IDAH2O MASTER WATER STEWARDS HANDBOOK

University of Idaho Extension

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Ashley McFarland

University of Idaho Extension, Moscow, Idaho

Bulletin 882

Author—Ashley McFarland is former University of Idaho Extension Area Educator in northern Idaho and founder of IDAH$_2$O Master Water Stewards.

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For more information on IDAH$_2$O, please contact
University of Idaho Extension
1031 North Academic Way #242
Coeur d'Alene, Idaho 83814
Phone: 208-292-1287
E-mail: idah2o@uidaho.edu
Web: www.uidaho.edu/cda/idah2o

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1 INTRODUCTION AND POLICIES

"To promote the health of Idaho's water through volunteer water quality monitoring."

–IDAH$_2$O mission statement

Introduction

Water quality is one of Idaho's top environmental concerns. Maintaining a high level of water quality is necessary to ensure safe water sources for drinking, recreating, and supporting businesses, industries, and fisheries and wildlife. Yet a wide range of pollutants that could threaten these uses enter Idaho's waterbodies each day.

IDAH$_2$O provides a platform for people throughout Idaho who are interested in monitoring water quality and learning more about the status of their local waterbodies. Working within their selected watersheds, Master Water Steward volunteers collect valuable data about local water quality, gain a better understanding of our interactions with the land, and reinforce the concept of public ownership of the environment.

The IDAH$_2$O program supports this network of volunteers with on-site training workshops, standardized monitoring protocols, an online database to store collected data, testing equipment, and tools for local advocacy on local water quality issues.

Although IDAH$_2$O is primarily educational, data collected by Master Water Stewards can help resource managers identify patterns of concern that lead to more detailed evaluations of water quality. In an era of smaller, friendlier, and more-efficient government programs, well-trained citizen volunteers can play an important role.

Funding

IDAH$_2$O is supported through University of Idaho Extension and external funding sources.

IDAH$_2$O history and founding principles

IDAH$_2$O was first conceived in northern Idaho in 2010 as a partnership between University of Idaho Extension and University of Idaho, Coeur d'Alene. It is based on successful volunteer monitoring programs in other states, such as IOWATER (*http://www.iowater.net*), and on the highly effective "master" volunteer model used in other extension programs such as the Idaho Master Gardener and Forest Stewards programs.

Three basic goals directed the development of the IDAH$_2$O program:

- Increase citizen knowledge on water issues
- Promote volunteer monitoring of Idaho streams
- Promote watershed stewardship

Founding principles of the IDAH$_2$O program include:

- IDAH$_2$O is a **citizen-based** program directed by citizen monitors within local communities.
- IDAH$_2$O focuses on **solutions**, not on documenting problems.
- IDAH$_2$O focuses on **results, not on regulation**.
- IDAH$_2$O is **flexible**, allowing local groups and individuals to design their own monitoring and action plans.
- IDAH$_2$O promotes **partnership** development and the sharing of information and resources throughout all levels in both public and private sectors.
- IDAH$_2$O utilizes trained adult volunteers who in turn can **mentor youth assistants**.
- IDAH$_2$O focuses on a **watershed approach**, integrating land use, stakeholders, and the waterbodies involved.
- IDAH$_2$O promotes **K–12 education partnerships** through teacher certification and student monitoring.

Getting involved

To become certified as an IDAH$_2$O Master Water Steward, you must complete the IDAH$_2$O Master Water Steward workshop. Upon completion of the workshop, you can decide whether or not to develop a monitoring plan and conduct assessments. All stewards, whether they are conducting monitoring or not, are invited to participate in program activities and educational opportunities.

IDAH$_2$O provides supervision, educational support, and resources to facilitate the work of the stewards. The IDAH$_2$O program also promotes and expects cooperation between volunteers and supporting agencies and organizations.

Benefits of being a Master Water Steward

IDAH$_2$O Master Water Stewards benefit in many ways:

- Improved understanding of the health and function of watershed ecosystems
- Increased skill in water quality monitoring
- Affiliation with an established monitoring effort
- Acquisition of resources to conduct water quality monitoring
- Improved understanding of local water quality concerns
- Opportunities to guide UI Extension water quality programs and publications as well as the direction of IDAH$_2$O

Expectations and opportunities

IDAH$_2$O Master Water Stewards are not water quality officials. Rather, they are volunteer water quality monitors and educators. Certified Master Water Stewards devote volunteer time to water quality monitoring and to educational efforts to inform the public of local water quality issues.

Master Water Stewards who commit to monitoring are expected to conduct regular monitoring at their chosen site(s), preferably wadable streams, although other waterbodies are also allowed. To continue being supplied with monitoring equipment, stewards must complete five monitoring activities each year and report their data to the IDAH$_2$O database.

Stewards are responsible for their own time and travel to conduct monitoring and education; however, they are equipped with the tools they need to conduct monitoring.

Potential volunteer opportunities for Master Water Stewards include:

- Water quality monitoring
- Assisting with total maximum daily load (TMDL) development by the Idaho Department of Environmental Quality by providing water quality data
- Teaching K–12 educators about IDAH$_2$O
- Assisting with youth involvement
- Marketing the program through outreach with other watershed groups
- Assisting with UI Extension programs, workshops, camps, and other educational events
- Coordinating with water quality management agencies to educate the public

- Participating in research efforts
- Writing articles to educate the public
- Identifying and writing grants to assist in the sustainability of the program
- Organizing community service projects

Training workshops

IDAH$_2$O certification workshops are 8 hours long, with 4 hours in the indoor classroom and 4 hours in the stream. At the workshop you will learn how to develop a monitoring plan. You will also be able to network with other people in your area who are concerned about water quality.

The workshop covers watershed investigations, the whys and how-tos of monitoring, water safety, and other topics related to water quality monitoring and includes hands-on field experience. Additional workshops may be available to help you continue developing your monitoring skills.

Workshops are scheduled in response to requests. To request a workshop, please email idah2o@uidaho.edu or contact the IDAH$_2$O project coordinator. Workshops are also posted at the IDAH$_2$O website: *www.uidaho.edu/cda/idah2o/workshops*

Publications

IDAH$_2$O supplies each trained monitor with this handbook, which contains background information about water quality and monitoring as well as step-by-step instructions on how to do water quality assessments. The handbook also refers to other useful resources, such as the *Streamkeeper's Field Guide*. For more information on this resource, or for information on how to obtain your own copy, please contact IDAH$_2$O. The quarterly IDAH$_2$O newsletter, *WaterWatch*, keeps volunteers up-to-date on the most current water quality topics.

Testing equipment and supplies

IDAH$_2$O provides Master Water Stewards and groups of stewards with the testing equipment and supplies necessary to do monitoring so long as they are actively monitoring and funding permits. Stewards who are no longer monitoring must return their equipment and supplies to the IDAH$_2$O program.

IDAH$_2$O also resupplies existing stewards throughout their involvement with the program so long as they meet program requirements and funding permits. See the appendix for IDAH$_2$O's resupply request form.

The IDAH$_2$O resupply policy aims to ensure the continued availability of monitoring materials and to provide justification for program expenditures. The IDAH$_2$O criteria for receiving additional monitoring equipment and supplies are as follows:

1. **To receive additional consumable IDAH$_2$O monitoring supplies** (CHEMets dissolved oxygen replacement supplies, Hach pH test strips, or Hach chloride titrators), you must at a minimum submit yearly to the IDAH$_2$O database:
   - One IDAH$_2$O habitat assessment
   - One IDAH$_2$O biological assessment
   - Three IDAH$_2$O chemical/physical assessments

   These data submittals will be calculated on the basis of one monitoring season, January 1 to December 31 of a given calendar year. Consumable monitoring supplies will also be provided upon request to replace expired supplies or to replenish supplies depleted during the course of the monitoring season.

2. **To receive additional nonconsumable supplies** due to breakage, loss, or expansion of a monitoring program, you must meet the above criteria and send a resupply form (see appendix) to the IDAH$_2$O program. Items may include transparency tubes, fiberglass tape measures, aquatic thermometers, and other items.

All supply requests will be handled under the sole discretion of IDAH$_2$O staff, and fulfilling your request may be contingent upon the availability of requested materials. The IDAH$_2$O program may discontinue this policy at any time, especially due to financial constraints.

Public database

Only Master Water Stewards can submit water monitoring data to the online database: *www.uidaho.edu/cda/idah2o/waterqualitydatabase.* Anyone can access and use the data.

IDAH$_2$O code of ethics

IDAH$_2$O Master Water Stewards carry out monitoring with integrity.

- Master Water Stewards use proper scientific methodology.
- Master Water Stewards fully document technical observations.
- Master Water Stewards accept the responsibility to report data.
- Master Water Stewards truthfully answer questions about sampling techniques, frequency, and location.
- Master Water Stewards make a good faith effort to include individuals with as many different interests and perspectives as possible in their monitoring program.

IDAH$_2$O Master Water Stewards develop good relations with private landowners:

- Master Water Stewards request written permission from the landowner if access to private property is necessary in the monitoring plan.
- When contacting the landowner, Master Water Stewards explain who they are, the purpose of their project, and the intended use of the data they collect.
- After receiving written permission, Master Water Stewards contact the landowners in advance to let them know the exact date(s) of sampling.
- Master Water Stewards do not harm private property.
- Master Water Stewards take complete responsibility for their personal safety while on private property.
- Master Water Stewards share their sampling data with landowners after review by the IDAH$_2$O coordinator.

IDAH$_2$O safety

The golden rule of water safety is to use common sense and ALWAYS consider your well-being as your first priority. Here are a few safety pointers:

- Always conduct monitoring with a "buddy" or team member, never alone.
- Always let someone know where you are going and how long you will be gone.
- Use caution when entering a stream, making sure you can get out, the current is not too strong, and the bottom will support you safely.
- Do not attempt to enter water if stream flow is too high. As a general rule, above your knees is probably too high.
- Always conduct monitoring during daylight hours.
- Wear waders or "river shoes" (old tennis shoes) to avoid cutting your feet on submerged glass, metal, or sharp rocks.
- Be aware of possible dangers, such as poisonous plants, unstable banks, wildlife, and livestock.
- Dress appropriately for the weather. Know how to recognize the signs and symptoms of both heat stroke and hypothermia and how to treat them. Most importantly, know how to prevent them.
- Wash up thoroughly with hot water and soap when you get home.
- If you are monitoring in areas with potential contamination, such as the Coeur d'Alene Basin, you may want to participate in additional safety training before getting into the stream.

Extensive safety training will be provided during the IDAH$_2$O Master Water Steward workshops.

photo by Steven Martine

2 WATER QUALITY IN IDAHO

Introduction

Idaho's surface water is a vital component of the state's heritage and economy. Water is used for recreating, drinking, irrigation, industrial processing, livestock watering, and providing aquatic habitat for plants and animals. Although thousands of people come to the state each year to enjoy Idaho's clear, cold-water streams, our streams are not without problems. Land-use practices over the last two centuries have dramatically changed the landscape and in turn have had an effect on surface water and the beneficial uses it serves. Citizen-based water quality monitoring can help both to identify those concerns and to formulate local solutions.

Water quality standards in the state of Idaho are based on the "designated beneficial use(s)" that a waterbody is intended to support. When a waterbody no longer supports its beneficial uses, it is determined to be impaired. Idaho's surface waters may have any combination of the following beneficial uses: aquatic life, recreation, water supply, wildlife habitat, and aesthetics.

A list of waterbodies that fail to fully support their beneficial uses or that exceed numeric water quality standards can be found in *Idaho's Integrated Report*. This biennial report lists all impaired waters (Clean Water Act 303(d) list) and the status of those waters (Clean Water Act 305(b) list). The most recent report can be found on the Idaho Department of Environmental Quality's website.

Pollution sources in Idaho

The most significant threat to Idaho's surface water today is nonpoint source pollution. This pollution does not come from a single point such as a factory; rather, it comes from diffuse sources throughout the watershed. Runoff from agricultural and natural resource land uses contributes sediment, nutrients, and pesticides to Idaho's surface waters. Runoff from construction sites, lawns, parking lots, and streets can contribute a smorgasbord of pollutants, including bacteria, heavy metals, nutrients, organic matter, pesticides, and silt. Sewage from combined sanitary and stormwater sewers plagues some communities that have outdated sewer lines or wastewater treatment plants.

Other land uses that affect water quality in Idaho include logging, forest roads, and mining. Logging, if not conducted using best management practices, can leave soil exposed and vulnerable to surface runoff. Mining has historically left behind an accumulation of heavy metals that has polluted both the soil and the water. Major clean-up efforts are underway to alleviate these effects; however, heavy metals continue to be a major concern in surface water.

Sediment

Soil erosion carries fine particles of dirt, called sediment, to our streams during runoff events (heavy rains or spring snow melts). Sediment also enters our streams from eroding streambanks. The rate of streambank erosion has increased in many streams as a result of land-use changes in the watershed. A reduction in vegetation increases soil erosion and water runoff, which increases sediment levels and stream flow. This in turn increases the speed of the water, and with minimal plant cover to retain the streambank soil, the streambed erodes even more. A stream that is eroding more sediment than it is depositing is called a degrading stream.

Sediment is carried by water until it settles to the bottom of a stream or lake (sedimentation). A stream that is depositing more sediment than it is eroding is called an aggrading stream. A small amount of sedimentation is natural; it has always happened, and always will. However, too much sediment is harmful to our lakes and streams.

As sediment settles out of the water column, it covers up stream and lake bottoms and harms the aquatic communities that live there. Many animals cannot feed and reproduce successfully because sediment clogs their gills, smothers their eggs, and destroys their food supplies and habitat.

Soil suspended in the water reduces light penetration, thereby reducing photosynthesis and slowing the growth of aquatic plants. This means less food and oxygen are available for aquatic wildlife.

Another way that sediment pollution can harm streams is by changing the types of habitat available. When sediment builds up in the bottom of streams it fills in pools, riffles, and runs and changes the shape of the streambed. Habitat is lost as sediment fills in the spaces between rocks and other streambed substrates, increasing substrate embeddedness. As these streams get shallower, they tend to widen, warm, and slow down. This results in lower dissolved oxygen levels (warm water holds less oxygen than cool water) and more streambank erosion.

Nutrients

Nutrients such as nitrogen and phosphorus are essential to plant growth. On agricultural fields, they are necessary elements for crop production. In our waters, however, excessive nutrients contribute to overproduction of algae, which can give the water a greenish hue and sometimes a foul odor.

Nutrient enrichment can start a chain of events during which the algal population explodes (called an algal bloom). When the algae die, the bacteria that decompose them deplete the water of oxygen, causing a condition called hypoxia (low oxygen). This can cause severe problems for fish and other aquatic animals and even kill them. Hypoxia, to some extent, occurs every year within many of our medium-sized lakes and slow-moving rivers.

Runoff of sediment, nutrients, and other nonpoint pollutants can be reduced through implementation of best management practices (BMPs). These practices include the construction of conservation buffers between agricultural fields and streams.

In urban areas, water runs off lawns, golf courses, streets, and parking lots. Many people believe that this runoff water is treated in a sewage treatment plant before entering a stream. To the contrary, however, most of this runoff empties directly into streams without undergoing any water treatment whatsoever. Overuse of fertilizers, dumping of contaminants, and even excessive grass clippings can contribute to water quality problems.

photo courtesy IDAH$_2$O

photo courtesy IDAH$_2$O

Temperature

Water temperature has a profound effect on organisms that live or reproduce in the water. This is particularly true of Idaho's native coldwater fish such as salmon, bull trout, westslope cutthroat trout, steelhead, and some amphibians (frogs and salamanders). When water temperature becomes too high, salmon and trout suffer a variety of ill effects ranging from decreased spawning success, to increased susceptibility to disease and toxins, to death. Water temperature also affects the toxicity of ammonia and perhaps other toxic substances.

Temperature increases often occur in systems that have had substantial removal of natural riparian vegetation—the vegetation along and adjacent to the waterbody. Without the shading of trees, stream and river channel temperatures can rise to dangerous levels through exposure to the solar radiation of the sun. Higher temperatures effectively reduce oxygen levels. Re-establishing riparian vegetation will ensure stream temperatures maintain habitable levels.

Bacteria

Bacteria are measured to determine the relative risk of swimming in a waterbody ("contact recreation"). These bacteria originate in the wastes of warm-blooded animals. Their presence indicates that pathogens from these wastes may be reaching the body of water from inadequately treated sewage, improperly managed livestock waste, pets in urban areas, aquatic birds and mammals, or failing septic systems.

Although some bacteria from wildlife that inhabit the riparian corridor are naturally occurring, excessive loads from livestock and human waste are often what cause high spikes in bacteria counts and make the surface water unusable for contact recreation. Minimizing human-induced loads (septic or livestock) to the stream is the best way to reduce this risk.

photo by Steven Martine

3 GETTING STARTED

The why—Your goals and objectives

So you've attended an IDAH$_2$O workshop and know how to gather, record, and report data about water quality. Now, how do you go about setting up and maintaining a water monitoring plan?

Monitoring is a long-term commitment. To be successful, it requires forethought and planning. First, you need to ask yourself some questions:

- Why do I want to monitor water?
- What do I plan to do with the information I gather?
- Who should I involve in the review of my goals and objectives?

Your answers to these questions can help you establish your overall goals. The major steps you need to take to accomplish each goal are your objectives. Objectives must be measurable and capable of being accomplished within a given time period. Think these out carefully because they will determine the entire setup of your monitoring program.

Example #1

Goal: *I want to monitor the creek behind my house to make sure it's safe for my children to play in. I plan to watch the trends from my monitoring to see if my creek is getting worse, better, or staying the same. I'm also going to report my data to the IDAH$_2$O database to contribute to the health of the environment.*

Objectives:

1. I plan to do a habitat assessment once a year, in June.
2. I plan to do two biological assessments a year, once in May and once in August.
3. I plan to do a physical/chemical assessment around the 1st of each month.
4. I'm going to watch trends in my data as I do the monitoring and graph my yearly data to compare it with the previous year's data. I'll do this sometime in October when things slow down around here a little bit.
5. I plan on entering my data into the IDAH$_2$O database right after each assessment.

