sevier River Watershed, Cedar/Beaver Watershed, Jordan River Watershed, Bear River Watershed and Uinta Basin Watershed.
- *E. coli* collection and analysis at recreational waters using the IDEXX method
- Stream Algal Monitoring throughout forest lands
- Monitoring beaver dams and beaver dam analogs (manmade)

For more information about any of these projects, contact the UWW Program Coordinator.



Volunteers may coordinate directly with the project managers or UWW Program Coordinators. UWW is always available to assist and answer any questions. Equipment will be supplied as needed to volunteers monitoring on their own. UWW will coordinate with the partners to ensure volunteers have equipment that they need.

For approved projects, volunteers may receive mileage reimbursement. We appreciate your work and want to reduce any barriers that may limit your participation. For all other needs, contact the UWW Program Coordinator.

UWW Quality Control and Quality Assurance

Training

To participate in Tier 2 monitoring, volunteers must first complete the Tier 2 training provided by Utah Water Watch. Volunteers will be familiarized with several SOPs and procedures during the training. These methods include multiprobe calibration and use; collection, handling, and processing of water chemistry; collection and analysis of *E. coli* samples, stream velocity and discharge, benthic macroinvertebrate collection, and photo point monitoring. Other procedures may be added as the program expands and will be updated in this manual.

Monitoring plans:

Monitoring plans for the effectiveness of BMPs are developed based on the project needs (i.e. track changes in nutrient loads, improvements and success of bank stability, or riparian vegetation improvements). A Sample Analysis Plan is developed for each monitoring project that clearly outlines goals, locations, methods, equipment needs, time period, partner responsibilities, and contact information.

Sampling Methods:

Upon completion of Tier 2 training, volunteers will have the following competencies: use and calibration of multi-probes, sample collection and processing, sample filtration, *E. coli* IDEXX collection and analysis, stream flow measurements and calculations, macroinvertebrate collection techniques, and photo point monitoring.

Additional measurements may be requested and appropriate training will be provided as needed.



Equipment:

Generally, volunteers will be assisting someone who has the equipment. In other instances, equipment may be loaned or checked out to volunteers as needed. These needs will be identified in the Sample Analysis Plan. Project coordinators are responsible for ensuring equipment is in good condition. Volunteers need to let the coordinator know if any issues arise during their sampling.

Data submission:

Water chemistry and field parameters: A Project Trip Sheet is provided along with the collection bottles. Ensure that all the information is correct. Entering the appropriate data into each data field is required at each sample site (date, time, temperature, pH, conductivity, dissolved oxygen, and flow). Additional information for each site is also required. This additional information will be recorded on the provided lab sheet for each site. Site information includes: time, date, specific conductance and any site notes. These data are submitted to DWQ along with the collected samples. The process of sample collection and shipping will be overseen by a DWQ trained sampler or meticulously outlined in the project plan. In addition, fill in the following fields:

***E. coli* IDEXX analysis:** Data are recorded on the *E. coli* Sample Summary Sheet. Be sure to fill in all of the fields with total coliform and *E. coli* counts, incubation start and stop time, incubation temperature, and Colilert expiration dates. These data sheets will be submitted to a UWW project coordinator who will update a spreadsheet that is submitted to the DWQ on a quarterly basis.

Photo point data will be submitted to the UWW Google Drive, following the protocols provided. Data is submitted as soon as possible.

Macroinvertebrate samples are submitted to the lab- typically the Bug Lab- with the Sample Collection Form. Be sure to fill in the number of jars for submission, types of substrate at each transect, and any field notes relevant to the sample. Data from the lab will be submitted to the DWQ or project coordinator.

Any other data collected by volunteers is submitted according to the project plan.

Data Analysis:

Data analysis is the responsibility of the project coordinator, though UWW Project Coordinator or volunteer may assist, as detailed in the SAP.



Tier 2 - Equipment Checklist

Listed below is required equipment for Tier 2 sampling. You may or may not need everything listed depending on the required parameters listed in the SAP you are working from.

General:

- Safety Equipment
- Waders/boots
- Pen/pencil
- Notebook / Data sheets
- Decontamination solution spray for multiple sites

Multiprobe calibration and reading:

- Multiprobe (Hydrolab, SmarTroll, Hannah, Oakton, etc.)
- Tablet or logger for multiprobe
- Deionized water
- Calibration Sheet
- Calibration Standards
 - pH 7
 - pH 4 (if low value expected)
 - pH 10
 - Conductivity 718 μ S or 1413 μ S
- Waste bottle
- Calibration cup and guard
- Barometric Pressure (required for some sondes)
- Data Sheet
- Pen/pencil

Shipping:

- Shipping labels
- Ice
- Cooler
- Shipping Address/FedEx Form
- Pen /pencil

Sample collection:

- Sample Kit (provided, check project specific SAP to ensure completion)
 - Lab Sheet
 - Sample Bottles
- Sharpie
- DI Water
- Cooler
- Ice

As needed:

- Dip sampler (used to reach further from the bank)
- Transfer bottle (from the lab, for filtered samples)
- Filtering equipment
 - 0.45 μ m Membrane Filters
 - Glass filter (0.7 μ m)
 - Filter apparatus
 - Pump (Hand pump/Geo Pump)
 - Forceps

IDEXX Collection:

- Sterile Sample bottles
 - Lake/Reservoir 3 per site
 - Streams/Rivers usu 1 per site
- Thermometer
- Cooler
- Ice
- Data sheet
- Sharpie
- Pen/Pencil



IDEXX Analysis:

- Collected Sample
- Gloves
- Quanti-Tray 2000
- Colilert Reagent
- Incubator
- Sealer
- UV light
- Comparators
- MPN Table
- Marker
- Pencil

Macroinvertebrate Collection:

- D-net
- Sketch Paper
- Sample collection form
- 1L HDPE sample bottle
- Tape measure
- Waders
- Sieve bucket (500 μ m)
- 95% ethanol
- Pencil

Stream Flow:

- Flow Meter
- Tape Measure (in feet)
- Data sheet
- Waders
- Pencil

Photo Point Monitoring:

- Camera/ Phone
- Photo point registration form or past photos for comparison
- GPS or compass
- Pencil

Tier 2 Sampling Instructions – Multiprobe Calibration and Data Collection

Supplies:

Multiprobe, tablet, or data logger, deionized water, calibration sheet, calibration standards (pH and conductivity), waste bottle, calibration cup and guard (should already be with your multiprobe), field data sheet, pen/pencil.