Example #2

Goal: *I am concerned that some land-use practices upstream of my favorite fishing spot on Jack Creek are hurting the fish. I want to make sure the water quality remains high, and I plan to pay special attention to dissolved oxygen, which the fish need to survive. I plan to submit my data to the IDAH$_2$O database and report any unusually low dissolved oxygen levels to the local Idaho Department of Fish and Game office and ask their advice.*

Objectives:

1. I'm going to do a habitat assessment as soon as ice-out in the spring and again during the year if there is a major land use change upstream.
2. I'm going to do three biological assessments per year: one as soon as ice-out in the spring, one about mid-summer, and one in the fall.
3. I plan to do a complete chemical/physical assessment the same time I do the biological assessment. I also plan to test for dissolved oxygen about every time I go out fishing (which hopefully will be about once every 2 weeks).
4. I plan to submit all my data to the IDAH$_2$O database in the fall. If I have spare time during the "season," I'll be fishing!
5. I plan to graph my dissolved oxygen data with a few other parameters and see if I can see any trends in the data.

Example #3

Goal: *As a teacher, my goal is to educate students about the basic procedures used to gather information about water quality and compare two watersheds (the land area that drains to a waterbody). I plan to have the students analyze land-use practices within the two watersheds and make inferences about differences in water quality data from these analyses.*

Objectives:

1. Locate two watersheds of different size, topography, and/or land use.
2. Locate monitoring sites along two similar streams within these watersheds.
3. Map land use in each of the two watersheds.
4. Conduct habitat, biological, and chemical/physical assessments once in the fall and once in the spring of each year.
5. Enter data into a database and generate summary statistics and graphs of the data the week following each monitoring session.
6. Have students input all data into the IDAH$_2$O database.
7. Work with our communications class to incorporate annual findings into a local news release.

Be sure to review and refine your program goals and objectives over time! A program can easily stagnate or even die if you meet your original goals and objectives and establish no new ones.

The what—Your monitoring parameters

What do you want to monitor? Based on your goals and objectives, you now need to decide which water quality parameters you will include in your monitoring plan. The following chapters describe the parameters the IDAH$_2$O program uses and the information each one provides. The IDAH$_2$O program chose these parameters based on:

- Scientific value
- Ease of doing tests in the field
- Low cost
- Safety
- Relevance to local water quality issues

IDAH$_2$O groups parameters into three assessments: habitat, biological, and chemical/physical, each with an associated data form for use in the field. You can collect most of the data for these assessments in the field, but some parameters require laboratory analysis.

Parameters requiring laboratory analysis include nitrate-nitrogen, total phosphorus, and bacteria. Because of the high cost of these analyses, water sampling for these parameters will occur only during scheduled "snapshot" events. A snapshot event ensures timely and efficient processing of your water samples. You will be notified and given the correct sampling equipment when a snapshot event occurs.

The where—Your monitoring sites

You are encouraged to choose your own monitoring sites. It is best to select a site close to home that you will be able to access readily. You may also want to monitor a site that has personal meaning to you, such as your favorite kayaking stream or fishing hole. Try avoiding a site that requires a lot of driving or is difficult for you to access because of its physical conditions. A convenient site is a monitored site.

Once you have determined the site(s) you will be monitoring, you need to submit coordinates of the locations to the IDAH$_2$O program so the data can be tracked spatially. If you need assistance locating a monitoring site that will best accomplish your goals and objectives, contact IDAH$_2$O for guidance. For information on choosing a monitoring site in a lake or pond site, contact IDAH$_2$O staff.

Follow these monitoring site selection guidelines:

- Before monitoring on private land, obtain written permission and keep the landowner informed.
- Choose a monitoring site that is representative of your stream. In other words, do your best to locate a monitoring site that best represents the characteristics of your stream.
- If possible, establish your site away from manmade structures such as bridges, which can provide 100% canopy cover all of the time and are not representative of the stream. If you are restricted to the right-of-way, however, monitoring at a bridge would be adequate.
- If you are monitoring at a bridge crossing, IDAH$_2$O recommends that you sample from the upstream side of the bridge. If safety issues and/or landowner considerations exist on the upstream side, err on the side of safety, respect private lands, and monitor on the downstream side of the bridge.
- Always monitor from the stream, if possible. If safety, weather, stream discharge, accessibility issues, time constraints, or other such conditions prevent you from obtaining water samples directly from the stream or lake itself, you may collect water samples using an IDAH$_2$O-approved sampling device (see appendix III).
- Perennial streams may dry up in exceptionally dry years, leaving little to no water or flow and in some cases only pools of water. Likewise, intermittent streams may dry up every year yet retain enough water to maintain perennially pooled conditions. If your transect is dry, you can monitor the nearest pool (for chemical assessment) or all the pools in the stream reach (for biological assessment), but please note the conditions in the notes section of your field forms and take a photograph, if possible.

The how—Taking samples

For instructions on using the IDAH$_2$O equipment and for sampling methodologies for specific parameters, refer to the appropriate chapters in this handbook.

The when—Monitoring frequency

When and how often are you going to monitor? Monitoring once represents a snapshot in time. To truly “know” a waterbody, you will need to monitor several times over the course of several years. Some things to consider:

- Time of year—Will you test all year or during a “season” (planting, fishing, summer when children are playing in the stream, etc.)?
- Frequency—Do you need to monitor weekly, monthly, quarterly, etc.?
- Time of day—Try to monitor the same time each day, preferably midday, although this may vary. For example, the lowest dissolved oxygen levels occur at dawn. Therefore, if dissolved oxygen levels are a concern, perhaps you need to sample early in the morning.
- Weather conditions—Rain can dramatically affect water quality. Perhaps you need this “snapshot” in time for your monitoring plan. On the other hand, rain causes increased streamflow, making monitoring physically dangerous. Never put yourself in danger to monitor water. Rather than monitor immediately after a rain, monitor a day or so later, or sample from a bridge or streambank for safety.

Suggested sampling schedule:

- Habitat assessment—Yearly unless significant changes occur
- Physical/Chemical assessment—Monthly when you are able and safe conditions exist
- Biological assessment—Low-flow conditions
- Bacteria—Seasonal snapshot (spring and fall)
- Nutrients (nitrate-N and total phosphorus)—Seasonal snapshot (spring and fall)

The who—The monitoring team

Who will do what? People come to an IDAH$_2$O workshop with different ideas of their "team." Some come to IDAH$_2$O as individuals, some in families, some as part of an established monitoring group, and some in hopes of starting a monitoring team. Monitoring as an individual or family is fine, although there are some definite advantages to working as part of a larger group. For this reason, IDAH$_2$O targets established watershed groups. Having more people involved increases the credibility of your data, lessens the monitoring load, is safer (IDAH$_2$O always recommends at least two people go out monitoring), and you'll have more fun!


photo by Lisa Kyle Young

4 GETTING TO KNOW YOUR WATERSHED

What is a watershed?

Before highways, post office boxes, and counties, people didn't have mailing addresses; they had "watershed addresses." A watershed, literally defined, is the area of land that drains into a body of water such as a lake, river, or stream (figure 4.1). To truly know your waterway, and to discover how to plan your monitoring, you need to learn your own watershed address.

Water quality is a direct reflection of the surrounding watershed. Our actions on the land are directly reflected in our streams, rivers, and lakes. If we manage our watersheds wisely, we can protect, preserve, and enjoy our aquatic resources forever.

Hydrologic unit codes (HUCs)

Scientists use watershed identification numbers, called hydrologic unit codes (HUCs), to describe the different scales of watersheds and identify specific watersheds. HUCs are the contemporary form of the watershed address and can be useful in identifying which watershed you want to consider as you plan your monitoring.

Within the HUC system, the United States is divided and subdivided into successively smaller watersheds or basins. As the watersheds get smaller, the descriptive and unique HUC numbers get larger. Idaho can be divided into 8-digit HUC, 10-digit HUC, and 12-digit HUC basins (figure 4.2). The focus of most of IDAH$_2$O stream monitoring sites is typically at the 12-digit HUC, termed the subwatershed level.

Driving tour of your watershed

With your watershed map in hand, you are ready to "hit the road." Taking the time to familiarize yourself with your watershed will be time well spent as you begin your monitoring program. Doing this at the onset of your project will give you a firm sense of what factors in your watershed may impact water quality.

You should have at least two people in the car—one to drive safely and one to mark your map and take notes. It is helpful to go during a time of day when there is not a lot of traffic. Take your tour in daylight, so you don't miss structures that may not be visible at night.

What should you be looking for and jotting down? The answer is ANYTHING that may affect your waterbody. Here's a list of a few things to pay attention to:

- Livestock—How many buildings housing livestock? What kind of livestock? How many animals? Do you see any drainage ditches or waste lagoons?

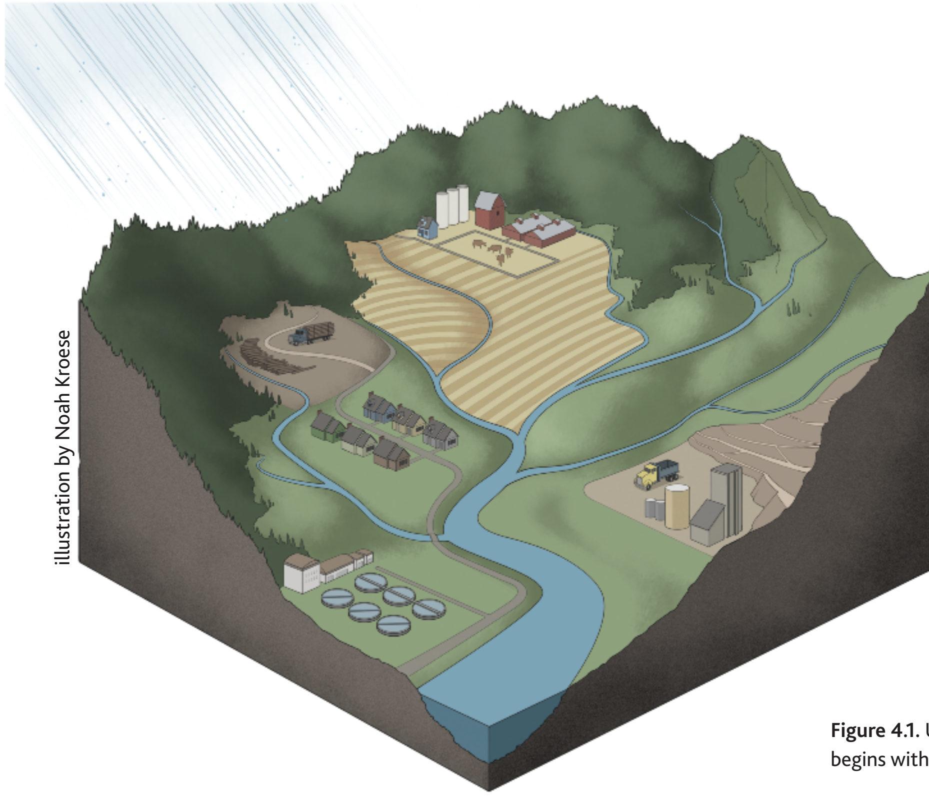

Figure 4.1. Understanding local water quality begins with understanding your watershed.

- Golf courses—How large are they? Do they have streams or drainage ditches? Are there buffers along these waterways? Any ponds?
- City, county, or state parks—How much mowed area is there? Are there areas of heavy pet use near waterways?
- Row crops—Is there evidence of good conservation practices such as grassed waterways, terraces, contour cropping, or others? Are streams lined with conservation buffers or is the crop growing to the water's edge?
- Residential areas—Can you pinpoint where storm sewers enter streams? Do you see construction sites? Do construction sites have erosion control measures in place? Are trees being planted along waterways? Where does the sewer district discharge, or are most houses on private septic systems?
- Retail or industrial areas—Does drainage from parking areas enter a stream or a storm sewer system that connects to a stream? Where does the sewer district discharge? Are power plants or factories discharging warm water from their cooling systems? Do you see piles of "unidentified" barrels or waste tires?
- Other types of land use—What potential impacts do they pose? Are there any conservation practices in place?
- Roads—Do you see stream crossings or culverts? How close to streams are the roads? Culverts can prevent fish passage or contribute to the overall sediment load if improperly installed. Check above and below the culvert for eroding areas. Some culverts that look properly installed can be velocity barriers to fish because of their slope.

This list is not complete by any means. Also, you need not answer every question. The questions are meant only to start you down the road to considering what is in your watershed and what may impact its water quality.

The information collected during your driving tour is for your use only. Collecting this information is especially important at the beginning of your monitoring effort. Annual updates may be useful.

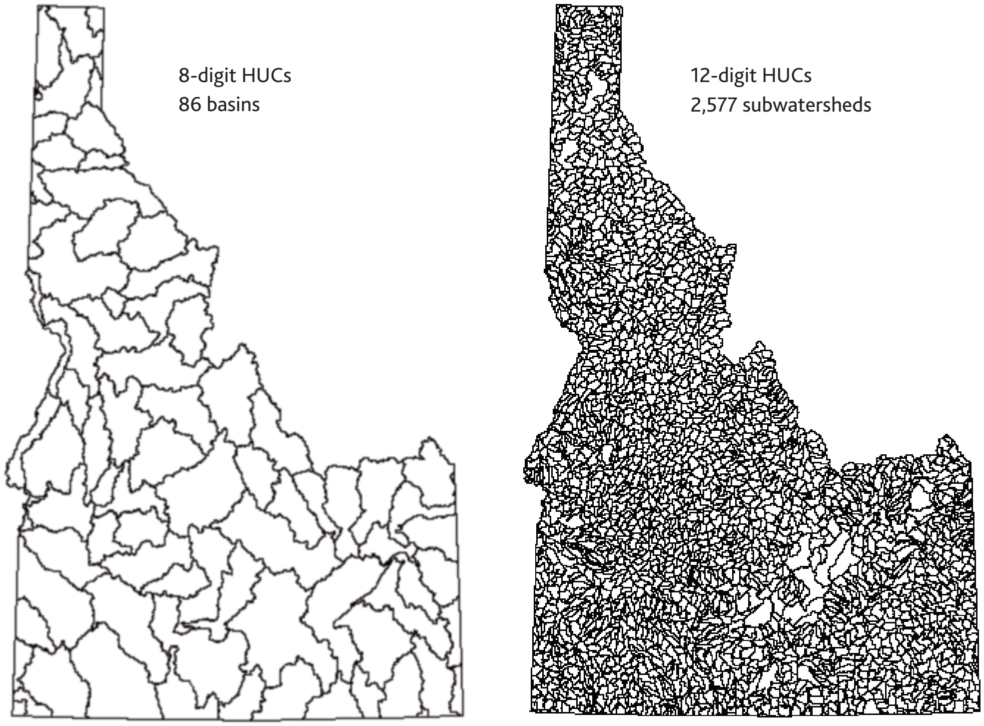

Figure 4.2. Idaho watersheds can be delineated at various levels, described by 8-digit and 12-digit hydrologic unit codes (HUCs).

Virtual tour of your watershed

You can learn a lot about your watershed without ever leaving home. Check out these websites for more information on your watershed:

- www.epa.gov
- www.usgs.gov
- www.noaa.gov
- www.deq.idaho.gov
- www.idwr.idaho.gov
- Websites of local watershed groups/coalitions

Perennial and intermittent streams

Idaho has many waterbodies, ranging from large rivers, lakes, and wetlands to a vast network of small streams. Waterbodies do not need to be large to support aquatic life, nor do streams need flowing water throughout the year to support plants and animals.

Stream segments are classified as either "perennial" or "intermittent" based primarily on their flow regimes. Perennial streams have water nearly all of the time, while intermittent streams tend to dry up on an annual basis.

A perennial stream can be defined as a body of water flowing in a natural or human-made channel year-round, except during periods of drought. Lakes and ponds that form the source of a perennial stream or through which a perennial stream flows are all characteristics of the stream. Generally, the water table is located above the streambed of perennial streams for most of the year and groundwater is the primary source of water for stream flow.

In the absence of pollution or other human disturbances, a perennial stream is capable of supporting a variety of aquatic life. A stream that contains normal flow during the dry period is likely to be a perennial stream assuming normal precipitation conditions.

Intermittent streams contain flowing water for only part of the year. During the dry season and periods of drought, streamflow ceases and the streambed may be completely dry.

The flow of intermittent streams is influenced by many factors, both natural and human-made.

The stream may be located above the water table and therefore lack the continuous presence of groundwater that provides flow within perennial streams. Human modifications to the stream channel or the watershed may also disrupt flow. Intermittent streams normally contain a low diversity of aquatic organisms, and those present can tolerate the constantly fluctuating conditions.

The dry season, July through September, is the ideal time to observe low-flow conditions. A stream that has no flow during the dry season is likely to be an intermittent stream section assuming that there was normal rainfall throughout the year.

Intermittent streams may be particularly important as nursery areas for fish and amphibians because they support fewer predators than perennial streams. Some species may be reared in the intermittent channels and then move downstream when they grow large enough to protect themselves. Because intermittent channels form a high proportion of the streams in a watershed, they can strongly influence downstream ecosystems through the input of sediment, water, woody debris, and nutrients.

One of the problems that we face as a state is a lack of data on many of our stream miles. Data gathered by Master Water Stewards help fill the gaps. With more and better information on these smaller, headwater, and oftentimes intermittent streams, the state can more accurately assess the status of our waters and move forward with field methodologies and protocols that will help ensure healthy aquatic systems well into the future.

photo by Steven Martine

5 HABITAT ASSESSMENT

Introduction

Making a habitat assessment is an important step in tracking changes within a stream over time. Habitat assessments take inventory of the availability and condition of both stream and riparian habitats for aquatic and terrestrial organisms. A healthy stream should support life in and around the channel.

Changes that take place slowly have a way of escaping our attention until the changes are dramatic in scope. How many of us remember our grandparents or other elders saying, “I remember what this stream looked like when I was a kid”? Even though these accounts are useful and entertaining, proper management of natural resources takes solid data and observations to document what’s going on within a natural system. Even with this documentation, it’s still difficult to determine cause and effect within a complex natural system.

Habitat assessments need to be conducted just once a year, unless there is some significant change in land use that may affect stream characteristics in a very short period of time. Examples might be stream channelization, a large industrial or housing development that gets built in a short period of time, or a catastrophic natural event such as a flood. In such cases, a second habitat assessment would be valuable. Biological impairment usually stems from poor habitat conditions.

When conducting your assessment, use the habitat assessment field form located at the end of this chapter and online at the IDAH$_2$O website. This chapter describes the various kinds of data you’ll collect while performing the habitat assessment.

Stream transect and stream reach

IDAH$_2$O habitat assessments are conducted at two physical locations within the stream, the stream transect and the stream reach. A stream transect is the exact cross-section of the stream where you are going to monitor (figure 5.1). This is the location you want your site coordinates to pinpoint.