General Probe Best Practices:

Calibration:

1. Calibrate within 24 hours prior to sampling, best done before going out in the field.
2. Calibrate for each sensor you will be using (conductivity, pH and dissolved oxygen).
 - a. Rinse with deionized water (DI) once, followed by the next standard you will be using. Rinse an additional two times with standard, for a total of three, before calibrating. Triple rinsing will be a common procedure in many of the SOPs you encounter.
 - b. Ensure probes are fully saturated in the buffer solutions
 - c. Take the “pre reading” value from the main reading screen.
 - d. Start with Conductivity (**SpCond**) – use 2 point calibration if possible
 - e. pH – use 2 point calibration that buffers the expected measurement
 - f. Dissolved oxygen, use saturated air to calibrate to 100% sat. Some probes may require knowing the barometric pressure.
 - g. Temperature cannot be calibrated, but is good to do a check against a NIST certified thermometer to make sure the equipment is working properly.
3. Document all buffers and readings on the calibration sheet provided.
4. Perform a check after calibration by taking a reading in the conductivity solution, pH solution and saturated air. The reading should be within $\pm 5\%$ of the expected value.



Data Collection:

1. Turn on the multiprobe and position the meter in the thalweg (main streamflow); or along a bank/edge in the flow if the waterbody is too deep or fast; or lower from a bridge. Ensure the measurements are upstream of other sampling activity, in well mixed water and avoid disturbing bottom sediments.
2. Wait 1-2 minutes for the values to settle and record them on the data sheet provided.
3. When finished sampling, make sure the probe is properly stored in the cap with a damp sponge or with tap or stream water to keep the sensors from drying out.

SmarTroll specific instructions

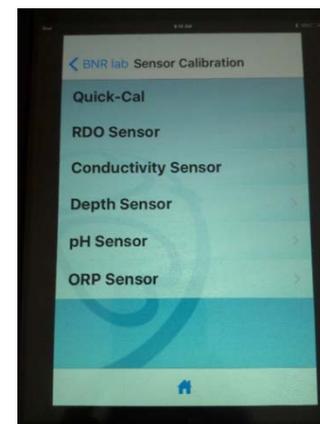
The SmarTroll probe is used to measure Temperature, pH, Conductivity, Dissolved Oxygen and Depth

Calibration:

Note: The DWQ recommends rinsing the conductivity probe with Deionized (DI) water, followed by a gentle dry with a lint free paper towel.

Connect multiprobe to the battery pack and turn on the battery pack and handheld device (e.g. tablet or phone).

- 1) Open the iSitu app on the handheld device.
- 2) Select a location for calibration, such as the lab or your home (You may need to select a new site on the bottom right)
- 3) It will show the sensor readings
- 4) Select flask icon at the bottom of the screen to start calibration



Conductivity

Use a standard close to what you expect the water body you are testing to be (we usually use 718 μ S/cm or 1413 μ S/cm).

Record the standard value and expiration date on the calibration sheet

1. In calibration mode, select conductivity sensor on the handheld device.
2. Rinse calibration cup once with DI water and three times with the appropriate standard.
3. Add conductivity standard to the fill line.
4. Select "Start" at the bottom of the screen. The unit should detect the calibration standard being used, but if not type it in.
5. When reading is stable, select "Accept".
6. Go back to the main screen and ensure the conductivity is reading the current calibration standard and record that as the post calibration reading.
7. Discard the calibration standard and rinse the probes and cup with DI water
8. Go back to the main calibration page

pH

In most environments in Utah, a 2-point with pH 7 and pH 10 is sufficient. If expected value is less than pH 7, use a pH 4 and pH 7.

Record the standard values and expiration date on the calibration sheet.

1. On the handheld device, select pH calibration, then "2-point-calibration". (If you are using a 3-point calibration, use all 3 standards – 4, 7 and 10 and select "3-point calibration". Follow the same steps as below.)

2. It will indicate Buffer “1 of 2”
3. Start with the lowest pH standard (usually pH 7) and rinse probe with standard three times
4. Add standard to the fill line and select “Start”, it should detect the buffer value
5. When stable, record the pre-calibration reading on the calibration sheet (it may take a couple of minutes to stabilize)
6. Select “Accept” and record the standard value (i.e. 7.00) as the post calibration reading.
7. It will immediately proceed to Buffer 2
8. Rinse cup and probes with DI Water and add next buffer
9. Repeat steps above with pH 7 or pH 10 for 2-point

Rinse probe with DI water

Dissolved Oxygen

Calibrate dissolved oxygen (DO) by selecting RDO Calibration, 100% Calibration

1. Add a saturated sponge in the cup and select “Start” at the bottom of the screen
2. When it is finished it will read “stable” and have 3 green check marks
3. Record the initial reading and temperature
4. Select “Accept”
5. Use arrow to go back to main calibration page
6. Remove damp sponge and rinse cup with DI water

Depth

Depth Calibration is only necessary if it is not reading zero out of the water

1. Select Depth, Zero in Air
2. Make sure the pressure sensor is open to the air
3. When stable, select “Accept”

Final Meter Check

After calibration is complete, a “check” is done to ensure proper calibration

1. Go back out of the calibration mode and to the Reading screen.
2. Place the probe in the calibration cup with saturated sponge to get a DO reading. Record the DO reading.
3. Rinse probe with conductivity standard and add conductivity solution to the calibration cup and place probe in the solution. Record the reading; it should be within $\pm 5\%$ of expected value. Rinse with DI water.
4. Rinse cup and probe with buffer solution and add pH buffer to the calibration cup and place the probe in the solution. Record the reading; it should be $\pm 5\%$ of expected value.
5. Rinse off the probe and cup and prepare for the field.



Data Collection:

1. Connect multiprobe to the battery pack and turn on the battery pack and handheld device (e.g. iPad).
2. Open the iSitu app on the handheld.
3. Select your site from the list.
4. If you are at a new site, you may need to create a new site at the bottom right. You will be able to add the Site Name, Description, take a picture and use the GPS or manually enter the Lat/Long coordinates.
5. Select “save” and it will bring you back to the Site list. To take a reading, select “set” which will bring up the readings.
 1. Position the sonde in the thalweg (main streamflow); or along a bank/edge in the flow if the waterbody is too deep or fast; or lower from a bridge. Ensure the sonde is upstream of other sampling activity, in well mixed water and avoid disturbing bottom sediments.
 2. Wait 1-2 minutes for the values to settle and record them on the data sheet provided. Also select “record” which will save the values on the handheld device.

When finished sampling, make sure the probe is properly stored in the cap with a damp sponge or with tap or stream water to keep the sensors from drying out.

Oakton PCSTestr

PCSTestr is used to measure Temperature, pH, and Conductivity.

Calibration:

Remove sensor cap and rinse the sensor under warm tap water for one minute. (Note: After extended period without use (2 months or more), remove the sensor cap and soak the sensor in warm tap water or pH 4 buffer for approximately 1 hour and then rinse) with tap water.

Press “ON/OFF” to turn on meter.

Conductivity

Note: In calibration mode, the larger number on top is the uncalibrated value, while the smaller bottom number should change and lock on the closest automatic calibration value.

1. Select "MODE ENT" until "Cond Auto" comes up on the screen
2. Rinse end of probe and calibration cup with deionized water and calibration standard (718 μ S/cm or 1413 μ S/cm).
3. Record standard value and expiration dates on calibration sheet
4. Fill the calibration cup with conductivity standard so that the probe will be immersed in solution and push "CAL".





5. Wait until the reading settles (1-2 minutes) and record the top number under "Initial Meter Reading" on the data sheet.
6. Press "MODE ENT" to confirm the calibration value.
7. The top number will flash after it has been calibrated. Record this new number under "Post Calibration Reading".

pH

This probe uses the 3-point calibration so you will use pH 4, pH 7 and pH 10 to calibrate. Record standards and expiration dates on the calibration sheet.

1. Select "MODE ENT" until "pH" comes up on the screen
2. Immerse the sensor in the pH buffer and push "CAL".
3. The larger number on top is the un-calibrated value, while the smaller bottom number should change and lock on the closest automatic calibration value.
4. Allow time for the top number to stabilize (1-2 min), then record the top number under "Initial Value" on the data sheet.

1. Next press "MODE ENT" to confirm the calibration value. The initial number will briefly blink before the post calibration number displays.
2. Record this new number under "Post Calibration Reading".
3. Repeat steps 3 and 4 for additional buffers as needed for 2 or 3 point calibration.

Data Collection:

1. Press "ON/OFF" to turn on meter and select "MODE ENT" to select the first parameter that you want to measure. Remove the cap and store in a safe location.
2. Hold the tip of the probe completely submerged underwater, but leave the screen visible.
3. Wait one to two minutes while the value adjusts. Once the value has settled, record the number on your data sheet.
4. You can press the "HOLD" button to lock in the current value if you need to remove the sensor from the water to write on the datasheet.
5. Pay special attention to the units. The conductivity, TDS, and salinity can change based on the hardness of the water. Record the units on your datasheet.
6. After you have measured all parameters, rinse the sensors off with clean water.
7. Place a little bit of tap water or pH 4 buffer in the cap. Replace the cap and store upright indoors. Do not leave your field probe in your car where it can be exposed to extreme temperatures.

Calibration, Maintenance and Use of Hydrolab Multiprobe DWQ SOP:

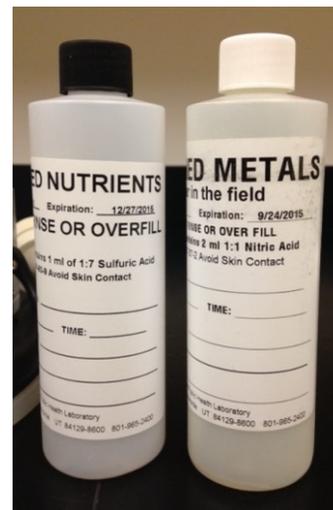
http://www.deq.utah.gov/Compliance/monitoring/water/docs/2014/05May/SOP_Hydrolabs_5.1.14_Rev0.pdf

Tier 2 Sampling Instructions – *Water Chemistry Collection and Processing*

Supplies: Sample kit provided by the lab (lab sheet, sample bottles, transfer bottle and deionized water), sharpie, cooler, ice, filtering equipment – 0.45µm membrane filter, 0.7 µm glass filter, filter apparatus, pump (GeoPump or hand pump), forceps.

Check the SAP or with the project coordinator for project specific equipment requirements and procedures.

Label all sample bottles with date, time, site, and initials. Label when you arrive at your site. Read each bottle and note any that have acid preservation or are filter bottles.



- Bottles with acid preservation: do not rinse and use caution not to overfill.
- Bottles for filtration: Do not fill these with native water. A transfer bottle will be used to collect water for these samples.

When using a transfer bottle (for filtered samples), rinse three times with native water between each site.

Collection by wading, when depth and flows are safe:

1. Wade out to collect the sample in the thalweg (deepest flow or main flow of the stream). If the thalweg is too deep, find another area where the water is flowing and appears to be well mixed.
2. Wait until disturbed sediment has moved down stream before collecting a sample.
3. Do not rinse the bottles unless you know they do not contain preservative. Bottles containing preservative are labeled as such. If using a transfer bottle, **triple rinse** it with stream water.
4. Remove first sample bottle cap. Avoid touching the inside of bottle cap, container or lip.
5. Reach forward with the bottle opening facing upstream and quickly plunge the bottle below the surface avoiding any surface scum, floating debris or the bottom of the stream.
6. Be careful not to overfill the bottle unless otherwise directed by the lab (for volatile organic compound analysis). For bottles that are prefilled with preservative, overfilling causes a loss of preservative. Leave some headspace in the bottle and immediately replace the cap.
7. Repeat with all sample bottles and return to shore.

Collection from bank edge (when water is too deep or fast to wade safely):

1. Use a dip sampler from bank to reach into the main flow.
2. If flow is too strong, sample may be collected by hand directly from the bank in a flowing, well-mixed area.