A stream reach is defined as one set of pool, riffle, and run habitats (figure 5.2). However, pool, riffle, and run habitats may not be present at all monitoring sites. In this case, you should define your stream reach as a set distance (e.g., 25 meters upstream and 25 meters downstream) from your transect. The level at which you make observations or measurements is outlined in the reporting technique section for each parameter.

Stream habitat types

A variety of habitats within a stream usually enhances the diversity of aquatic life that you find there. Stream habitats are divided into four main types: pools, riffles, runs, and glides (figure 5.3).

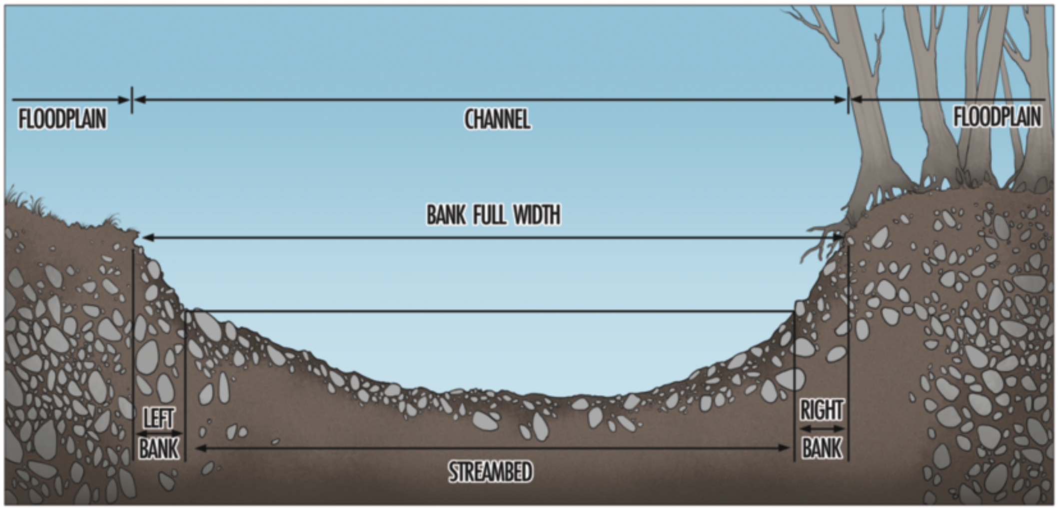

illustration by Noah Kroese

Figure 5.1. Many IDAH$_2$O assessments occur at your stream transect, or the imaginary line that runs across your stream from left bank to right bank and that includes the channels, stream bottom, and banks.

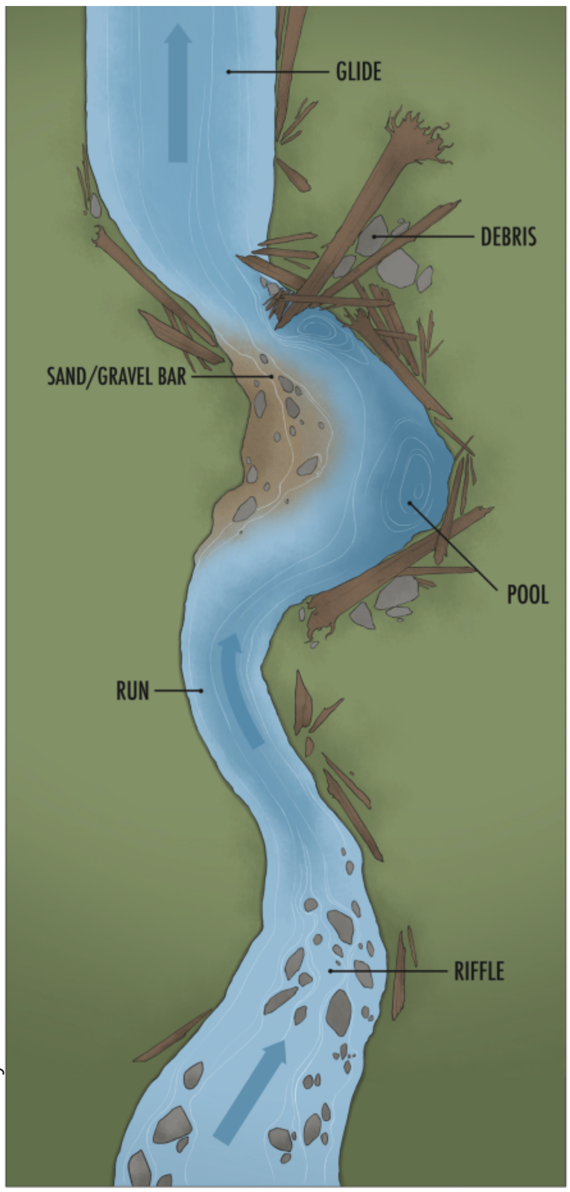

illustration by Noah Kroese

Healthy streams show alternating pools and riffles, while lower-quality streams generally consist of long, continuous runs.

A pool has a relatively slow current and is usually found at stream channel bends, upstream of riffles, and on the downstream sides of obstructions such as boulders or fallen trees. The stream bottom in a pool is often bowl-shaped and serves as excellent habitat for fish.

A riffle is an area of the stream that has a swift current and water that is normally “bubbling” due to a rocky streambed. The water in this habitat type has relatively high dissolved oxygen levels from tumbling over and around the rocks. Riffles typically have high numbers of invertebrates and the small fish that feed on them.

A run has a moderate current, medium depth, and smooth water surface. Runs can have diverse mixtures of aquatic life, depending on the quality and quantity of the in-stream habitat (boulders, logs, root wads, etc.).

A glide has smooth, “laminar” flow. It is similar to a pool but shallower and with slightly greater stream velocity. The water surface gradient is near zero. Glides are often found in stream reaches without any pools.

9 REPORTING TECHNIQUE

Stream habitat type
Check the habitat type that best describes your stream transect.

Figure 5.2. Some IDAH$_2$O assessments occur along your stream reach—a pool, riffle, run sequence near your stream transect. If you do not have these habitat types near your transect, establish a set distance upstream and downstream from your transect that you will monitor as your reach.

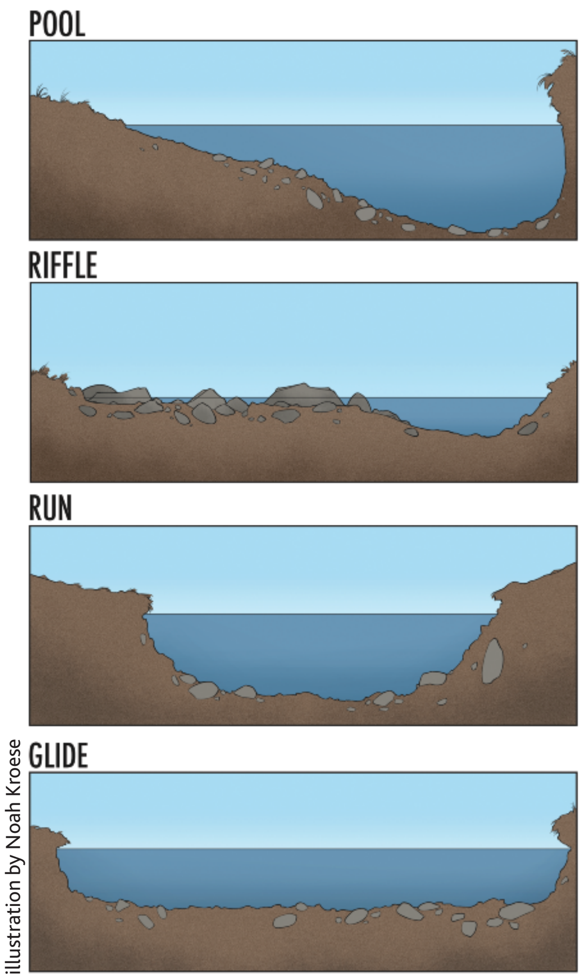

Figure 5.3. Diversity in stream habitat types is very important in healthy stream systems. Habitat types consist of pools, riffles, runs, and possibly glides.

Streambed substrate

The characteristics of the stream bottom are very important to habitat quality and the type of aquatic life you find there. In general, a shifting sand or silt streambed will not support as diverse a population as more stable streambeds consisting of gravel, cobble, boulders, or fallen trees.

What a streambed is made up of is called the substrate. IDAH$_2$O uses the Wolman pebble count technique to assess substrate (figure 5.4). Although natural geology is responsible for the original substrate of Idaho streams, human activities in the watershed, such as those that increase soil erosion rates, can produce sand or silt that cover the existing substrate.

9 REPORTING TECHNIQUE

Wolman pebble count

At your stream transect, perform a Wolman pebble count:

1. At your transect, start at the edge of your left bank and take one step into the water perpendicular to the flow and, while averting your eyes, pick up the first pebble touching your index finger next to your big toe. In this context, "pebble" means any rocky material from silt and clay particles to large boulders.

2. Measure and record the B-axis (figure 5.4) with the Wolmanator Ruler. Make certain to record your counts in the "in wetted" or "out wetted" columns, depending on if the pebble was in the water or out of the water, respectively. For embedded pebbles or those that are too large to move, measure the shortest axis visible.

3. Discard the pebble downstream so that it is not counted again.

4. Moving across the transect step by step, repeat steps 1–3 until you reach the edge of the right bank.

5. Establish a new transect just upstream from your last and begin the process over again. If your stream reach is relatively narrow (< 2 m), you can modify the method by walking upstream in a zigzag pattern instead of perpendicular to flow. In general, you will need to collect 50 measurements in order to accurately quantify pebble distributions, however, always finish any transect you start.

6. Noting the shine of the substrate can help determine if the substrate moves during periods of bankful discharge. A dull substrate may indicate more bedload than the stream can move and process (aggradation) or show that bankful flows were not reached.

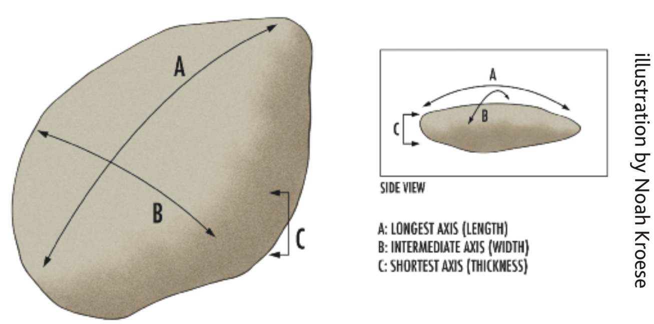

Figure 5.4. In a Wolman pebble count you will always measure the B-axis of pebbles, which is the mid-length axis.

Embeddedness

Embeddedness is the measure of how cemented the streambed substrate has become through the sedimentation of fine particles within the gravel, cobble, boulders, and other substrate material. Embeddedness reduces biodiversity by destroying aquatic habitat. Fish and invertebrates need spaces between rocks where they can hide from predators, lay their eggs, and feed upon their favorite foods.

> 9 REPORTING TECHNIQUE
>
> **Embeddedness**
> Along your stream transect, try manually to move or shift the substrate. Record embeddedness as a percentage. An inability to move the substrate corresponds to 100% embeddedness. Substrate that contains free space between all particles would have 0% embeddedness.

Streambanks

You can tell much about the stream's long-term stability and about the aquatic life it can support by looking at the shape and condition of its banks. Are the streambanks high, crumbling walls or gently sloping banks with grass, shrubs, and trees growing on them? All streams and rivers move within their floodplains, but a mature, stable stream will not move very rapidly. A stable bank is a sign of a stable stream.

Bank sloughing, cut banks (banks that are actively eroding), and high-walled banks without trees or other soil-holding plants are signs of bank instability and poor physical condition resulting in poor biological condition. Streambanks are an important source of sediment and nutrients, but when streambank erosion increases beyond the stream's ability to assimilate the sediment, streambank erosion will result in negative impacts to aquatic life.

A sloping bank covered with vegetation is more stable and indicates a healthier watershed. Not only do gently sloping banks offer better habitats for wildlife near the water's edge, they work to slow and filter watershed runoff.

So what determines whether a stream's bank is stable? Factors that can impact the stability of streambanks include:

- Channelization—Stream straightening means water moves faster so the stream can have extremely high flow at certain times during the year, often producing cut banks.
- Soil types—The type of soil that the stream channel is cutting through will affect bank appearance. A stream cutting through soft loamy soil tends to produce eroding cut banks. A more stable soil such as clay usually will result in more stable slopes.
- Vegetation—A community of native wetland plants such as willow thickets at the water's edge will prevent or slow bank erosion, whereas growing row crops or harvesting timber to the edge of a stream will increase erosion.
- Livestock—Cattle are one of the most erosive forces along streambanks, especially along "cow paths" or watering places.
- Road culverts or drainage tiles—Outlets can cause erosion if not properly positioned and installed.

> 9 REPORTING TECHNIQUE
>
> **Streambank characteristics**
> Record the characteristics of both left and right streambanks as you face upstream at your site's stream transect.

photo courtesy IDAH$_2$O

Channel shape

Channel shape is the angle formed by the downward sloping streambank and the stream channel bottom. Fish often congregate near the streambank for the cover it provides. If the bank has been cut away and moved back from the water column, valuable rearing habitat has been lost. Various land uses can change stream morphology.

9 REPORTING TECHNIQUE

Channel shape
At your stream transect, record the channel shape of both left and right streambanks as you face upstream. Choose from among trapezoidal /_\, rectangular |_|, and inverse trapezoidal _/.

Streambank condition

Streambanks are the portions of the stream channel that are the most susceptible to erosion. They are important transition zones between terrestrial and aquatic life. Banks in good condition are well vegetated, stabilized by deep root systems, and provide excellent aquatic habitat. Eroding streambanks are likely to have very little vegetation and easily fall to flow-related erosion. Human disturbances in and around the riparian corridor heavily influence streambank condition. Poor streambanks increase sediment load to the channel and allow more solar radiation to reach the water.

9 REPORTING TECHNIQUE

Streambank condition
At your stream transect, record the condition of both left and right streambanks. For each streambank, choose one of the following descriptions:

- covered, stable
- uncovered, stable
- covered, unstable
- uncovered, unstable

photo courtesy IDAH$_2$O

Canopy cover

Canopy cover influences the amount of light that can filter through overhead vegetation before reaching the stream. It is the vegetation (tree branches, leaves, grasses, etc.) that hangs over the stream. Like clouds in the atmosphere, canopy cover can help protect the stream from extreme fluctuations in water temperature. Vegetation is also important for streambank stabilization and the aquatic food web.

If the canopy of vegetation over a stream is reduced or eliminated, the health of the stream suffers. Elevated water temperatures resulting from solar heating may directly affect aquatic life. Warm water holds less dissolved oxygen than cold water, and thus less oxygen is available in warm water for fish and other aquatic life. Without a good canopy cover, a stream's water temperature can fluctuate greatly and stress aquatic communities.

9 REPORTING TECHNIQUE

Canopy cover
At your stream transect, estimate what percentage of the area above the stream is covered by tree branches, leaves, and/or grasses. Make your best estimate of canopy cover in 25% increments.

Riparian zone

The stream's riparian zone is the area of land directly adjacent to the stream. A healthy riparian area consists of trees, shrubs, and/or grasses (figure 5.5). This zone is extremely important to the health and protection of the stream. Trees help stabilize the bank during flood events and may provide habitat for both aquatic and terrestrial organisms. Shrubs, grasses, and other plants can slow and filter runoff water before it enters the stream.

9 REPORTING TECHNIQUE

Riparian zone width and plant cover

Measure each of the following at the stream transect:

- Riparian zone width—Facing upstream, estimate the width of the riparian zones along the left and right banks in increments of 0–5 meters, 5–25 meters, and more than 25 meters. Utilize the vegetation to assist you in determining the width of the riparian zone.
- Riparian zone plant cover—Facing upstream, estimate the percentage of plant cover (trees, shrubs, grass/low plants, other) in the left- and right-bank riparian zones. The percentages of each bank should add up to 100%.

Stream sinuosity

Sinuosity is a measure of the stream channel's tendency to meander back and forth within the stream valley. Strictly speaking, sinuosity is the ratio of the channel length between two points in a channel and the straight line distance between the same two points. Describing the sinuosity of the stream reach as low, moderate, high, or braided does not necessarily mean that the entire stream has that level of sinuosity but that the portion of the stream being monitored can be viewed in this way.

Stream channels with low sinuosity are relatively straight with few bends or meanders. Stream channels with moderate sinuosity have few bends greater than 90 degrees. A high sinuosity rating is for streams with a significant number of bends and meanders that make a greater than 90-degree curve. Braided channels are divided into several smaller channels, typically due to an accumulation of deposits within the bankfull channel (figure 5.6).

9 REPORTING TECHNIQUE

Stream sinuosity

Record the sinuosity of your stream reach as low, moderate, high, or braided.

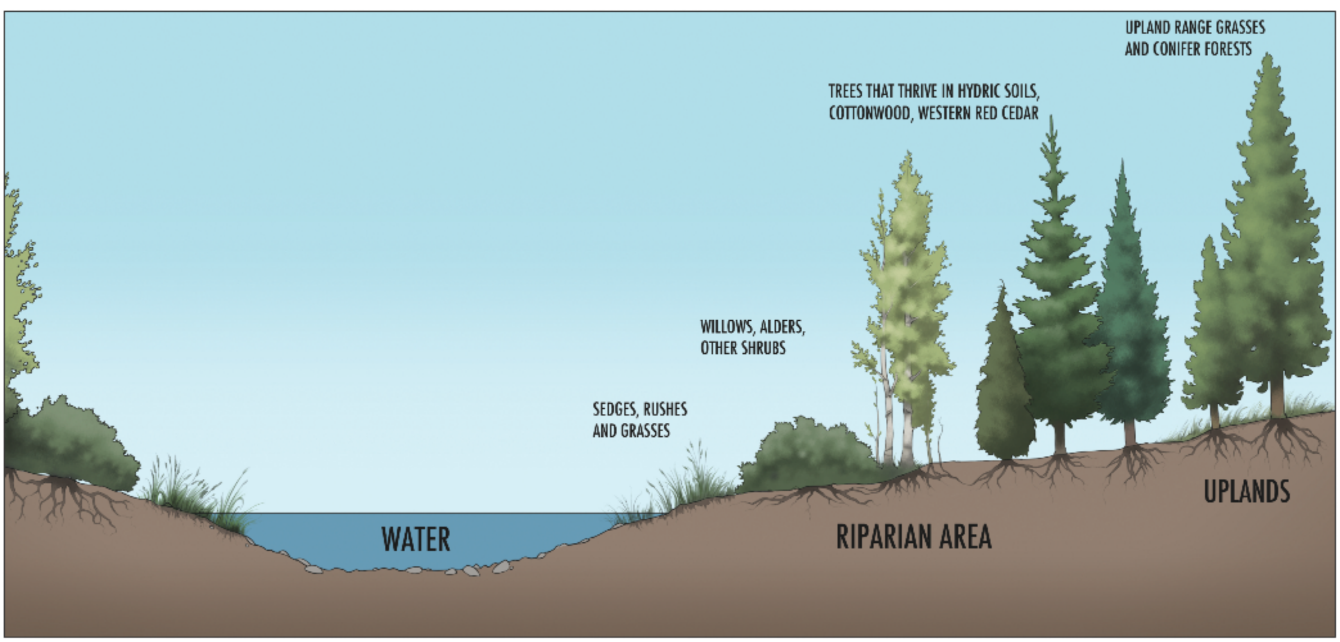

illustration by Noah Kroese

Figure 5.5. A healthy riparian area will equate to a healthy stream. Diverse vegetation throughout this area helps stabilize soil, filter runoff, and shade the stream, which promotes cold-water aquatic life.