3. Follow the same instructions as above.

Filtering:

1. Gently invert the sample you collected for filtering to mix thoroughly and place intake tubing in the sample container.
2. Flush the filter holder and tubing with 500mL of sample water to rinse using either the GeoPump or hand pump.
3. Unscrew the filter holder to access the filter stage, being careful not to touch the inside.
4. Using clean forceps, load the filter holder with an unused membrane filter (0.45 μm), being careful not to touch the filter.
5. You may use a glass-fiber pre-filter if there is visible turbidity in the sample. The pre-filter should be “upstream” of the membrane filter.
6. Screw the filter holders back together.
7. Remove caps from sample bottles, turn on the pump and hold the filter holder over the sample bottle without touching it to the bottle. The filter stream will fill the bottle(s).
8. Continuously swirl the raw water sample during filtration to ensure homogeneity.
9. If the filter clogs before filling the bottle, stop the pump, remove and replace used filter with a new one.
10. Be sure not to overfill the preserved sample bottles and leave some headspace. Overfilling pre-preserved bottles will cause a loss of preservative.
11. Stop the pump and replace the bottle cap.
12. Remove and discard used filter and rinse apparatus with 500mL DI water.



Figure 6 Filtering chemistry samples using a GeoPump

Post Collection Handling:

1. After collection at each site, record time, date, specific conductance and site notes on the individual lab sheets provided. See an example in the appendix. *Be sure time and date match the trip sheet*
2. Keep all samples on ice in a cooler and out of the light until delivered to the lab. Send samples with the trip sheet and lab sheets and deliver samples within the holding time. If unsure of the holding time, refer to the SOP, SAP or check with the project coordinator.
3. At the end of the day, clean the sampling equipment by soaking the filter holders and GeoPump tubing in a solution of Liqui-nox overnight followed by light scrubbing and rinse with DI water in the morning.



Quick guide:

- *Label bottles, noting filtered and preserved bottles*
- *Collect sample from thalweg, standing downstream*
- *Collect from bank if water is too deep or dangerous*
- *Filter immediately following sampling*
- *Do not mix caps*
- *Store samples on wet ice*

Collection of Water Chemistry Samples DWQ SOP:

http://www.deq.utah.gov/Compliance/monitoring/water/docs/2014/05May/SOP_WaterChemSampleCollection_5.1.14_Rev0.pdf

Tier 2 Sampling Instructions – *Stream Flow*

Supplies:

Flow meter, tape measure (in feet), paper to write data, waders, pencil/pen

Choosing a Site:

Establish a stream cross section for flow measurement to occur. Desirable characteristics for the site location include:

- A straight section of stream, away from stream bends;
- Stream flow approximately parallel to stream banks;
- A constant stream gradient;
- No obstacles protruding from water surface (i.e. stones, plants, bridge piers).

When establishing the cross section, **look for an area of smooth flow with minimal obstructions and turbulence**. Obstructions, including large rocks, can be moved out of the way of the cross section, but only before flow measurements begin and never during the measurement. When wading, depth should not exceed 3 feet.

Conducting a measurement:

1. Stretch a tape measure across the stream and attach it on both ends. Make sure it is perpendicular to the flow and tightly stretched.

2. Using the tape, measure the interval given below:

- If **stream width < 10 feet**, collect data **every 0.5 feet**; and take first reading at 0.25 feet (half of interval) from edge.
- If **stream width > 10 feet**, collect **20 evenly divided measurements** across the entire stream; take the first reading at half of the determined interval from edge

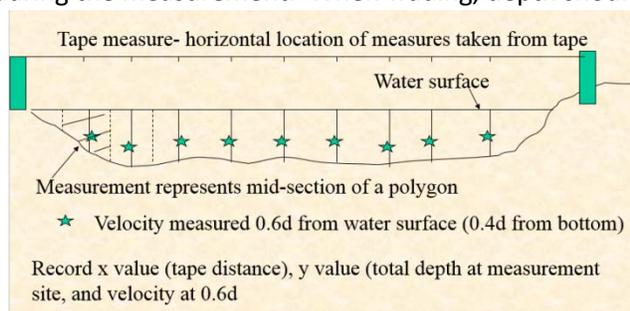


Figure 7 Cross section view of velocity measurement locations.

Data Collection:

Collecting flow data works best with a team of two people. One person handles the flow meter while the other records the stream width, depths, and velocities.

1. Make sure the flow meter is reading flow in feet per second (ft/s) and the allotted time for reading flow is set at twenty seconds.
2. The sensor must be facing upstream and both members of the team must take care to stand to the side and slightly behind the flow meter, to avoid impacting the measurement.
3. The operator will measure the actual water depth using the wading rod and call it out to the recorder who will record it on the field sheet.

4. The wading rod is then adjusted to the correct depth – place the flow meter at 0.6 (60%) of the water depth, measured from the surface. (If using a probe without a wading rod such as a Globe Flow Probe, moving the probe throughout the depth will calculate an average velocity, instead of using the 0.6 depth).
5. Begin measuring velocity once the depth is set. After 20 seconds, the operator will call out the average velocity to the recorder and then continue to the next location.

Calculating the flow:

Remember, flow is (velocity*width*depth) or
(ft/sec * ft * ft = ft³/sec or CFS)

To calculate total flow, use the mid-point method (see figure).

Total Flow is a combination each measurement across the stream cross-section. Just add up all the flows for the smaller cross sectional areas (boxes).

$$\text{(Combination of each box)} = (W_1 * SD_1 * SV_1) + (W_2 * SD_2 * SV_2) + (W_3 * SD_3 * SV_3) + \dots$$

Where W = distance between measurements; SD = Stream depth; SV = Stream velocity; 1,2,3, etc. refer to each box.

We provide a spreadsheet that will do this for you, but it is always good to check your calculations to be sure they make sense.

Find the Excel template on our Utah Water Watch Website in the flow instructions.

(<http://extension.usu.edu/utahwaterwatch/monitoring/field-instructions/flowmeasurements>).

Stream Flow Measurement DWQ SOP:

http://www.deq.utah.gov/Compliance/monitoring/water/docs/2014/05May/SOP_StreamFlow_5.1.14_Rev0.pdf

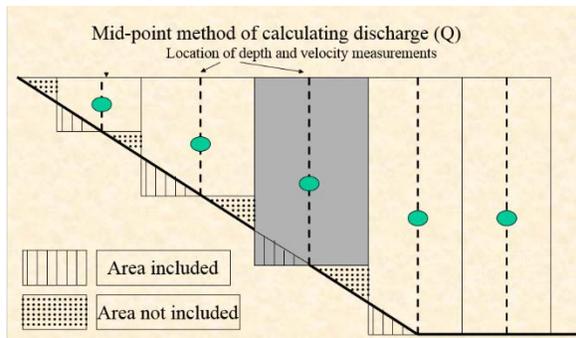


Figure 8 Figures from University of Massachusetts, Boston, 2014. <http://www.slideserve.com/sheadon/how-do-we-measure-how-much-water-is-in-a-stream>

Tier 2 Sampling Instructions – *Flow Measurement*

MagnaRod Simple Instructions

The Magna Rod is commonly used by Watershed Coordinators and follows the basic principles of all flow meters. The model you will be using may have a different interface, but the same basic procedural guidelines still apply and are simple to follow once you learn the interface.

To turn on/off: press and hold both buttons

There are two main modes, rod adjustment, which tells you the depth to set the probe, and the current meter counter, which measures flow. **Press and hold the left button to toggle modes.**

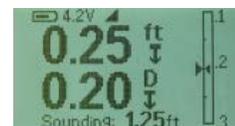


Figure 9 MagnaRod display

Once you have set a tape across the stream and established the measurement interval, you may begin measuring the flow. Position the flow meter pointing upstream while standing to the side.

Setting up the rod:

1. Hold left button until Top Set Rod (TSR) mode is activated, the screen should look like this:
2. Move the rod to the bottom of the stream, press the left button
3. Bring the rod upwards until the mechanism is at the surface: the water depth is now shown, press the right button.
4. **Slide the rod downwards until the lower number displays 0.6 D.** The upper number displays the depth from the surface while the lower number is the distance below the surface. The rod is now positioned at 0.6 of the depth, you are ready to take a measurement.



Taking a measurement:

1. Press and hold the left button until the current meter counter (CMC) screen shows.
2. You may need to adjust the interval setting, which should be at **20 seconds**. To do this, press and hold the right button: this will bring up the settings menu. Use the left button to toggle until “Time” setting is selected, pressing the right button until 20 seconds shows. Save and exit.
3. To begin the measurement, press the right hand button. The 20 second measurement will commence, and the display will show the average velocity and elapsed time, which will both stop changing after 20





seconds is reached.

4. In your notebook record the tape interval, depth, and velocity. Repeat these steps at the next interval.

Tier 2 Sampling Instructions – *E. coli* IDEXX Collection

Supplies:

Sample bottles (3 per site for lakes, 1 per site for streams), thermometer, cooler, ice, data sheet, sharpie, pen/pencil

Lakes and Reservoirs:

1. Label 3 - 120mL sterile sample bottles with sampling location, replicate number, date and time of collection. Do not label the lids, as these can potentially get mixed and placed on the wrong bottle.
2. If needed, prepare a field blank (the project coordinator will notify you before sampling if this is required). The usual protocol is one field blank per day at the first site. This is prepared by filling the bottle with 100mL deionized water into the bottle. Bottle is labeled “Blank” with the date and time. Place the blank in the cooler.
3. Take thermometer and 3 sample bottles out into reservoir until about knee deep.
4. Record water temperature by holding the thermometer below the surface 15 cm (6in). Let it adjust for 1 minute before removing. Record the temperature at the same time as sample collection.
5. Gently invert and fill up first replicate bottle at a depth of 12-18 in, being careful not to pour out the sodium thiosulfate and avoiding surface scum and bottom sediment. Make sure to fill the bottle to the 100mL mark as accurately as possible. **Do not rinse** the bottle, as it has sodium thiosulfate.
6. Replace lid securely and mix by shaking the bottle.
7. Walk 10 feet parallel to the shoreline to fill up the replicates. Repeat steps 4-5, for a total of 3 samples.
8. Store on wet ice or ice packs in a cooler and out of the sun. **Deliver to the lab within 8 hours**- this is the maximum holding time.
9. If processing the IDEXX samples in the lab, follow the instructions for IDEXX processing.

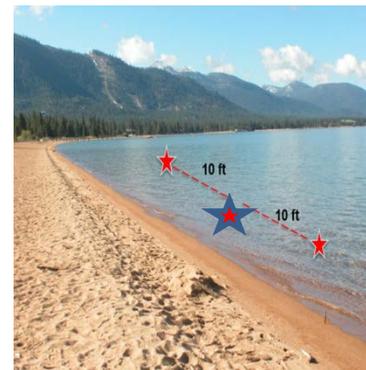
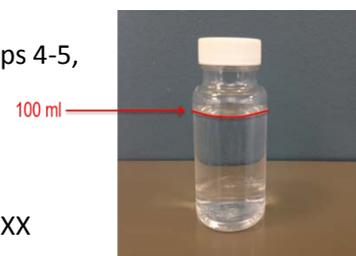


Figure 10 Lake sampling method, 10 feet apart at knee depth, parallel to shore.



Streams and Rivers:

1. Label a 120mL sterile sample bottle with sampling location, replicate number, date and time of collection.
2. Prepare a field blank if needed (One field blank per day at the first site). This is prepared by filling the bottle with 100mL distilled water into the bottle. Bottle is labeled “Blank” with the date and time. Place the blank in the cooler.
3. If entering the water is unsafe, water may be collected from shore while ensuring the sample is representative of the main flow.



4. Record water temperature by holding the thermometer below the surface 15cm (6in). Let it adjust for 1 minute before removing. Record the temperature at the same time as the sample collection.
5. Gently invert and fill up bottle at a depth of 12-18 in, being careful not to pour out the sodium thiosulfate and avoiding surface scum and bottom sediment. Make sure to fill the bottle to the 100mL mark as accurately as possible. **Do not rinse** the bottle, as it has sodium thiosulfate.
6. Replace lid securely and mix by shaking the bottle.
7. Store on wet ice or ice packs in a cooler and out of the sun. Deliver to the lab within **8 hours**- this is the maximum holding time.
8. If processing the IDEXX sample in the lab, follow the instructions for IDEXX analysis and processing.