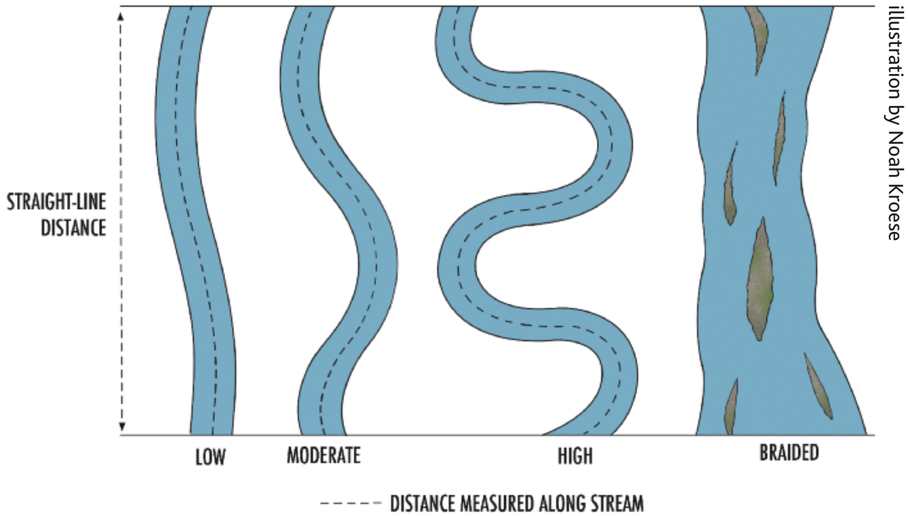

Figure 5.6. Stream sinuosity is a measurement of how curvy or sinuous the stream channel is. It is the ratio of the actual length of the channel between two points to the straight-line distance between those two points. For this assessment, simply categorize your stream reach sinuosity as high, medium, low, or braided—indicating multiple channels.

Microhabitats

Smaller habitat areas, called microhabitats, exist within the larger stream habitat types (pool, riffle, run, and glide). These microhabitats consist of algae mats, leaf packs, logjams, rock piles, root wads, undercut banks, fallen trees, weed beds, and large rocks. Microhabitats ensure stream diversity by supporting a variety of aquatic life.

> 9 REPORTING TECHNIQUE
>
> **Microhabitats**
> Record all of the different types of microhabitats that you see in your stream reach. Describe them as well as possible.

Land use

The land use adjacent to the stream and riparian zone is also very important to document. Feedlots, wastewater treatment facilities, or city storm sewers can be sources of nutrients to nearby waters. Other important influences could include golf courses, roadways, parking lots, construction zones, dump sites, airports, and state or federally protected natural areas.

It is important to document any land use in the watershed that might influence water quality, especially those that exist in close proximity to your stream reach. Additionally, documenting human use, or even evidence of human use, can help illustrate our physical connections to our aquatic resources.

> 9 REPORTING TECHNIQUE
>
> **Adjacent land use, human use, and evidence of human use**
> Check all those that apply along the stream reach:
>
> - Adjacent land-use—Check all land uses in the area adjacent to the riparian zones. Record all other land-use practices that could affect the stream.
> - Human use activities—Check all activities you've either witnessed or participated in at this site.
> - Evidence of human use—If there's any evidence of others using the stream, check all uses that apply.

Photographs

As the adage goes, a picture is worth a thousand words. Photographic documentation of habitat conditions along your stream reach may prove to be extremely useful for tracking changes over time. Be sure to use landmarks to identify specific locations so you can compare images from year to year. The more pictures, the better!

University of Idaho Extension

IDAH2O MASTER WATER STEWARDS

Habitat Assessment

Recommended frequency—yearly

Photographic documentation is recommended and strongly encouraged

Date ____________ Time _________ IDAH$_2$O monitor # ___________ Site number _____________

# of adults (including you)__________ # under 18__________________

Other volunteers involved ____

____

Site description ____

____

Was the stream dry when it was monitored? _____Yes _____No

Stream habitat type (*at transect; check one*): _____Pool _____Riffle _____Run _____Glide

Wolman pebble count (*at transect*)

Size class	Dimension	In wetted	Out wetted
Silt/Clay	0—1 mm	________	________
Sand	1.1—2.5 mm	________	________
Very fine pebble	2.51—6 mm	________	________
Pebble	6.1—15 mm	________	________
Coarse pebble	15.1—31 mm	________	________
Very coarse pebble	31.1—64 mm	________	________
Small cobble	64.1—128 mm	________	________
Large cobble	128.1—256 mm	________	________
Small boulder	256.1—512 mm	________	________
Medium boulder	512.1—1024 mm	________	________
Large boulder	1024 mm and larger	________	________
TOTAL		________	________

Embeddedness (%):___________%

Streambank characteristics (*facing upstream at transect; check all that apply*)

Left bank	Right bank
______ Cut bank—eroding	_______ Cut bank—eroding
______ Cut bank—vegetated	_______ Cut bank—vegetated
______ Sloping bank	_______ Sloping bank
______ Sand/Gravel bar	_______ Sand/Gravel bar
______ Riprap	_______ Riprap
______ Constructed bank (i.e., drainage ditch)	_______ Constructed bank (i.e., drainage ditch)
______ Other: ________________________________	_______ Other: ________________________

Streambank condition (*facing upstream at transect; check one for each bank*)

Left bank	Right bank
______Covered stable	_______ Covered stable
______Covered unstable	_______ Covered unstable
______Uncovered stable	_______ Uncovered stable
______Uncovered unstable	_______ Uncovered unstable

Channel shape (*facing upstream at transect; check one for each bank*)

Left bank	Right bank
______Trapezoidal /__\	_______ Trapezoidal /__\
______Rectangular |__|	_______ Rectangular |__|
______Inverse trapezoidal __/	_______ Inverse trapezoidal __/

Canopy cover (*over transect; check one*): ____0–25% ____25–50% ____50–75% ___75–100%

Riparian zone width (*facing upstream at transect; check one for each bank*)

Left bank	Right bank
______0–5 meters	_______0–5 meters
______5–25 meters	_______5–25 meters
______Over 25 meters	_______Over 25 meters

Riparian zone plant cover (*at transect—estimate percentage of each*)

Left bank	Right bank
______% Trees	_______% Trees
______% Shrubs / Low trees	_______% Shrubs / Low trees
______% Grass / Low plants	_______% Grass / Low plants
______% Exposed soil	_______% Exposed soil
______% Other (riprap, concrete, etc.)	_______% Other (riprap, concrete, etc.)
______**100% TOTAL**	_______**100% TOTAL**

Note: the following parameters are conducted at the level of the stream reach

Stream sinuosity (*along stream reach*): ____Low _____Moderate _____ High _____Braided

Microhabitats (*check all present in stream reach*)

______ Algae mats
______ Large organic debris
______ Root wads
______ Fallen trees
______ Silt/Muck
______ Sand
______Other: ________________________________
_______ Leaf packs
_______ Rocks
_______ Weed beds
_______ Undercut banks
_______ Riprap
_______ Overhanging vegetation
_______ Junk (tires, etc.)

Adjacent land use (*along stream reach; check all that apply*)

______ Row crop
______ Pasture
______ Urban
______ Industrial
______ Timber
______ Wetland
______ Prairie
______ Park
______ Playground
______Other: ________________________________
_______Boating accesses
_______Nature trails
_______Fence
_______Steep slopes
_______Stairs/Walkway
_______Rural residential
_______Conservation lands
_______Animal feeding operations/lots
_______Campground

Human use activities (*along stream reach; check all that apply*)

Check activities you've participated in or witnessed at this site.

______Swimming
______Tubing
______Water skiing
______Wind surfing
______Canoeing/Kayaking
______Other: ________________________________
_______Boating
_______Wading
_______Rafting
_______Hunting/Trapping
_______Fishing
_______Kids playing

Evidence of human use (*along stream reach; check all that apply*)

Check evidence you've witnessed at this site.

______Streamside roads
______Footprints or paths
______Dock/Platform
______Livestock watering
______ATV/ORV tracks
______Other: ________________________________
_______Rope swings
_______Camping sites
_______Fire pit/Ring
_______Fishing Tackle
_______Evidence of play

Record all other land-use practices that potentially could affect the stream.

____

____

____

____

Are noxious weeds present? ____

____

photo by Steven Martine

6 PHYSICAL ASSESSMENT

Introduction

The physical characteristics of a stream greatly influence what type of aquatic life it can support. Within the theatre that is the stream, the physical aspects make up the stage on which all life performs. The stage backdrop—consisting of stream width, depth, velocity, flow, and water temperature—influences all of the chemical and biological aspects of the stream.

When conducting your assessment, use the physical/chemical assessment field form located at the end of this chapter and online at the IDAH$_2$O website. Physical assessments should be conducted monthly, if possible. This chapter describes the various kinds of data you'll collect while performing the physical assessment.

Weather

Weather strongly influences the physical characteristics of water. For example, a strong 4-hour spring rain may result in most of the stream's annual sediment and pollution load. Long-term weather conditions can also greatly affect our streams. Floods, droughts, or other climatic extremes can change the stream's physical and chemical characteristics quite dramatically (e.g., creating new stream channels or drainage patterns).

Weather can also impact streams in other ways:

- Cloudy weather may result in lower dissolved oxygen levels because of less plant photosynthesis.
- Recent rains may dilute point source pollution.
- Recent rains may increase nonpoint source pollution by increasing surface water runoff and pollutant transport.
- Wind may raise dissolved oxygen levels by increasing turbulence.
- Temperature affects many parameters, such as the stream's ability to retain dissolved oxygen.

9 REPORTING TECHNIQUE

Weather

Report the weather conditions at the time of your stream assessment. Use the thermometer to measure air temperature before you use it for water temperature. Use your own rain gauge or contact a local radio station or newspaper to find out the amount of precipitation during the previous 24-hour period. Web-based resources for precipitation information may also be available.

Water color

The water's color can provide you immediate clues as to a stream's condition. Although clear water may or may not be of high quality, other colors may indicate certain conditions:

- Clear—Clear water doesn't necessarily mean clean water, but it could indicate low levels of dissolved or suspended substances.
- Brown—Brown water is usually due to heavy sediment loads.
- Green—Green water is usually the result of excessive algae growth.
- Oily sheen—Oily sheens can be caused by petroleum or chemical pollution, or they may be natural by-products of decomposition. To tell the difference between petroleum spills and natural oil sheens, poke the sheen with a stick. If the sheen swirls back together immediately, it's petroleum. If the sheen breaks apart and does not flow back together, it is from bacteria or plant or animal decomposition.
- Reddish—Reddish or orange colors are usually due to iron oxides.
- Blackish—Blackish water is usually caused by natural processes of leaf decomposition. Pigments leached from decaying leaves can cause the water to appear murky.
- Milky—A milky appearance may be caused by salts in the water.
- Gray—Gray water may be a result of natural or human-induced activities. Surface foam is common and can be naturally occurring. Vegetation can produce surface-acting agents, or "surfactants," which can cause surface foam. Human-induced surface foam may be an unnatural color (red, pink, blue, yellow, or orange) and have a fragrant smell. This foam is most likely generated by household detergents and may be a sign of a failing septic drain field or discharge.

9 REPORTING TECHNIQUE

Water color

Report water color based on the categories listed above.

Water odor

Water odor, like water color, can provide immediate clues about potential problems in a stream:

- Sewage/Manure—These smells can be common in Idaho's air but should not be what our water smells like. It is important to differentiate whether the odor is coming from the water or the air.
- Rotten egg—This odor can be caused by hydrogen sulfide gas, a by-product of anaerobic decomposition (rotting without oxygen). This is a natural process that occurs in areas that have large quantities of organic matter and low levels of dissolved oxygen. It may be caused by excessive organic pollution.
- Petroleum—Any petroleum or chemical smells can indicate serious pollution problems from a direct source, such as a factory or parking lot/storm sewer runoff.
- Musky—Musky odors may result from natural or human-induced activities.

9 REPORTING TECHNIQUE

Water odor

Determine whether the water produces any of the odors described above.

photo courtesy IDAH$_2$O

Water temperature

Many of the chemical, physical, and biological characteristics of a stream are directly affected by water temperature. Some species, such as trout, are quite sensitive to temperature changes. Water temperatures can fluctuate seasonally, daily, and even hourly.

Human activities can adversely raise stream temperatures in a variety of ways. Thermal pollution can be caused by:

- Warmed water entering a stream from industry discharges or runoff from paved surfaces
- Removal of riparian corridors, which increases solar heating
- Soil erosion, resulting in darker water, which can absorb more sunlight

Water temperature affects the following:

- The amount of oxygen dissolved in water. Cool water holds more oxygen than warm water
- The rate of photosynthesis by algae and aquatic plants, which increases with higher temperatures
- The metabolic rates of aquatic animals, which increase with higher temperatures
- The sensitivity of organisms to diseases, parasites, and toxic wastes

Human impacts are most critical during the summer, when low flows and higher temperatures can cause greater stress on aquatic life. It is important to note that the temperatures of some streams are naturally higher than others, depending on groundwater flow into the stream, weather, and other factors.

9 REPORTING TECHNIQUE

Water temperature
At your stream transect place the thermometer directly into the stream, holding it underwater in the main flow of the stream (not in a pool) for at least 2 minutes so the reading can stabilize.

photo by Steven Martine

Transparency

Transparency is a measure of water clarity and is affected by the amount of material suspended in the water. The more material in suspension, the less light can pass through, making the water less transparent. Suspended materials may include soil, algae, plankton, and microbes. Transparency is measured in centimeters using a transparency tube.

It is important to note that transparency differs from turbidity. Transparency is a measure of water clarity in centimeters, while turbidity measures how much light is scattered by suspended particles in NTUs (nephelometric turbidity units).

Low transparency (high numbers of suspended particles) is rarely toxic to aquatic animals, but it indirectly harms them when solids settle out and clog gills, destroy habitat, and reduce the availability of food. Furthermore, suspended materials in streams promote solar heating, which can increase water temperatures (see Water Temperature), and reduce light penetration, which reduces photosynthesis, both of which contribute to lower levels of dissolved oxygen. Sediment particles also can carry attached chemicals, which can have harmful environmental effects.

Sources of suspended particles include soil erosion, waste discharge, urban runoff, eroding streambanks, bottom sediments disturbed by bottom-feeding fish (carp), and excess algal growth.

9 REPORTING TECHNIQUE

Transparency

1. Make sure the finger clamp on the hose of your transparency tube is closed. Facing upstream in the area along your transect with the greatest flow, fill the transparency tube.

2. Hold the tube upright in the shade. Use your body to shade the tube if nothing else is available.

3. With your back to the sun, look directly into the tube from the open top and release water through the small hose, regulating the flow with the finger clamp until you are able to distinguish the black and white pattern (Secchi pattern) on the bottom of the tube. Close the finger clamp.

4. Read the number on the outside of the tube that is closest to the water line. Record your reading in centimeters (cm).

5. Rinse the tube after each use so that the bottom Secchi pattern does not become dirty and clouded.

photo by Steven Martine

Stream width

Stream width is measured from the edge of the left bank to the edge of the right bank and recorded in meters (figure 6.1). This may not be the actual width of the water, but instead represents the width of the stream channel.

9 REPORTING TECHNIQUE

Stream width

Facing upstream and starting from the left bank of your stream transect, measure the width of the stream in meters with the measuring tape. Make sure to measure the width at the same place each time you assess the stream! To make stream depth and velocity measurements, you will need to either stake the tape across the stream in this position or monitor with others who can hold the tape across the stream transect.

Stream depth

Water depth is important for many fish. Most fish require deeper water for overwintering. Shallow waters are important food production and feeding areas.

9 REPORTING TECHNIQUE

Stream depth

Facing upstream and starting from the left bank of your stream transect, measure and record the depth of the water, in meters, at 1-meter increments (figure 6.1). Remember to convert centimeters to meters. If your stream is less than 2 meters wide, measure one spot in the middle.

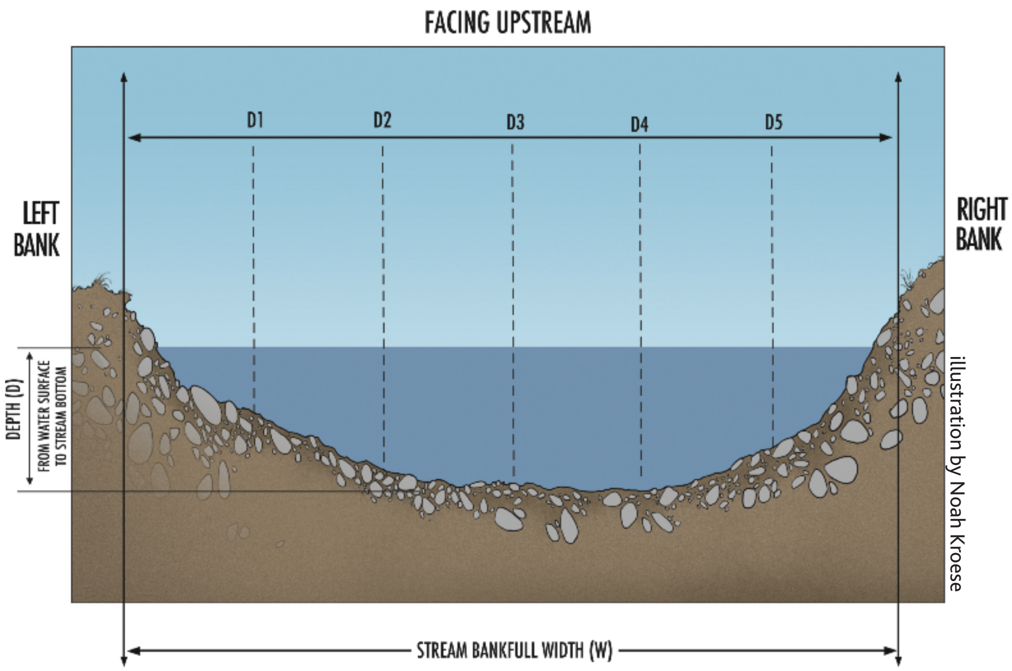

Figure 6.1. Accurate measurements along your stream transect will allow you to track changes in channel migration and effects of sedimentation in your stream.

Maximum stream depth

Stream depth is important not only for aquatic life, but also for recreation. Recording maximum stream depth can help provide a more accurate assessment of streams.

> 9 REPORTING TECHNIQUE
>
> **Maximum stream depth**
> Find the deepest spot in the stream along your transect and record the depth in meters.

Stream velocity

A stream's velocity is a measurement of how fast the water is flowing. This information, along with the stream's depth and width, is needed to calculate the flow (or stream discharge rate). This information can help us understand the effects of other parameters.

> 9 REPORTING TECHNIQUE
>
> **Stream velocity**
>
> **1.** Hold the tennis ball with its attached 1-meter string with one hand and the end of the string in the other. Hold both of these directly below the 1-meter mark on the tape measure. Facing upstream, you should be 1 meter out from the left bank. Use an outstretched arm to make sure your body is not altering the stream flow in the vicinity of the tennis ball.
>
> **2.** Have someone with a stopwatch say "go," while you release the ball but continue to hold the string at the 1-meter mark.
>
> **3.** When the ball floats to the end of the string (1 meter), stop timing. Record in seconds the time it took the tennis ball to travel the 1 meter.
>
> **4.** Repeat the procedure for each 1-meter increment. If your stream is less than 2 meters wide, measure one spot in the middle.

Stream flow

After visiting your site a few times, or by looking closely for high water marks on the land or trees, you will be able to assess stream flow (i.e., whether it's high, normal, or low). Advanced flow measuring equipment may also be available; contact your IDAH$_2$O coordinator for availability.

9 REPORTING TECHNIQUE

Stream flow

Use these definitions to determine stream flow:

- High—Stream flow is higher than normal.
- Normal—Stream flow is normal.
- Low—Stream flow is lower than normal.
- Not sure—If normal stream flow is not known, stream flow cannot be estimated.

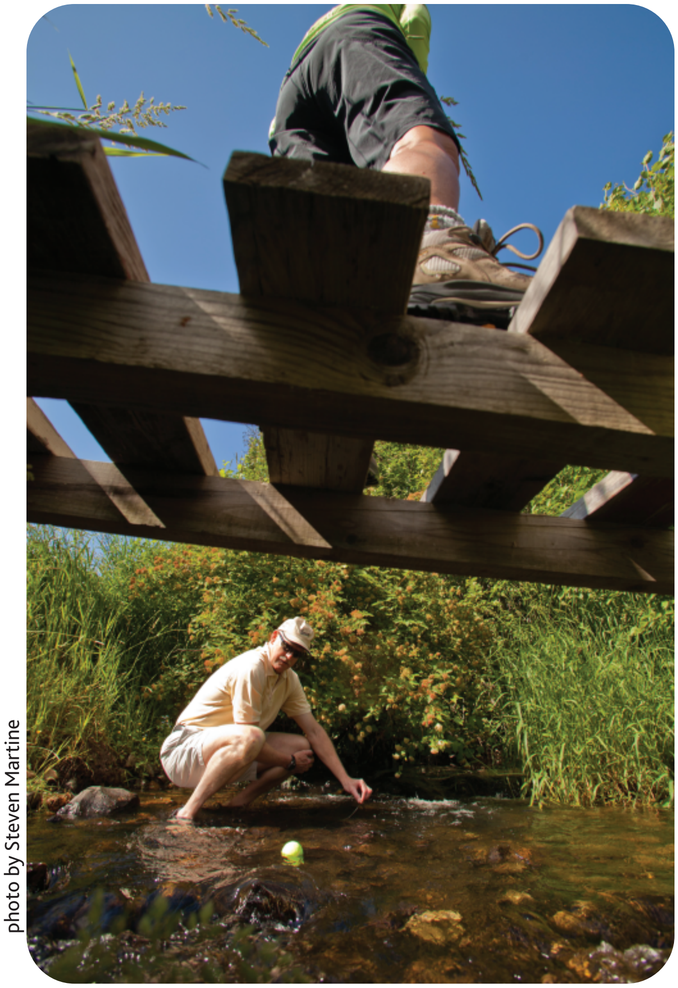

photo by Steven Martine

Physical/ Chemical Assessment

Recommended frequency—sample monthly at transect

Photographic documentation is recommended and strongly encouraged

Date ____________ Time _________ IDAH$_2$O monitor # ___________ Site number _____________

# of adults (including you)__________ # under 18__________________

Other volunteers involved ____

____

Site description ____

____

Was the stream dry when it was monitored? _____Yes _____No

Weather (*check all that apply*)

___Sunny ___Partly sunny ___Cloudy ___Rain/Snow ___Windy ___Calm

Air temperature _____ °Fahrenheit **Precipitation** _____ inches over the last 24 hours

Water color (*check all that apply*)

___Clear ____Brown ___Green ____Oily ___Reddish ___Blackish ___Milky ___Gray

Water odor (*check all that apply*)

___None ___Sewage/Manure ___ Rotten eggs ___Petroleum ___Musky

Water temperature _____ °Fahrenheit

Transparency (*record whole numbers only—no tenths*) ______ centimeters

pH Expiration date on bottom of bottle _______
(*check one*) ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9

Dissolved oxygen (mg/L) Expiration date on back of color comparator _______
(*check one*) ___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12

Chloride (*optional*) Expiration date on bottom of bottle _______
_________ mg/L—Convert Quantab Units to mg/L using the chart provided on the bottle

Stream width ___.____ meters

Stream flow (*along your transect*) ______ high ______ normal ______ low ______ not sure

Stream depth (*in meters*)		**Stream velocity** (*in seconds*)
1st spot	___._____	___._____
2nd spot	___._____	___._____
3rd spot	___._____	___._____
4th spot	___._____	___._____
5th spot	___._____	___._____
6th spot	___._____	___._____
7th spot	___._____	___._____
8h spot	___._____	___._____
9th spot	___._____	___._____
10th spot	___._____	___._____

Maximum stream depth (*along your transect*) ___._______ meters

Other observations and notes ____
____
____
____

photo by Steven Martine

7 CHEMICAL ASSESSMENT

Introduction

Stream water chemistry is perhaps the most complicated and least understood characteristic of streams. While some chemicals are absolutely necessary for life (such as nutrients), others can be harmful (such as pesticides). Some chemicals may not directly impact human health, while others such as nitrate can have harmful effects in our drinking water.

As you explore your stream's water chemistry, it is important to understand that water chemistry is very complex and that extreme natural variation in some chemicals is not unusual but actually the norm. Some of these natural variations will be addressed in the following sections in this chapter.

The following are just a few examples of how environmental conditions can influence water chemistry:

- Season of year—In late spring, nitrate and phosphate levels in streams may rise in response to bare soil, heavy rains, increased tilling of farm fields, and application of chemicals to row crops and urban lawns.
- Time of day—Dissolved oxygen levels rise during sunlight hours due to increased photosynthesis in aquatic plants and algae. They decrease overnight when photosynthesis is not occurring and plants and algae are using up dissolved oxygen in respiration.
- Weather—Runoff from heavy rains can transport pollutants to streams, thus having a strong impact on nonpoint source pollution.
- Physical influences—Decreased canopy cover from riparian zone removal results in solar warming of the water, which can decrease dissolved oxygen levels.
- Land use—Increased development throughout a watershed can result in more curb and gutter stormwater runoff. Land use changes can also increase nonpoint sources of erosion that increase in-stream nutrient concentrations.

When conducting your assessment, use the physical/chemical assessment field form located at the end of chapter 6 and online at the IDAH$_2$O website. Conduct chemical assessments monthly, if possible. This chapter describes the various kinds of data you'll collect while performing the chemical assessment and periodic sampling for snapshot parameters.

pH

pH is a measure of how acidic or basic water is and is measured in pH units on a scale of 0 to 14. A pH of seven 7 is neutral (distilled water), while a pH greater than 7 is basic/alkaline and a pH less than 7 is acidic.

The pH of stream water is influenced by the concentration of acids in rain and the types of soils and bedrock in the watershed. The typical rainfall in the U.S. is slightly acidic, with a pH ranging from 5.0 to 5.6. As rainwater falls, carbon dioxide from the atmosphere dissolves into it, thus forming a weak carbonic acid and lowering the pH of the precipitation.

Low pH levels (acidic water) can have a harmful impact on the health of aquatic communities. Very acidic water or acid rain can allow toxic substances such as ammonia and heavy metals to leach from our soils and possibly be taken up by aquatic plants and animals in a process called bioaccumulation.

Most aquatic organisms require habitats with a pH of 6.5 to 9.0. Extremely high or low pH values are quite rare in Idaho. Most values that exceed 9.0 (basic) are caused by excessive algal growth, a sign of nutrient enrichment. Very low (acidic) pH readings are generally near point sources of pollution.

9 REPORTING TECHNIQUE

pH

For use with Hach pH test strips

Store test strips in the dark at room temperature.

1. Check the expiration date on the bottom of your bottle of Hach pH test strips. If the expiration date has passed, do not use them.

2. Facing upstream in the area along your transect with the greatest flow, dip the test strip in the water then remove it immediately. Hold the strip level for 15 seconds. Do not shake excess water from the test strip.

3. Estimate pH by comparing the color of your test pad with those in the color chart on the test strip bottle. Remove your sunglasses before reading the strip. *The pad will continue to change color, so make a determination immediately after 15 seconds*.

4. Record your result on the physical/chemical assessment field form.

5. Dispose of the test strip in a waste container, which can be emptied into your household trash.

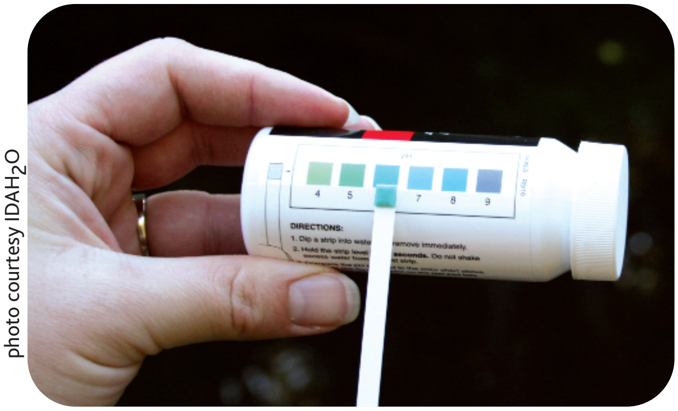

photo courtesy IDAH$_2$O

Dissolved oxygen

Dissolved oxygen (DO) is necessary for nearly all aquatic life to survive. Certain processes add oxygen to a stream, while others remove or consume oxygen. Oxygen is added to a stream from the atmosphere through mixing in turbulent areas. Plants also contribute oxygen through photosynthesis. DO in streams can be affected by the following:

- Water temperature—Cold water holds more oxygen than warm water.
- Season—DO levels are higher in winter than in summer.
- Time of day— On a sunny day, DO levels rise from morning through the afternoon as a result of photosynthesis, reach a maximum in late afternoon, and steadily fall during the night, reaching their lowest point before dawn.
- Stream flow—DO varies with the volume and velocity of water in a stream; faster-moving water mixes readily with atmospheric oxygen, thus increasing DO.
- Aquatic plants—Plant photosynthesis contributes oxygen to stream water by day, and plant respiration depletes it at night.
- Dissolved or suspended solids—Oxygen dissolves more readily in water that does not contain high amounts of salts, minerals, or other solids.
- Human impacts—Lower DO levels may result from human impacts including organic enrichment, urban stormwater runoff, riparian corridor removal, stream channelization, and dams.

9 REPORTING TECHNIQUE

Dissolved oxygen

For use with the Chemetrics dissolved oxygen test kit

Store the kit in the dark at room temperature. Keep the color comparator and unused ampoules away from direct sunlight, or they will turn blue and be no longer usable.

1. Check the expiration dates on the color comparator and on the ampoule box. If your equipment has expired, **do not use it**.

2. Remove the 25 ml sample cup from the kit and rinse it **three times** with stream water.

3. Facing upstream in the area along your transect with the greatest flow, fill the sample cup to the 25 ml mark, mixing the water and air as little as possible. To do so, first lower the sample cup down to wrist depth while holding it upside down. Turn the opening downstream so that the cup backfills with water, then turn the cup upstream and carefully remove it from the stream. Gently tip the sample cup to pour off excess water.

4. Place the ampoule in the sample cup, tilting it so the tip is wedged in one of the spaces along the side of the sample cup.

5. Snap off the tip of the ampoule by pressing it against the side of the cup, allowing it to fill with water.

6. Remove the ampoule from the cup and mix the water by inverting the ampoule several times. Be careful not to touch the broken end as it will be sharp.

7. 2 minutes after you break off the ampoule tip, compare the ampoule to the color standards provided in the kit. *Read the ampoule right at 2 minutes as the ampoule will continue to change color*. Remove your sunglasses before making a determination.

Hold the comparator nearly flat while standing directly beneath a bright source of light. Place your ampoule between the color standards, moving it from left to right until you find the best color match. Record your result on the physical/chemical assessment field form.

8. The ampoule and ampoule tip may be disposed of in your household trash, but be careful of the broken glass. Also avoid breaking the ampoule open, as the contents may be mild skin and/or eye irritants.

photo courtesy IDAH$_2$O

Dissolved oxygen is measured in milligrams per liter of water (mg/L). Idaho standards, which are set to protect aquatic life, call for a minimum of 6 mg/L of DO.

Chloride

Chloride is a chemical found in salts, which tend to dissolve easily in water. In natural waters, elevated levels of chloride may indicate inputs of human or animal waste or inputs from fertilizers, many of which contain salts. During winter months, elevated chloride levels in streams may occur as a result of road salt runoff. Chloride can be used as a “conservative” measure of water contamination since other natural processes, such as breakdown by bacteria, do not affect it.

The amount of chloride dissolved in water is expressed in milligrams per liter of water (mg/L). Average chloride concentrations for Idaho streams range widely and are most often affected by road de-icing efforts.

Testing for chloride is optional and occurs only when contamination is suspected.

9 REPORTING TECHNIQUE

Chloride

For use with Hach chloride titrators and sample cup from one of the Chemetrics test kits

Store Quantab titrators at temperatures not to exceed 86°F.

1. Check the expiration date on the bottom of the chloride bottle. If your equipment is expired, **do not use it**.

2. Rinse the 25 ml Chemetrics test kit sample cup three times with stream water.

3. Facing upstream in the area along your transect with the greatest flow, fill the sample cup to the 25 ml mark with stream water.

4. Remove a titrator from the bottle and replace the cap immediately.

5. Insert the lower end of the titrator into the sample cup. Do not allow the yellow completion string located at the top of the titrator to become submerged in the water sample.

6. Allow the water sample to completely saturate the wick of the titrator. There is no time limit for this test; the reaction is complete when the yellow string turns dark (this will take a few minutes).

7. Note where the tip of the white chloride peak falls on the numbered Quantab scale. This represents the Quantab unit value.

8. Refer to the table on the Quantab test strip bottle to **convert the Quantab units into a chloride concentration** and record the result on the physical/chemical assessment field form. If the Quantab unit is below 1.0, report the chloride concentration as < (less than) the lowest concentration listed on the test strip vial, which for data submission purposes is 25 mg/L. Chloride concentrations may also exceed the upper limits of this test, which can be recorded as > 600 mg/L.

9. Quantab test strips may be disposed of with household trash. Sample water can be disposed of in the field.

High-range chloride strips, with a range of 300–6,000 mg/L, are available. Please contact IDAH$_2$O to acquire them.

photo by Steven Martine

Nitrate-N

Nitrogen is an essential plant nutrient, but excessive nitrogen can cause water quality problems. Too much nitrogen and phosphorus in surface waters causes nutrient enrichment, increasing aquatic plant growth and changing the types of plants and animals that live in a stream. This process of nutrient enrichment, called eutrophication, can also affect other water quality parameters such as temperature and dissolved oxygen.

Nitrate and nitrite are two forms of nitrogen. Nitrate dissolves easily in water and is more common in streams than nitrite. Sources of nitrate include soil organic matter, animal wastes, decomposing plants, sewage, and fertilizers. Nitrate is more soluble in water than phosphorus and can move more readily into streams.

Nitrite is rare in streams because it is quickly converted to nitrate or returned to the atmosphere as nitrogen gas. Due to its instability, detectable levels of nitrite in streams and lakes are uncommon. Detectable nitrite levels in streams may indicate a relatively fresh source of ammonia.

The amount of nitrate or nitrite dissolved in water is reported as nitrate-N (nitrate expressed as the element nitrogen) or nitrite-N in milligrams per liter of water (mg/L). The U.S. Environmental Protection Agency's drinking water standard for nitrate is 10 mg/L as nitrate-N. Stream water nitrate levels may vary greatly depending on season and rainfall, fertilizer application rates, tillage methods, land use practices, soil types, and drainage systems. Consistently high nitrate readings (over 10 mg/L) may be cause for concern and warrant further investigation.

SNAPSHOT SAMPLING TECHNIQUE

Nitrate-N

1. Obtain sample bottles from the IDAH$_2$O coordinator.

2. Sample with clean hands and keep the lid and rim of the bottle clean.

3. Facing upstream, take your sample from the thalweg (area in channel with the most concentrated flow) with the provided sample bottle double rinsed with stream water from your site.

4. Keep the sample bottle cool during transport.

5. Return the sample by the time indicated.

Your sample will be analyzed by a lab designated by the IDAH$_2$O program. The nitrate test utilizes HACH TNT Chemistries—Spectrophotometer. Results will be posted at the IDAH$_2$O website no later than 2 weeks after you submit the sample.

Phosphorus

Phosphorus is an essential nutrient for plants and animals and is found in natural waters. Plant growth in surface waters is generally limited by the amount of phosphorus present. The amount of total phosphorus in water is expressed in milligrams per liter of water (mg/L).