***E. Coli* Collection and Handling DWQ SOP:**

http://www.deq.utah.gov/Compliance/monitoring/water/docs/2014/05May/SOP_EcoliSampleCollection_5.1.14_Rev1.2.pdf

Tier 2 Sampling Instructions – *E. coli* IDEXX Analysis and Quantification

Once you have collected your sample(s) for *E. coli* analysis, processing will need to take place within 8 hours. Sample(s) should be kept on ice until then.

Follow the instructions below and refer to the DWQ SOP provided in your notebook or the link below.

Supplies: Collected Samples, gloves, incubator (set at 35°C), sealer and rubber tray, UV light, comparator trays, MPN table, marker, datasheet.
For each sample: Quanti-Tray 2000 and Colilert reagent.



Preparation and sealing:

1. Make sure to turn on incubator and sealer an hour before starting so that they have time to warm up.
2. Wash hands or put on gloves.
3. Pour one packet of Colilert reagent into each bottle
4. Gently swirl bottle until reagent is fully dissolved. This may take a few minutes if the sample is cold. Avoid vigorous mixing, which creates bubbles.
5. Prepare the 97-well Quanti-tray by labeling the tray for each sample, including site name, replicate number (if applicable), initials, and time.
6. Squeeze the sides of the 97-well Quanti-tray to open, being careful not to touch the inside of the tray.
7. Pour entire 100mL sample into the tray and tap the tray to remove any air bubbles
8. Place tray well side down on the rubber sealer insert.
9. Feed sample through the sealer with the opening of the tray facing away from the sealer.
10. Place the trays evenly into the incubator and incubate at $35 \pm 0.5^\circ\text{C}$ for 24-28 hours (18-22 hours if using Colilert 18).
11. Remove the trays from the sealer and quantify the results.



Quantification:

1. There are 49 large wells and 48 small wells that are counted individually. (The elongated well on top is counted as one of the large wells.)
2. Count the number of yellow wells (large and small) and record on the data sheet provided. This indicates the presence of coliform bacteria.
3. Hold the UV light 5 inches from the tray (turn out ambient lights for best results). Do not look directly at the light or wear safety glasses to protect your eyes from the UV light.

- Count the number of wells (large and small) that are **both yellow and fluorescent** under UV lighting and record on the data sheet. This indicates the presence of *E. coli* bacteria. If unsure, there is a comparator tray to use as a guide.

*Empty wells: If there are > 2 empty wells, the test is invalid. If there are 1 or 2 empty wells, record these as negative (no *E. coli*). If only 1 well is empty and all other wells are positive, count the well as positive.

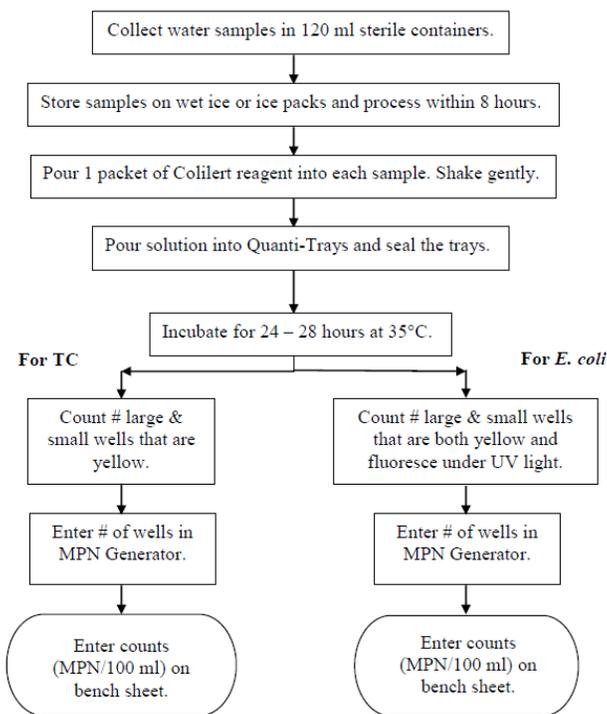
- After counting the number of large and small wells that are yellow, or yellow and fluorescent, we will use an MPN (most probable number) table to determine *E. coli* concentration. The units are colonies /100 ml.
- Record the MPN result the data sheet.



Disposal

Trays will need to be autoclaved (sterilized) before disposal. Check with the lab you are working in for disposal protocol.

Figure 1. Overview of *E. coli* and total coliform quantification.



If levels are >409 MPN/100ml, contact UWW or Calah Worthen (calahworthen@utah.gov).

E. Coli Collecting and Handling DWQ SOP:

http://www.deq.utah.gov/Compliance/monitoring/water/docs/2014/05May/SOP_EcoliSampleAnalysis_5.1.14_Rev%201.2.pdf

Tier 2 Sampling Instructions – *Benthic Macroinvertebrate (BMI) Collection*

Supplies: D-net, sketch paper, sample collection form, 1L HDPE sample bottle, tape measure, waders, sieve bucket (500 μ m), 95% ethanol.

Definitions:

Riffle – Water that moves over a shallow area of cobbles and gravel creates a riffle (a length of stream characterized by shallow, fast moving water broken by rocks).

Pool – A deep area of fairly still water which creates refuges for fish to hide in and to rest from the current.

Glide – A shallow stream reach where the water is moving more slowly

Reach – section of stream used for assessment

Run – an area where the water is flowing rapidly and is deeper than a riffle.

Rapid – water movement is rapid and turbulent; surface with intermittent “white water” with breaking waves

Fine/sand – not gritty to gritty, up to lady bug-sized (2mm)

Gravel – fine to coarse gravel (ladybug to tennis ball-sized; 2mm to 64mm)

Coarse – cobble to boulder (tennis ball to car-sized; 64mm to 4000mm)

Establish a sampling reach and subsample locations:

1. Establish average wetted width. Multiply this width by 40 to get the length of the reach to sample.
2. Put a stake at the start and end of the reach.
3. Take GPS points within the reach and record the coordinates, preferably in the center of the reach.
4. Complete a rough sketch map of the designated stream reach being sure to note any interesting features or landmarks/directions that can be used to find the reach in future visits along with the GPS points.
5. The collected sample is made up of 8 subsamples within the reach targeting riffle habitat. If no riffles are available, the edge may be targeted. **Note: if edge sampling is required, it is best if volunteers are first shown by someone who has sampled edge habitat before.**
 - a. To reduce human bias, alternate locations in the stream (e.g. Left- 25% of channel width, center- 50% of channel width, right- 75% of channel width). Start randomly with one of these locations and consistently follow the pattern of left (L), center (C), right (R) and repeat



until all 8 subsamples are collected (See Figure 1 below). **Multiple subsamples can be collected in one riffle habitat if riffle habitat in the reach is limited.**

- b. Begin walking upstream along the reach. While walking, look for **desirable habitat: riffle/runs with coarse substrates**. Target coarse substrates such as gravel (pea-sized and larger) to small boulders (basketball-size and smaller). If coarse substrates are lacking, woody debris, macrophytes (submersed plants) or leaf packs can be targeted. Identify and document these factors on the field sheet.
- c. At each collection point, determine:
 - i) habitat type - pool, glide, riffle, or rapid
 - ii) substrate - fine/sand, gravel, coarse or other (other includes occurrence of wood, leaves, edge habitat, overhanging vegetation, bedrock, hardpan, etc.)
- b) At each of the collection points, follow specific instructions for each habitat type.

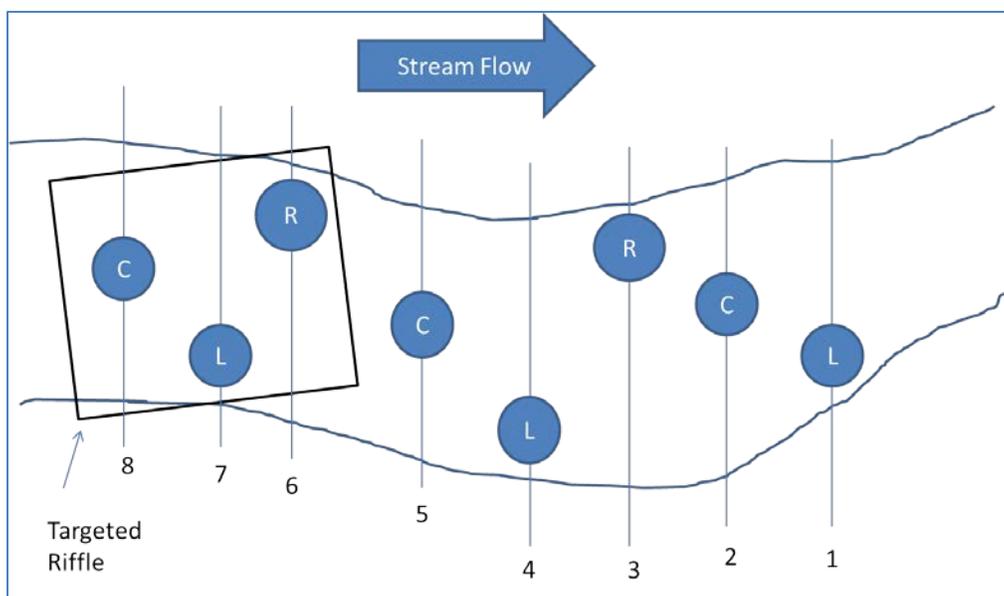


Figure 11 Sampling locations within a reach. (Image not to scale)

Collection of a sample in riffle/run habitats:

1. Rinse net, sieve and bucket with site water. Do not dip sieve in water, instead rinse from the outside.
2. Make sure net opening is facing upstream, directing flow into the net and eliminating gaps under frame by avoiding large rocks that prevent full streambed contact.
3. Collect all available BMI w/in the area upstream of the net opening (net width wide and net width long or 1 ft²).
 - a. Disturb substrate w/hand, be sure to pick by hand larger organisms like mussels and snails.
 - b. Pick up loose rocks or other substrate and dislodge organisms washing them into the net, ensuring substrate remains in front of the net opening and flow directed into the net.



- c. After scrubbing larger substrates (> golf-ball size) and removed from the area in front of the net, focus on the smaller substrate to a depth of 3 inches. Vigorously perturb smaller substrate within the quadrat for 30 seconds with your hands. You may use your boot if it is too deep.
1. Immerse the net (excluding the opening) in the stream several times to remove fine sediments and send all bugs to the bottom of the net.
2. Determine the predominant substrate size/type you sampled within the quadrat and record on the Sample Collection Form. Note: if there are multiple co-dominant substrate types, you may fill in more than one circle. (Fine/sand, gravel, coarse, other)
3. Identify the habitat type where the sampling quadrat was located and fill in on the Sample Collection Form. (Pool, glide, riffle or rapid).
4. If the net is full, transfer contents to the bucket before moving to the next location.
5. Repeat this process at the seven remaining locations within the reach.

Collection of sample in Any Habitat Type

Preservation and transport of the sample:

1. Transfer contents of net into a 2.5 gallon bucket, inspecting the net for any remaining bugs that may still be clinging to it. Using a wash bottle full of stream water and/or forceps, flush/pick them off the net and into the bucket.
2. Fill the bucket with stream water to cover the collected materials.
3. Swirl the bucket to suspend lighter organic materials (sticks, leaves, organisms). Pour into sieve bucket leaving the heavier material (inorganic) in the 2.5 gallon bucket.
4. Continue rinsing and swirling until no more bugs are seen crawling around in the 2.5 gallon bucket and are back in the sieve bucket. Be sure to inspect the bucket for caddisfly cases as sometimes the cases are composed of gravel-sized materials.
5. Place the new contents of the sieve bucket into a 1L sample bottle by hand, no more than 40% full. Use multiple jars if necessary. Check to make sure no organisms are left in the bucket. If so, use a pair of forceps to pick the bugs out.
6. Completely fill the jar with 95% ethanol (no headspace). Denatured alcohol preferred.
7. Fill out two labels – one on waterproof paper with pencil that will go inside the jar. The second will be taped on the outside. Label includes Site name, STORET #, Initials, date, # of bottles (1 of 1) or (1 of 2) and equipment/method (D-net; 8subsamples)
8. Slowly tip the jar to a horizontal position and then gently rotate the jar to mix the preservative. Do not shake. After mixing, place waterproof label inside the jar and seal the jar lid with electrical tape. Place the sample label on the jar.