There are natural sources of phosphorus, such as certain soils and rocks, but most elevated levels of phosphorus are caused by human activities. These include human, animal, and industrial wastes as well as runoff from fertilized lawns and cropland. Excessive phosphorus in water speeds up plant growth, causes algal blooms, and can result in very low levels of dissolved oxygen (hypoxic conditions) that can kill certain fish, invertebrates, and other aquatic animals.

SNAPSHOT SAMPLING TECHNIQUE

Phosphorus

1. Obtain sample bottles from the IDAH$_2$O coordinator.

2. Sample with clean hands and keep the lid and rim of the bottle clean.

3. Facing upstream, take your sample from the thalweg (area in channel with the most concentrated flow) with the provided sample bottle double rinsed with stream water from your site.

4. Keep the sample bottle cool during transport.

5. Return the sample by the time indicated.

Your sample will be analyzed by a lab designated by the IDAH$_2$O program. The phosphorus test utilizes HACH TNT Chemistries—Spectrophotometer. Results will be posted at the IDAH$_2$O website no later than 2 weeks after you submit the sample.


photo by Steven Martine

8 BIOLOGICAL ASSESSMENT

Introduction

There are many forms of life within a stream. From tiny mayfly larvae to the large white tailed deer that use the stream for water, life abounds within and around a healthy stream system. Certain species lend themselves especially well to telling us something about the health of a stream. Scientific studies of natural ecosystems often use these indicator species as a type of "environmental thermometer." Some plants and animals are intolerant of pollutants or other negative environmental conditions, and their presence can indicate a great deal about the health of the water they live in.

Biological assessments require little expense or labor, involve relatively easy analysis, and allow you to follow environmental conditions in your stream over a number of years. Normally, you conduct a biological assessment during times of low flow in the summer and fall.

This chapter describes the various kinds of data you'll collect when you do the biological assessment and the periodic sampling for bacteria, a snapshot parameter. When conducting your biological assessment, use the biological assessment field form located at the end of this chapter and online at the IDAH$_2$O website.

Benthic macroinvertebrates

Scary phrase, but it's not as difficult as it appears! "Benthic" means bottom or bottom dwelling, "macro" means large, and "invertebrate" refers to animals without backbones. Therefore, benthic macroinvertebrates are bottom-dwelling animals that do not have backbones and can be seen with the naked eye. These include aquatic insects, clams, crustaceans, leeches, snails, and worms.

In order to effectively study living things, scientists had to develop a classification system that would enable them to not only name organisms (using scientific rather than common names) but also to show their relationships to other living things. This classification system, which was developed in 1757 by Swedish botanist Carl Linnaeus, classifies organisms into a hierarchy (kingdom, phylum, class, order, family, genus, species) based on similar characteristics.

You'll identify most of the invertebrates you study through IDAH$_2$O monitoring to the level of order. For example, stoneflies are in kingdom Animalia, phylum Arthropoda, class Insecta, and order Plecoptera. Stoneflies may be further differentiated from one another down to individual species, but for the purposes of IDAH$_2$O monitoring, we'll refer to them as one group.

Benthic macroinvertebrate monitoring is the most common method of assessing the biological health of a stream. As water conditions change, the benthic macroinvertebrate community that lives there changes too. The number and kinds of critters you collect and identify are relatively good indicators of stream health. Having an abundance of different types of critters, or high biodiversity, is important.

IDAH$_2$O assessment relies heavily on benthic macroinvertebrate information. Benthic macroinvertebrates are assessed because they are stable in their range (they don't travel long distances), are easy to collect and identify, and much is known of their tolerance levels to different pollutants.

Remember, however, that finding a species from the pollution tolerant (low water quality) group does not automatically indicate a dirty stream. Critters with a high tolerance for pollution can live anywhere; therefore, we find them in areas with high water quality as well as low water quality. A benthic macroinvertebrate assessment in a general way indicates high, medium, or low water quality in a stream.

photo by Steven Martine

9 REPORTING TECHNIQUE

Benthic macroinvertebrates and microhabitats

Attempt to collect as diverse a group of critters as possible from your stream reach. You will find them living under rocks, hanging on overhanging grasses and roots, on woody debris in the stream, in leaf packs, within gravelly riffles, and even in sand and silt. It is very important to sample all microhabitats. Remember, you are only trying to find different species. While there's no need to turn over every rock or pull apart every leaf pack, it is important that you search all available (or accessible) microhabitats so that you get a representative sample of what lives in the stream.

Using your benthic nets, collect critters from the stream and deposit them in the ice cube tray filled with water. To sample where there is flow present in the stream, hold the leading edge of the net along the stream bottom and "wash" the substrate upstream so critters are forced into your net. Riffles are the best places to target when collecting aquatic insects.

On the biological assessment field form record all the microhabitats that are present in your stream reach and indicate which you were able to sample. After you have sampled your stream, bring the tray to shore and use the key to identify your catch. Record what you found on the biological assessment field form and return the critters to the stream.

The IDAH$_2$O program recommends you do this assessment no more than three times a year (summer and fall months). More frequent sampling may impact the populations of critters you are collecting. If you are monitoring a stream of exceptionally high quality, try to limit your collecting to no more than 30 minutes.

Vertebrates

“Vertebrate” refers to animals with backbones. This includes amphibians, reptiles, fish, birds, and mammals. Although they may be the most captivating members of a natural community, they are difficult to use as indicator species because of their ability to move great distances.

Fish are arguably the most recognized animals in our streams. Interest in sport fishing from salmon to trout leads hundreds of thousands of Idahoans to the water each year. Fish can be used in assessing stream health, although collecting and identifying fish for this purpose can be difficult.

> 9 REPORTING TECHNIQUE
>
> **Fish**
> At your stream transect, note any fish you see in the stream reach. Determine species and size if you can. Take note of any spawning activity or fry. A space is provided on the biological assessment field form for your comments.

Aquatic plants

Aquatic plants include all those that grow in the water or wet soils. Aquatic plant communities can be dominated by a single species or by a variety of species. Drawbacks to using plants as environmental indicators include the difficulty of identifying them and the scarcity of information about their tolerance to pollution. In general, aquatic plants are indicators of clear water and stable substrate. They provide habitat and stabilize substrate during high flow conditions. They also produce oxygen and remove contaminants from sediment via root absorption.

When plants become overabundant or excessively outcompete other species, they can become invasive, which inhibits natural plant diversity in the system. Invasive plants, some of which are non-native or “exotic,” can impair the stream’s ability to fulfill its beneficial uses.

Non-native, invasive species should be inventoried at monitoring sites to help prevent further spread of the problem. These plants can reside in the water, on streambanks, and in riparian areas. Utilize your *Idaho’s Noxious Weeds* field guide when identifying these plants. Take care not to spread them to other sites!

> 9 REPORTING TECHNIQUE
>
> **Aquatic plants**
> At your stream transect, estimate the percentage of the streambed covered with aquatic plants in increments of 25%. Note any invasive species in the Other Observations portion of the field form.

Algae

There are many different species of algae, and most take a microscope to identify. Algae are commonly found attached to rocks or other streambed substrates in slower-moving water. Excessive growths of algae can be caused by too many nutrients entering the stream from the watershed. Too much algae can lead to oxygen depletion and may harm animals living there. Certain kinds of algae can cause odors or foul tastes or even produce toxic by-products that are a concern for drinking water treatment facilities.

In the presence of raw sewage, gray or “sewage” algae can form. This is not algae, but rather large colonies of filamentous bacteria. In a stream, this is usually a sign of severe fecal contamination. Do not wade in this stream! If you observe sewage algae in your stream, please contact IDAH$_2$O for assistance.

> 9 REPORTING TECHNIQUE
>
> **Algae**
> At your stream transect, estimate the percentage of the stream or streambed covered with algae in increments of 25%.

photo by Steven Martine

Bacteria

Bacteria are very tiny organisms. Some bacteria serve as indicators of certain types of pollution, such as sewage, while other bacteria indicate organic pollution, such as gasoline spills. In most cases, “indicator” bacteria are not dangerous to animals (including us), but their presence may indicate the presence of pathogens (disease-causing organisms). People can become ill by accidentally swallowing certain types of pathogens, such as certain strains of *E. coli*, fecal coliform bacteria, enterococci, viruses, *Giardia*, and some parasites.

Bacteria is a snapshot parameter; however, you can do a self-test by asking a few simple questions. Do you see cattle, horses, or other livestock in or adjacent to the reach? Do you know of any failing septic tanks within your reach or directly upstream? Do people swim or fish in the area? Answering yes to these questions may indicate a high likelihood of bacteria in the stream. Please note your observations on the biological assessment field form under Other Observations and Notes.

SNAPSHOT SAMPLING TECHNIQUE

Bacteria

1. Obtain sample bottles from the IDAH$_2$O coordinator.

2. Sample with clean hands and keep the lid and rim of the bottle clean.

3. Facing upstream, take your sample from the thalweg (area in channel with the most concentrated flow) with the provided sample bottle double rinsed with stream water from your site.

4. Keep the sample bottle cool during transport.

5. Return the sample by the time indicated.

Your samples will be analyzed by a lab designated by the IDAH$_2$O program. The bacteria test utilizes Quanti-Tray/2000 analysis by IDEXX. Results will be posted no later than 2 weeks after you submit your sample.

Biological Assessment

Recommended frequency—no more than three times per year (summer and fall)
Photographic documentation is recommended and strongly encouraged

Date ____________ Time _________ IDAH$_2$O monitor # ___________ Site number _____________

# of adults (including you)__________ # under 18__________________

Other volunteers involved ____

____

Site description ____

____

Was the stream dry when it was monitored? ______Yes _____No

Did you find benthic macroinvertebrates? (*If yes, please check all those you found. If no, please provide any relevant comments in the Other Observations and Notes section at the end of this form. Also indicate why you think critters are not present*.)

Benthic macroinvertebrates (*check all found*)
High water-quality group (pollution intolerant)

______Caddisfly
______Dobsonfly
______Mayfly
_______Riffle beetle
_______Snail (not pouch)
_______Stonefly
_______Water penny beetle

Middle water-quality group (somewhat pollution tolerant)

______Alderfly
______Backswimmer
______Crane fly
______Crawdad
______Crawling water beetle
______Damselfly
______Dragonfly
_______Giant water bug
_______Limpet
_______Mussels/Clams
_______Orbsnail
_______Predaceous diving beetle
_______Scud
_______Sowbug
_______Water boatman
_______Water mite
_______Water scorpion
_______Water strider
_______Whirligig beetle

Benthic macroinvertebrates (*check all found*)

Low water-quality group (pollution tolerant)

______Aquatic worm	_______Flatworm	_______Mosquito
______Black fly	_______Leech	_______Pouch snail
______Bloodworm	_______Midge fly	_______Rat-tailed maggot
______Other _______________	(no tolerance group assigned)	_______Water scavenger beetle

Benthic macroinvertebrate collection time (*check one*)

___0–15 min. ___15–30 min. ___30–45 min. ___More than 45 min.

Collection nets (*How many nets did you use to collect critters?*)

___1 ___2 ___3 ___ 4 ___5 ___6+

Stream reach length (*How far along the stream did you search for macroinvertebrates?*)

___0–25 meters ___25–50 meters ___50–75 meters ___75–100 meters ___100+ meters

Microhabitats (*check all present in stream reach; check if sampled*)

Algae mats	___Present	___ Sampled	Junk (tires, garbage, etc.)	___Present	___ Sampled
Logjams	___Present	___ Sampled	Leaf packs	___Present	___ Sampled
Root wads	___Present	___ Sampled	Rocks	___Present	___ Sampled
Fallen trees	___Present	___ Sampled	Weed beds	___Present	___ Sampled
Silt/Muck	___Present	___ Sampled	Undercut banks	___Present	___ Sampled
Sand	___Present	___ Sampled	Riprap	___Present	___ Sampled
Other (*describe*)	___Present	___ Sampled	Overhanging vegetation	___Present	___ Sampled

____

Stream habitat type (*check all types sampled in stream reach*)

_____Pool _____Riffle _____ Run _____ Glide

Are fish or sign of fish present? ________________________________

Aquatic plant cover of streambed (*at transect; check one*)

___0–25% ___25–50% ___50–75% ___75–100%

Algae cover of stream or streambed (*at transect; check one*)

___0–25% ___25–50% ___50–75% ___75–100%

Other observations and notes____

____

____

University of Idaho Extension
IDAH2O MASTER WATER STEWARDS

Benthic Macroinvertebrates

High water-quality group—Pollution intolerant

1 Stonefly
1/2–1 1/2 inches long, two hair-like tails, no gills on rear half of body, six legs, and hooked antenna

2 Caddisfly
Up to 1 inch long, three pairs of legs on upper third of body, two claws at rear end, may be found with its head sticking out of a case made of sticks, rocks, or leaves

3 Mayfly
1/4 –1 inch long, gills present on sides of lower body, six large hooked legs, most often found with three hair-like tails (sometimes only two)

4 Water penny beetle
1/4–1/2 inch long, flat, saucer-shaped body, six tiny legs, fluffy gills

5 Dobsonfly (Hellgrammite)
3/4–4 inches, six legs, stout body with large pinching jaws, short antennae, two short legs (tails) at the back end with claws

6 Riffle beetle
1/16–1/4 inch long, very small oval body covered with tiny hairs, six legs plus two antennae, walks slowly underwater

7 Gilled snail
1/4–1 inch long, opens to the right when the narrow end is pointed upward, opening covered by a thin plate, the operculum, gill breathing

Middle water-quality group—Somewhat pollution tolerant

8 Crayfish (Crawdad)
Up to 6 inches long, one large set of claws, eight legs, resembles small lobster

9 Sowbug
1/4–3/4 inch long, flat, segmented body, long antennae, armored appearance

10 Scud
1/8–1/4 inch long, body higher than it is wide, swims sideways, resembles small shrimp

11 Alderfly
1 inch long, similar to dobsonfly, but with a long, thin, branched tail with no hooks, no gill tufts underneath

illustrations by Tommy Moorman

Middle water-quality group—Somewhat pollution tolerant

12 Flishfly
Up to 1/2 inch long, similar to dobsonfly with no gill tufts underneath, two short tube-like structures on the tail end

13 Damselfly
1/2–1 inch long, large eyes, six thin, hooked legs, three oar-shaped tails

14 Watersnipe fly
1/4–1 inch long, tapered body, caterpillar-like legs, two stout, pointed tails with feather hairs at back end

15 Crane fly
1/3–2 inches long, plump, caterpillar-like segmented body, four finger-like lobes at the back end

16 Dragonfly
1/2–2 inches long, large eyes, six hooked legs, stocky body without tails

17 Clams and Mussels
Up to 5 inches long, fleshy body enclosed between two clamped shells, when alive, the shells cannot be pried apart

Low water-quality group – Pollution tolerant

18 Aquatic worm
Usually 1 inch long, but can be up to 4 inches long, can be very thin and slender or look like earthworms, no legs or distinguishable head, segmented body

19 Midge fly
Up to 1/4 inch long, worm-like, segmented body, two tiny legs on each side

20 Black fly
Up to 1/4 inch long, body larger at the rear end, black head with fan-like mouth brushes, often curls up into U shape when held

21 Leech
1/4–2 inches long, slimy, segmented body, one suction pad at each end of the body

22 Pouch snail
Up to 2 inches long, usually opens to the left when the narrow end is pointing up, no operculum (breathes oxygen from air)


photo by Lisa Kyle Young

9 STANDING WATER ASSESSMENT

Introduction

Idaho has numerous lakes and reservoirs. This vital resource provides natural beauty and water for drinking, recreation, industry, agriculture, and aquatic life.

“Lentic waters” is a broad term that encompasses all standing waters, whether naturally formed or constructed. Naturally formed lakes include glacial lakes and oxbow lakes. Glacial lakes form after advances of glacial ice stagnate and deposit large blocks of ice on the landscape. Glacial till—unsorted glacial material—deposited around these blocks of ice confine kettle lakes when the ice melts. Oxbow lakes and backwater marshes form as meandering streams cut off their own meanders, leaving behind a body of standing water. Reservoirs, on the other hand, are formed by building a dam across a stream.

For the purposes of water monitoring, standing waters will be referred to as “lakes.” Lakes serve as “sinks,” or storage areas. Everything (sediments, chemicals, nutrients, etc.) transported through watersheds eventually finds its way into standing waters, where the pollutants may become concentrated and their effects observed. Lakes are direct reflections of the watersheds around them, and their natural function is to collect water, clean it, and then release it.

Site selection

The number and location of your monitoring sites for the standing water assessment (see end of chapter for the field form) will be influenced by the goals and objectives of your monitoring program. A program designed primarily for public education, for example, may include sites chosen for nonscientific reasons, such as their proximity to residential neighborhoods or convenient access. Such a program may even include more monitoring sites than necessary to meet scientific goals so more volunteers can participate in monitoring.

Near-shore areas of lakes may be the first to show impairment due to pollution. Deep locations will show long-term trends in water quality. A mixture of near-shore and open-water sites would be best for a quick characterization. However, you won’t be able to characterize an entire lake based on just one or a few samples.

A program that is designed to collect scientific data will focus on the most representative location of the lake. In most cases, average conditions are best represented in the deepest, open-water area of your lake. The deepest point in circular, natural lakes is usually near the middle. The deepest section of a human-made reservoir is usually near the dam. Lakes that have large arms or bays should be sampled in the deepest section of each individual arm or bay.

The location of each monitoring site needs to be consistent. In the field, identify and locate your sampling site. Mark it clearly on a lake map, then register it in the IDAH$_2$O database in the same manner as stream sites. Finding a shoreline or dock monitoring site is easier than finding sites in open water, but the location still needs to be documented (figure 9.1).

As with stream monitoring, it's best to start with background research and a driving tour of the watershed. Some sources of information for lakes could include:

- Bathymetric (depth contour) maps or general knowledge of the location of the deepest part of the lake. Soundings with a depth finder can help you identify a suitable monitoring location.
- Watershed and topographic maps that show the lake's major inflows and outflows.
- Information on any current activities in the watershed that may affect sampling results, including point sources of pollution such as water treatment discharges, storm drain overflows, and failing septic systems and nonpoint sources such as agricultural and urban land uses and construction areas.
- Information on any current lake activities that may affect sampling results like dredging, water level draw-downs, and chemical applications.

Point sampling

To ensure consistency when conducting lake monitoring, IDAH$_2$0 uses point sampling from a specific depth, approximately ½ meter.