BENTHOS (95% ETOH) USU

Site ID: _____

STORET: _____ # Bottles: _____

Samplers: _____ Date: _____

Method: _____



9. Store filled jars in an empty cooler or jar tote during transportation. Samples do not need to be refrigerated or stored on ice.

After collection, follow decontamination procedures to reduce the spread of invasive species.

- Remove all visible attached mud, debris, plants or animals from the equipment
- Scrub equipment with a stiff bristled brush to dislodge anything that is stuck
- Spray boots and nets and sieve with Clorox Formula 409

Aquatic Benthic macroinvertebrate Collection in Rivers and Streams DWQ SOP:

http://www.deq.utah.gov/Compliance/monitoring/water/docs/2014/06June/SOP_StreamBMI_5.1.14_Rev0.pdf

Tier 2 Sampling Instructions - *Photo Point Monitoring*

Supplies:

To register a new site, bring the Photo Point Registration Form, phone or camera, compass/GPS and a pen or pencil.

Follow up visits require a camera, compass and preferably a copy of the previous photo.

Determine a location:

Most volunteers will take photo points at pre-determined sites, in which case skip to the “Take a photo” section.

Things to consider when determining a photo point site:

- What are the changes we are looking to document?
- Will the photo capture the “area of interest”?
- Is this location consistently easy to access?
- Will the location of the photo point need to change over time? (ideally no)
- You will want to have as much of your site visible as possible from the photo point location.



Fill Out the Photo Point Registration Form:

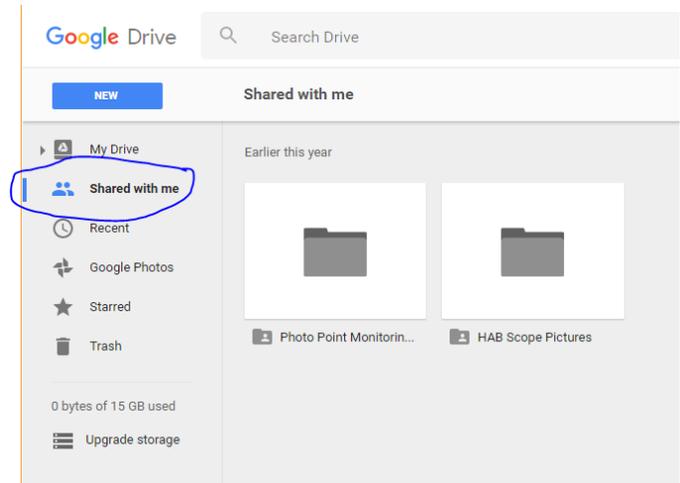
1. *The site name* (your UWW site name, or name assigned by coordinator)
2. *The retake frequency* (e.g. seasonally, monthly, etc.) Mark these dates on your calendar so that you do not forget. This frequency will be established specific to the project and need.
3. The subject and purpose of the photo point monitoring site (e.g. ‘Monitor UWW site’, or ‘To document recovery after bank stabilization’)
4. *Establish a site marker:* Determine a marker from which you will be taking photos. An ideal marker would be something permanent like a large tree or a bridge. Describe and **take the GPS points of the marker**. Take photos of the marker and place in Google Drive in your ‘notes’ subfolder. Label the photo ‘site marker X’ GPS points should be taken in the decimal degree format (e.g. 31.542321342° N, 152.463564354° W)
5. Determine the direction photos are to be taken and record these on the registration form.
6. When you have completed the form, scan or take a photo of the form and upload it into the Google Drive ‘notes’ folder associated with the site, this form will be used as reference for taking photos.
Be sure to send the form to waterquality@usu.edu too.

Take the photo:

1. If possible, take a photo from the previous photo point and line up the site using the photo as best you can.
2. Choose the camera settings that give the greatest depth of field. For digital cameras a "landscape" setting generally fulfills this requirement.
3. Hold the camera at eye level. Try to include about 1/3 sky in the photo for scale and for consistent replication.
4. Take the photos in early morning, late afternoon or slightly overcast days to eliminate harsh glares or dark shadows. Take the photos with the sun at your back and avoid days when visibility is poor due to fog or heavy rain.

Upload and share photos:

1. Name the photo: The name of the file should contain the site name (e.g. WER-01-S), the direction (by using a compass) 'bearing N' as well as the date (MMDDYYYY). You can easily edit the photo's file name via your computer file manager.
 - e.g. using cardinal direction: "WER01S-N-08222016"
2. Submit the pictures: Save the photos on Utah Water Watch Google drive in a folder created for each site and located under the watershed.
 - Utah Water Watch will share access to your site folder.
 - Folders will be visible under the My Drive or Shared with me sections on the left in your Google drive, as shown in the picture.





Helpful Resources:

Tip When using the Utah DWQ webpage (<http://waterquality.utah.gov>) use the search bar to find what you are looking for

Utah DWQ, Quality Control Quality Assurance (QAQC): Includes links to SOPs

<http://www.deq.utah.gov/Compliance/monitoring/water/qaqc.htm>

Integrated Report, 303d list: Updated list of the impaired water bodies in the state

<https://deq.utah.gov/legacy/programs/water-quality/monitoring-reporting/assessment/2016-integrated-report.htm>

Approved TMDLs:

<http://www.deq.utah.gov/ProgramsServices/programs/water/watersheds/approvedtmdls.htm>

BMP monitoring guide for stream systems: <https://extension.usu.edu/waterquality/files-ou/Publications/Best-Management-Practices-monitoring-guide.pdf>

Utah Nonpoint Source Partnership:

<http://utahcleanwater.org>

Utah Water Watch - Tier 2

<http://extension.usu.edu/utahwaterwatch/monitoring/tier2>

USU Water Quality Extension

<http://extension.usu.edu/waterquality>



Attach data sheets:

- Calibration
- E. coli
- Photopoint registration
- BMI
- Water Chemistry