Point sampling involves these steps:

1. Rinse the sampling bottle three times in an area away from where you will sample.
2. Submerge the bottle upside-down into the water to elbow depth (½ meter).
3. Slowly turn the bottle right side up.
4. Gently lift the bottle out of the water.

Collect a separate water sample for each chemical parameter you're monitoring (pH, dissolved

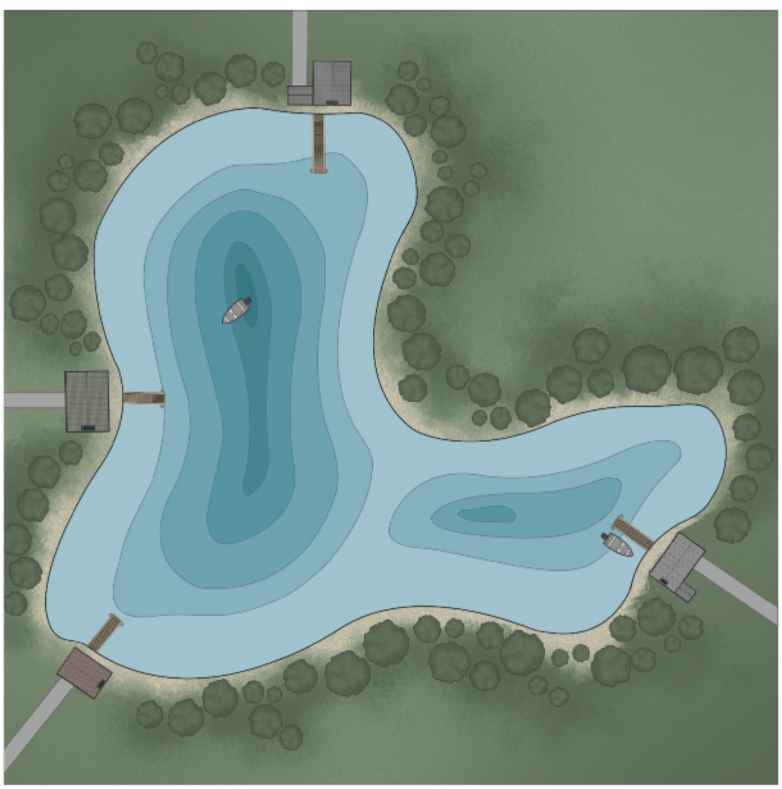

illustration by Noah Kroese

Figure 9.1. Lake sampling is best conducted in the deepest portion of the lake. However, sampling off docks and in bays can help you determine where sources of pollution may be entering the water.

oxygen, and chloride). You'll use different sampling guidelines for the snapshot parameters nitrate-N, total phosphorus, and bacteria.

Frequency of monitoring

IDAH$_2$O suggests beginning lake monitoring at spring ice-out and continuing on a monthly schedule until fall freeze-over. Habitat assessment, however, takes place just once per year, preferably in July. If this is too rigorous a schedule, or if the goals and objectives of your program don't require this frequency, set a schedule that works for you. The most important concept is consistency. If you sample the first week of May, July, and September one year, be sure to repeat this as closely as possible the next year.

In general, IDAH$_2$O recommends sampling between 10 a.m. and 3 p.m. Understand, however, that there is flexibility in both the day and time you sample, especially in light of weather conditions. Use good judgment as to when to sample. IDAH$_2$O recommends that you not sample alone, and be sure to let someone know when and where you are going out to sample. Under no circumstances should volunteers be on the water during rain or electrical storms, high winds (white caps), thin ice, or other unsafe conditions.

When conducting your assessment, use the standing water assessment field form located at the end of this chapter and online at the IDAH$_2$O website. The remainder of this chapter describes the various kinds of data you'll collect when you do the standing water assessment.

Standing water habitat assessment

Inlets/Outlets

You may find it useful to conduct IDAH$_2$O stream monitoring on the lake's inlets and outlets. By monitoring water inlets, you may be able to determine if they are significant contributors of pollution, or if fluctuations in the levels of various parameters in the inlet correlate with fluctuations in your lake. For example, do "spikes" in phosphate and nitrate and decreases in water clarity in the inlet correlate with increased algal growth in your lake? Monitoring the outlet may be useful in determining if the lake is contributing to downstream sediment or nutrient loading. It may also gauge the effect your lake has on water quality as it passes through the system.

Use caution, however, when drawing conclusions of cause and effect. Many unmeasured variables may be contributing to water quality, such as rainfall directly on the lake, groundwater flows from underground aquifers, leaking city sewers, and private septic systems. Your monitoring information can identify trends or send up "red flags" to a potential problem, but it will probably not tell the full story of what is happening within your waterbody.

Lake banks

Documenting the condition of the lake banks over time may be useful. In the IDAH$_2$O database and on your standing water assessment field form, you will be able to give a written description of your lake banks. Be sure to include approximate relative distances if possible (e.g., most of south shore is riprap covered, west shore from southern riprap to Eagle Point is the gently sloping grass bank of Swan State Park, rest of west shore and whole north end is cattails with gently sloping bank, and east shore down to Smith property where the riprap starts is cut bank eroding).

Adjacent land use

Using the same categories for this parameter as in IDAH$_2$O stream monitoring (agriculture, urban, light industrial, etc.), estimate the percentage of each type of adjacent land use. If you want to document changes in land use not reflected in these categories, include them as well.

Standing water physical assessment

Weather

Weather categories are the same as in IDAH$_2$O stream monitoring except for the addition of wind direction and wind speed. Wind direction refers to the direction the wind is coming from.

Water clarity—Secchi disc transparency

A Secchi disc is used to measure water clarity, or how deep a person can see into the water. A Secchi disc is a circular disk, about 20 centimeters

(8 inches) in diameter, painted with black and white quadrants. It is a standard piece of equipment used by scientists and volunteers since its development in 1865 by Professor P. A. Secchi.

Many natural and human-caused factors occurring both inside and outside the lake affect water clarity. Do not assume algal density is directly measured by the Secchi disc!

Inside the lake, water clarity can be reduced by:

- Organisms such as diatoms and plankton
- Dissolved materials that are natural, or unnatural
- Sediment suspended in the water column

Outside the lake, water transparency can be misinterpreted by:

- Human error, such as the observer's eyesight
- Time of day, latitude, and season of the year, which affect the angle at which sunlight strikes the lake surface
- Cloud cover, rain, and other weather conditions
- Water surface conditions, such as waves, sun glare, and surface scum

Because of these factors, transparency measurements taken with the Secchi disc should only be considered a baseline. Proving a direct correlation between algae populations and transparency requires direct measurement of the algal population. A measurement of algal population would include sampling for chlorophyll, which is not a field test.

Water temperature

Take water temperature at a depth of approximately ½ meter (elbow depth).

Water level

The categories IDAH$_2$O uses for water level in lakes are normal, low, and high. Many of you may have the ability to more precisely measure lake water level in terms of inches above or below "normal," and we encourage you to document this on your field form and in the IDAH$_2$O database if possible.

9 REPORTING TECHNIQUE

Secchi disc depth

The following procedures are modified, with permission, from the Illinois Environmental Protection Agency and Northeastern Illinois Planning Commission's *Volunteer Lake Monitoring Program Training Manual*:

1. Remove your sunglasses. If monitoring from a boat, at your monitoring site carefully lower an anchor over the side until it reaches the bottom. The force of the anchor hitting the lake bottom will disrupt a certain amount of bottom sediment. Let out plenty of anchor line so that the boat drifts away from the sediment plume that may have been kicked up by the anchor.

2. Attach the Secchi disc to the tape measure. Lean over the shaded side of the boat or dock and slowly lower the Secchi disc into the water until it is no longer visible.

3. When the disc is no longer in view, mark the tape measure at the water's surface with some type of marker, like a paperclip or clothespin.

4. Lower the disc a few more feet into the water, and slowly raise it back toward the surface. When the disc reappears, mark the tape measure at the water's surface with another marker. Bring the tape measure and disc back into the boat.

5. Form a loop between the two markers. Use a third marker to mark the center of the loop. This marks the "average" of the two readings and is considered to be the Secchi depth. Record the results on the IDAH$_2$O standing water assessment field form.

In some shallow lakes, it is impossible to get a Secchi disc reading because the disk hits the bottom before vanishing from sight. This means the true Secchi disc reading is greater than the depth of the lake in that location. In this case, use a transparency tube to get a reading of water clarity and record your results on the standing water assessment field form.

Sometimes the Secchi disc is lost from view because it disappears into a dense growth of rooted aquatic plants. Try moving a few feet away to improve your view of the Secchi disc through the vegetation. If this doesn't work, use a transparency tube to get a reading of water clarity and record the result.

Water odor

The water odor categories used in lake assessments are the same as those used in stream monitoring, with the exclusion of the category "musky" and addition of "fishy."

Standing water chemical assessment

Remember, you are doing point sampling at a specific depth. To collect water samples for chemical assessments submerge the sample bottle upside down into the water to elbow depth ($^1/_2$ meter), turn the bottle right side up, and gently lift the bottle out of the water. Use a separate water sample for each chemical parameter you are monitoring.

pH

Once you've collected your sample, follow the reporting technique given in this handbook for stream samples (chapter 7). For more information on pH, also see chapter 7.

Dissolved oxygen

The amount of dissolved oxygen (DO) in water is an important indicator of lake health, and many experts consider it to be the most important parameter used to characterize lake water quality. DO plays a crucial role in determining the types of organisms that can live in a lake. Some species, such as many sport fish, need consistently high oxygen concentrations to survive. Other aquatic species are more tolerant of low or fluctuating concentrations of oxygen. Oxygen is supplied naturally to a lake through the diffusion of atmospheric oxygen into the water (enhanced by wind and waves) and through its production during photosynthesis by aquatic plants and algae.

Water temperature affects the capacity of water to retain dissolved oxygen. Cold water can hold more oxygen than warm water. Therefore, a lake will typically have a higher concentration of dissolved oxygen during the winter than the summer.

Algae and aquatic plants produce oxygen as a by-product of photosynthesis, but they also take in oxygen for respiration. Respiration occurs all the time in both plants and animals, but photosynthesis occurs only in the presence of light. Consequently, a lake that has a large population of algae or plants can experience a great fluctuation in dissolved oxygen concentrations during a 24-hour period. In extreme cases, respiration by plants and animals can deplete the oxygen in water during the late evening and pre-dawn hours.

Once you've collected your sample, follow the dissolved oxygen reporting technique given in this handbook for stream samples (chapter 7).

Chloride

Chloride is an optional monitoring parameter.

Once you've collected your sample, follow the chloride reporting technique given in this handbook for stream samples (chapter 7). More information on chloride is also available in chapter 7. Remember to convert the Quantab units into mg/L using the chart provided on the vial.

Nitrate-N

You'll monitor for nitrate-N only during snapshot events. Once you've collected your sample, follow the snapshot technique given for nitrate-N in chapter 7. For more information on nitrogen in surface water, see chapter 7.

Total phosphorus

You'll monitor for phosphorus only during snapshot events. Phosphorus is essential to plant growth and reproduction. Plants and algae most readily take up a form of phosphorus known as orthophosphate, or free phosphate, which is the simplest form of phosphorus found in natural waters. Orthophosphate is so quickly taken up by growing algal populations that, if present, it is typically found in low concentrations. Since phosphate is taken up more readily than nitrate, it is often regarded as a limiting resource for algal growth.

Once you've collected your sample, follow the snapshot technique given for phosphorus in chapter 7. For more information on phosphorus in surface water, see chapter 7.

photo courtesy IDAH$_2$O

Standing water biological assessment

Plankton and water color

Algae act like very small plants. They contain chlorophyll and perform photosynthesis, but they do not have true roots, stems, or leaves. Algae grow in many forms. Some species are microscopic single cells; others grow as masses (colonies) or strands (filaments). Some even resemble plants growing on the lake bottom.

Like all plants, algae require light, a supply of nutrients, and specific temperature ranges to grow and reproduce. Of these factors, it is usually the supply of nutrients that will have the greatest impact on algal growth. In most lakes, increasing the supply of nutrients (especially phosphorus) in the water will usually result in a larger algal population.

Excessive growth of one or more species of algae is called an algal bloom. Algal blooms, which usually occur in response to an increased supply of nutrients, are often a disturbing symptom of human-induced eutrophication.

Blooms of algae can give the water an unpleasant taste or odor, reduce clarity, and color the lake a vivid green, brown, yellow, or even red. These blooms can even be toxic to humans and animals. Filamentous and colonial algae are especially troublesome because they can mass together to form scum or mats on the lake surface. These mats can drift and clog water intakes, foul beaches, and ruin recreational opportunities.

Record any significant colors in the water column that may be caused by an algal bloom.

Aquatic plants

IDAH$_2$O does not have methods for surveying aquatic plants. If you know the names of aquatic plants and wish to document a plant list, please include the list on the standing water assessment field form and in the IDAH$_2$O database under Other Observations and Notes.

Also important in monitoring lakes is keeping an eye out for the presence and growth of aquatic invasive plants. Report any occurrence of invasive plants on the field form and in the IDAH$_2$O database under Other Observations and Notes.

Benthic macroinvertebrates

If you wish to include benthic macroinvertebrate sampling in your monitoring program, you are encouraged to use the methods from the IDAH$_2$O stream biological assessment and conduct your sampling near the shoreline. Report the microhabitats you sample, such as boat docks, shore cobble, etc.

You will probably encounter a lesser variety and abundance of benthic macroinvertebrates in a lake than you would in a stream. Even though variety may be lacking, benthic macroinvertebrate populations in a lake should thrive. Common inhabitants in lakes and ponds include filter-feeding mayflies, predatory alderflies that live buried in sediments, caddisflies that produce portable protective cases, aquatic worms, water boatmen, water striders, crawfish, and fly larvae.

Standing water assessment

Recommended frequency—monthly from ice-out to freeze-over

Date ____________ Time _________ IDAH$_2$O monitor # ___________ Site number _____________

# of adults (including you)__________ # under 18___________________

Other volunteers involved ____

____

Site description ____

____

Site location ____Open water _____Shore or dock

PHYSICAL ASSESSMENT

Weather (*check all that apply*)

___Sunny ___Partly sunny ___Cloudy ___Rain/Snow ___Windy ___Calm

Air temperature ______ °Fahrenheit

Precipitation ______ inches over the last 24 hours

Wind direction (*check one*)

_______Not applicable
_______North
_______South
_______East
_______West
_______Northeast
_______Northwest
_______Southeast
_______Southwest

Wind speed (*check one*)

_______Calm (0–5 mph, felt on face, leaves rustle)
_______Breezy (sustained 5–15 mph, small branches move)
_______Gusty (15+ mph, small trees sway occasionally)
_______Strong (sustained over 15 mph, small trees sway continuously, waves form)

Secchi disc depth ____.____ meters OR **Transparency tube** _______ cm (record whole numbers only)

Water temperature ____ °Fahrenheit

Water level (*check one*) _____Above normal _____Normal _____Below normal
Inches above or below normal _____________

Water odor (*check all that apply*)
___None ___Sewage/Manure ___ Rotten eggs __Petroleum ___Fishy

CHEMICAL ASSESSMENT

Use point sampling technique!

pH Expiration date on bottom of bottle _______
(*check one*) ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 9

Dissolved oxygen (mg/L) Expiration date on back of color comparator _______
(*check one*) ___ 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12

Chloride Expiration date on bottom of bottle _______
__________ mg/L—Convert Quantab units to mg/L using the chart provided on the bottle

BIOLOGICAL ASSESSMENT

Water color
Is there an obvious algal bloom? (*algal mats present, water appears green or scummy*)
____ No ____ Yes (*if yes, please submit a photo record*)

Benthic macroinvertebrate assessment
Use the IDAH$_2$O Biological Assessment Field Form to record your data.

HABITAT ASSESSMENT

Conduct only once per year, preferably in July, or if a major land use change occurs.

Describe lake banks ____
____
____
____

Describe adjacent land use ____
____
____
____

Other observations and notes ____
____
____
____
____

photo by Lisa Kyle Young

10 SUBMITTING AND INTERPRETING DATA

Monitor identification number

Every Master Water Steward will receive an IDAH$_2$O monitor identification number once becoming certified. You will write this number on all your assessment field forms and enter it when submitting data online. Your identification number will be different from your site's registration number.

Registering a monitoring site

As a certified Master Water Steward, you will be allowed to register one or more monitoring sites. These sites can be chosen either by you or by IDAH$_2$O program staff. In order to register a monitoring site, you'll need coordinates of the location. These can be obtained with a map, GPS, or online. Ask your IDAH$_2$O coordinator if you have any trouble locating the coordinates of your site.

Each registered site will also be assigned an identification number, the site number. This will be different from your monitor identification number.

Entering data online

The IDAH$_2$O program hosts an online database where Master Water Stewards can post their data. Once you have become a Master Water Steward and have registered a monitoring site(s), links to the database will be provided to you. The database will also be accessible via our website for the public to view the data.

When entering data, please follow directions closely. Once you have submitted your data, you will not be able to go back in and edit it. Any changes will need to be emailed to the IDAH$_2$O coordinator.

Assessment field forms online

Field forms for the IDAH$_2$O assessments are available online at the IDAH$_2$O website and can be downloaded.

What is "typical"?

You may have to spend some time researching to find out if your body of water is "typical." You might try to compare your stream to similar streams or compare stream segments above and below a potential pollution source. Data are only numbers. Trends and departures from "typical" don't become apparent until you have collected data over a period of time under a variety of conditions. This allows you to become familiar with the waterbody, determine what readings are to be expected, and what values might be considered atypical.

In some cases, state agencies, volunteer groups, county conservation boards, high school or college instructors, or others may have some historical water quality data to jump start this process. Often, however, data holes exist. This is why you, the citizen monitor, are of vital importance. If nobody knows a problem exists, nobody cares. When problems are brought to light, the focus on solutions can begin.

Unusual sampling results

As you probably realize by this point, water quality monitoring is affected by many variables, and your data can be challenging to interpret. As a citizen monitor, you may measure water quality parameter values that are unusual or exceed water quality criteria. Many factors determine whether an actual water quality violation has occurred.

While they may not necessarily indicate unusual sampling results, please consider contacting IDAH$_2$O if you encounter any of the following:

In chemical/physical assessments:

- Dissolved oxygen values of 5 or less (1–5 mg/L)
- pH values of 6 or less (4, 5, 6)
- Chloride values of 100 or greater ($\geq$ 100 mg/L)

In biological assessments:

- No benthic macroinvertebrates
- Only benthic macroinvertebrates from the low water-quality group (particularly bloodworms) in very high abundance

As you examine what appear to be unusual data, keep in mind that many parameters will exhibit seasonal shifts. Nitrate levels rise sharply in the spring and then fall off throughout the growing season. Populations of benthic macroinvertebrates change in composition as some insects complete their annual aquatic life cycles. Water temperatures in many streams steadily increase through the summer and decrease again in the fall.

Some parameters are quite sensitive to rain. A heavy overnight rain can cause dramatic changes in chemical levels. This is important to document over time but is not a cause for an emergency response.

If you find abnormal values for a certain parameter, reread the section on the parameter in this manual to give you a background about its characteristics.

Dramatic change refers to relatively short-term changes that contradict what you would expect to find. For example, suppose your first benthic sample contained six high water-quality critters, two middle water-quality critters, and one low water-quality critter. Now suppose your next sample 2 months later gave you no high water-quality critters, no middle water-quality critters, and six low water-quality critters. This is a dramatic shift in species makeup over a relatively short period of time and should be reported to the IDAH$_2$O program.

Once a problem has been documented, IDAH$_2$O believes that effective and long-lasting change should involve local units working together to develop solutions and achieve results. Remember, IDAH$_2$O is about results, not regulations!

When to involve law enforcement or IDAH$_2$O staff

In some cases, notification of local law enforcement or IDAH$_2$O staff is needed:

- There is evidence of criminal activity that is immediately dangerous to yourself or the surrounding environment (e.g., illegal drug activity). Leave the area immediately and call the sheriff or local law enforcement.
- Off-roading or mudding is causing resource damage. Report your observations to the authorities in that jurisdiction or to the U.S. Forest Service if the activity is occurring on federal land.
- There is evidence of dangerous pollution discharges, fish kills, or public health hazards. Report your observations immediately to the Idaho Department of Environmental Quality Surface Water Division field office for your area. Be sure to document the location and collect visual information, but do not disturb the area or evidence.

- There has been a dramatic shift in the makeup of your stream's benthic macroinvertebrates. Contact IDAH$_2$O staff.
- Your results for a given parameter exceed water quality standard limits, or you are otherwise concerned about them. In these cases, first check the expiration dates of your equipment and double and triple check your results. It would also be helpful to have someone else sample the same site independently to see if they get the same result. If you are getting the same results, contact IDAH$_2$O staff.
- You find evidence of excessive chemical or petroleum inputs. If oily sheens are present, first conduct a simple test to determine whether or not the sheens are natural. Poke the sheen with a stick. If the sheen swirls back together immediately, it's petroleum. If the sheen breaks apart and does not flow back together, it is from bacteria or plant or animal decomposition. If you think the input could result in an immediate hazard, call your local Idaho DEQ field office.

Under no circumstances should a volunteer monitor confront a private landowner or commercial entity in an attempt to assess or rectify these types of situations!

If you have questions about anything at any time, please contact IDAH$_2$O for assistance—idah2o@uidaho.edu.

Your credibility as a Master Water Steward

Be careful when trying to interpret data. It is often difficult to determine cause and effect and doing so may take years of monitoring. Your credibility may take years to build but only an instant to destroy. To build credibility, adhere to the IDAH$_2$O code of ethics and contact IDAH$_2$O if you believe your data may be revealing a problem.

Glossary

Acid rain. Rain with a pH of 4.5 or less.

Aerobic. Life or processes that depend on the presence of oxygen.

Aggrading stream reach. Deposition is greater than erosion within the stream reach.

Algae. Green plants that occur as microscopic forms suspended in water (phytoplankton) and as unicellular or filamentous forms attached to rocks and other substrates. These plants lack roots, stems, flowers, and leaves, live mainly in water, and use the sun as an energy source.

Algal bloom. A sudden increase in the abundance of suspended (planktonic) algae, especially at or near the water surface, producing a green appearance to the water. Excess nutrient can cause an algal bloom.

Alkalinity. A measure of water's ability to neutralize acid.

Ampoule. A sealed, bulbous glass tube that contains a liquid product. Ampoules are used in the orthophosphate and dissolved oxygen field kits.

Anaerobic. Refers to life or processes that occur in the absence of oxygen.

Anaerobic decomposition. The breakdown of organic material without oxygen.

Anoxia. A condition of no oxygen in the water. Often occurs near the bottom of eutrophic, stratified lakes in summer and under ice in winter.

Aquatic community. All the groups of plants and animals occupying a common body of water.

Bank. The portion of the stream channel that restricts the movement of water out of the channel during times of normal water depth. This area is characterized as being the exposed areas on either side of the stream above water level.

Baseline. A level or concentration that is the norm.

Baseflow. That portion of stream flow originating from groundwater discharging into the stream.

Basin. Another word for a watershed.

Benthic. Describes all things associated with the bottom, or sediments, of a stream.

Benthic macroinvertebrates. Bottom-dwelling organisms that lack a backbone, inhabit streams or lakes, and can be seen with the naked eye.

Benthic zone. The zone on the bottom of moving or standing waters.

Bioaccumulation. The build-up of toxic substances in animal flesh.

Biodiversity. Biological diversity in an environment as indicated by the numbers of different species of plants and animals.

Biomass. Living things and their by-products.

Biotic index. A numerical value that describes the biological integrity of aquatic communities for a waterbody.

Canopy cover. Overhanging vegetation that provides shade to a stream.

Carrying capacity. The number of individuals the resources of a given area can support.

Channelization. The straightening of streams by eliminating the meanders or bends. A channelized stream resembles a ditch with few or no meanders.

Chemical weathering. Erosion caused by chemical reactions (e.g., rainwater dissolving limestone).

Chlorophyll. Green plant pigments that are necessary for photosynthesis; may be used as an indicator of algal population levels in a stream or lake.

Collectors. Benthic macroinvertebrates that eat decomposing organic matter (filter feeders).

Confined aquifer. An aquifer that is protected by an impervious layer of rock.

Cultural eutrophication. Accelerated enrichment of waters due to human activities. Excess nutrients from agricultural runoff, sewage, or other sources allow waters to support a higher amount of plant and animal matter than they would naturally.

Decomposer. An organism that feeds on and breaks down dead plant or animal matter, thus making organic nutrients available to the ecosystem.

Dead zone. An area of the Mississippi River delta that cannot support aquatic life during certain times of the year due to low dissolved oxygen levels.

Degrading stream reach. A stream reach where erosion is greater than deposition.

Denitrification. The process of converting nitrate nitrogen into nitrite nitrogen, which can convert to nitrogen gas and escape into the atmosphere.

Discharge, Flow. A measure of how much water passes a given point in a given time (m^3/s).

Discharge permits. The maximum amount of a pollutant that an entity is permitted to release into a waterbody.

Dissolved oxygen. The amount of oxygen dissolved in water. Higher amounts of oxygen can be dissolved in colder waters than in warmer waters. Dissolved oxygen is necessary to support fish and other aquatic organisms.

Diversity. A large variety of organisms.

Dystrophic. Low in nutrients; highly colored with dissolved humic organic matter.

Ecology. The study of relationships among living and nonliving things.

Ecoregion. Large area within which local ecosystems reoccur in a more or less predictable pattern. Ecoregions provide a spatial framework for ecosystem assessment, research, inventory, monitoring, and management.

Ecosystem. A community of animals, plants, and microorganisms interacting within the physical and chemical environment.

Embeddedness. The degree that larger particles (boulders or gravel) in a stream are surrounded or covered by fine sediment.

Emergent vegetation. Plants living along the edges (or banks) of a stream that are rooted in sediment but grow above the water's surface.

Ephemeral stream. A stream that flows during the wet season and is dry in the dry season; see Intermittent stream.

Erosion. The wearing down and removal of soil, rock fragments, and bedrock through the action of running water, wind, moving ice, and gravitational creep (or mass movement).

***E. coli* (*Escherichia coli*).** A bacterium of the intestines of warm-blooded organisms, including humans, that is used as an indicator of water pollution for disease-causing organisms.

Eutrophic. A term used to describe very productive or enriched lakes. These lakes tend to exhibit some or all of the following characteristics: an abundance of rooted plants, elevated turbidity levels due to high algal populations, loss of oxygen in bottom waters during the summer months, rapid accumulation of soft bottom sediments, and abundant fish, which may include stunted and/or rough species in the most fertile lakes.

Eutrophication. A gradual increase in the productivity of a lake ecosystem due to enrichment with plant nutrients, leading to changes in the biological community as well as physical and chemical changes. This is a natural process, but can be greatly accelerated by humans (see Cultural eutrophication).

Fecal coliform bacteria. The portion of the coliform group that is present in the gut or feces of warmblooded organisms. The presence of fecal coliform bacteria in water is an indication of pollution and potential human health problems.

Filamentous. Refers to cells appearing as attached, hairlike growths, often as waving strands in the water.

Floodplain. An area on both sides of a stream where flood waters spread out during high flow. The surface may appear dry for most of the year, but it is generally occupied by plants adapted to wet soils.

Flow, Discharge. A measure of how much water passes a given point in a given time (m^3/s).

Gaining stream. A stream that receives its baseflow from the groundwater system.

Geographic Information System. A mapping application that uses different overlaid layers of information to represent the earth's surface.

Geography. Study of land (what it looks like, what it's used for, etc.), the things living there, the people (who they are and what they do), the interactions among these things, and their locations.

Geology. The study of the earth's history, the materials that make up the earth, and the processes that act on the earth.

Glacial till. Unsorted material deposited by a glacier.

Grazers. Benthic macroinvertebrates that eat algae and diatoms off other surfaces.

Groundwater. Water found beneath the earth's surface.

Habitat. The place where a plant or animal lives that has all of the conditions necessary to support its life and reproduction.

Habitat diversity. The range of habitats within a region.

Hydrogeology. The effect geology has on water quality and stream morphology.

Hydrologic unit code (HUC). A description of watersheds that indicates size and location of particular watersheds; a watershed address.

Hydrologic cycle. The continuous movement of water among the oceans, air, and the earth in the form of precipitation, percolation, evapotranspiration, and stream discharge.

Hydrology. The science of how water flows on top of, and below, the earth's surface.

Hypereutrophic. Refers to murky, highly productive waters, closest to the wetlands status. Many aquatic species cannot survive in them.

Hypoxia. A condition of low dissolved oxygen levels in a waterbody that can result from the decay of plants and algae.

Immobilization. The process of converting inorganic forms of nitrogen into organic forms.

Impervious. Water cannot pass through; waterproof.

Indicator species. Groups or types of organisms used to assess the environmental health of a waterbody.

Infiltration rate. The rate at which water soaks into the soil.

Inorganic. Any compound not containing carbon.

Intermittent stream. A stream that flows when there is adequate precipitation and is dry when there's not. The stream does not flow continuously.

Invertebrate. An organism without a backbone.

Lake. A large body of water that has water all year long.

Lake turnover. The circulation of the entire water column that occurs in spring and autumn.

Leaf litter. Plants and plant parts that have recently fallen and are partially or not at all decomposed.

Leaf pack. Any cluster or gathering of leaves and organic debris on the edges of streams or washed up on the upstream side of large rocks, fallen trees, or logs in the stream.

Left bank. When facing upstream, the bank to your left.

Lentic water. Standing water, such as lakes, ponds, and wetlands.

Limiting resource. A resource that limits the abundance of an organism.

Loamy soil. Material composed primarily of sand and silt particles with some clay present.

Losing stream. A stream that loses flow to the groundwater system.

Lotic water. Flowing water, such as rivers and streams.

Macroinvertebrate. An animal large enough to be seen that does not have a backbone.

Meander. A bend in a stream.

Mesotrophic. A term used to describe lakes that are moderately productive. These waters contain more nutrients and, therefore, more biological activity.

Metamorphosis. A series of changes in body structure (form) from egg to adult.

Methemoglobinemia. The presence of methemoglobin in blood caused by poisoning by certain substances, such as nitrate. Young babies (less than 6 months old) are particularly susceptible to methemoglobinemia, leading to a condition known as "blue baby syndrome," which if untreated can cause death.

Microhabitat. Local conditions that immediately surround an organism. Microhabitats include algae mats, leaf packs, logjams, rock piles, root wads, undercut banks, and weed beds.

Mineralization. The process of decomposition and transformation of organic nitrogen found in plant parts and animal manure into available forms of inorganic nitrogen.

Niche. The function or position of an organism or population within an ecological community, or the particular area within a habitat occupied by an organism.

Nitrate. A form of nitrogen. Nitrate is water soluble and is the most common form of nitrogen found in streams and lakes.

Nitrogen. An element necessary for the growth of aquatic plants. It may be found in several forms, including nitrate, nitrite, and ammonia. Nitrogen is considered to be limiting because it is needed by plants and animals in the stream in moderate amounts. When present in higher amounts, such as from large amounts of fertilizer runoff from local farm fields or urban lawns, large algal blooms occur, which can result in a depletion of dissolved oxygen.

Nitrogen cycle. The uptake of inorganic nitrogen by plants that convert it to organic forms, which are used by animals and transformed back into inorganic nitrogen by bacteria.

Nitrification. The process of converting ammonium nitrogen into nitrate nitrogen.

Nonpoint source pollution. A type of pollution whose source is not readily identifiable as any one particular point, such as pollution caused by runoff from streets, agricultural land, construction sites, and parking lots. Polluted runoff and pollution sources not discharged from a single point.

Nutrient. Any of a group of elements necessary for the growth of living organisms, such as nitrogen and phosphorus. Excessive supplies of phosphorus or nitrogen, however, may enhance plant growth in surface waters.

Nutrient enrichment. Elevated levels of nitrogen and/or phosphorus in a waterbody that result in nuisance growths of algae or other aquatic plants.

Organic matter. Plant and animal material.

Organic phosphate. Phosphates that are found in plant and animal tissue, waste solids, or other organic matter.

Orthophosphate. Inorganic form of phosphorus.

Oxbow lake. Lake formed when a river meander is completely cut off from the river.

Pathogen. An organism capable of causing disease.

Pathogenic. Capable of causing disease.

Perennial stream. Stream that flows nearly all year long.

Periphyton. Organisms attached to or clinging to the stems and leaves of plants or other objects projecting above the stream bottom of freshwater ecosystems. They may be in the form of algae attached to large rocks or tiny plants and animals living on surfaces below water.

Perennially pooled conditions. Intermittent streams may cease to flow from year to year, but those that don't dry up completely often maintain pools of water throughout the year.

Pervious. Allows water to pass through.

Pesticides. Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term also applies to herbicides, fungicides, and various other substances used to control pests.

pH. A measure of acidity or alkalinity on a scale of 0 to 14. A pH of 7 is neutral, less than 7 is acidic, and greater than 7 is alkaline (basic).

Phosphorus. An element necessary for the growth of aquatic plants. Elevated levels of phosphorus can affect water quality by increasing the production of algae and rooted plants. This can lead to eutrophication of waterbodies.

Phosphorus cycle. The process of orthophosphate being converted to organic phosphate by plants and animals and converted back to inorganic phosphate and recycled when they die and decay.

Photosynthesis. The process by which green plants produce oxygen from sunlight, water, and carbon dioxide.

Physical weathering. Erosion caused by mechanical forces (e.g., water expanding as it freezes and breaking apart rocks).

Phytoplankton. Algae that are microscopic and suspended in water.

Plankton. The community of microorganisms consisting of plants (phytoplankton) and animals (zooplanton) inhabiting open-water regions of lakes and rivers.

Point sampling. Sampling from a specific depth, or point, in the lake water column.

Point source pollution. Pollutants originating from a "point" source, such as a pipe, vent, or culvert.

Point source contamination. Contamination stemming from a single, isolated source, such as a drainpipe or an underground storage tank.

Pollution. An undesirable change in the environment, usually the introduction of abnormally high concentrations of hazardous or detrimental substances, such as nutrients or sediment. The presence of any substance that harms the environment.

Pollution-sensitive organisms. Organisms that cannot withstand the addition of pollution to their aquatic environment.

Pollution-tolerant organisms. Organisms that can withstand polluted environments.

Pond. Body of water that has water in it year-round but that is smaller than a lake.

Pool. That portion of a stream that is deep and slow moving, often following a riffle.

Predators. Benthic macroinvertebrates that eat other animals.

Producers. Organisms that produce their own food through photosynthesis.

Recharge areas. Areas that allow surface water to infiltrate and recharge groundwater.

Respiration. Oxygen consumption in living organisms.

Riffle. That portion of a stream that is shallow and fast moving. An area of the stream where shallow water flows swiftly over completely or partially submerged rocks or other debris.

Right bank. When facing upstream, the bank to your right.

Riparian zone. An area adjacent to and along a watercourse that is often vegetated and constitutes a buffer zone between nearby lands and the watercourse. The natural plant community adjacent to a stream.

Riprap. Any material (such as concrete blocks, rocks, car tires, or log pilings) that may have been used to stabilize a stream from erosion.

Row cropping. A method of farming used in the production of corn and beans.

Run. A stream habitat type characterized as having a moderate current, medium depth, and smooth water surface.

Runoff. Water from rain, snowmelt, or irrigation that flows over the ground surface and runs into a waterbody.

Sanitary sewer. A pipe that carries food and human wastewater to a municipal sewer system or a septic system.

Stormwater sewer. A pipe that transports stormwater and meltwater runoff from roads and parking lots to streams and lakes. Stormwater sewers rarely lead to any type of treatment facility; the water is piped directly to streams and lakes.

Secchi disc. A device used to measure the depth of light penetration in water.

Sediment. Eroded soil particles (soil, sand, and minerals) transported by water.

Sedimentation. The process by which soil particles (sediment) enter a water body, settle to the bottom, and accumulate. The addition of soils to lakes or streams.

Shredders. Benthic macroinvertebrates that eat living plant tissue.

Silt. Fine particles of soil and minerals formed from erosion of rock fragments.

Siltation. The process of silt settling out of water and being deposited as sediment.

Slope. Change in elevation over a given distance.

Stable stream reach. A stream segment where sediment deposition is equal to erosion (i.e., no net gain or loss of sediment within the reach). It maintains its dimensions, pattern, and profile through time.

Streambank. The sides of the stream that contain the flow, except during floods.

Streambed. The bottom of a stream where the substrate and sediments lie.

Stream depth. A measurement of the depth of a stream from the water's surface to the streambed.

Stream energy. Erosion potential of a stream.

Stream flow. The amount of water moving in a stream in a given amount of time.

Stream morphology. The shape of a stream.

Stream order. Stream classification system.

Stream reach. A specified length of stream.

Stream transect. An imaginary line drawn from water's edge to water's edge perpendicular to the flow of the stream.

Substrate. The surface upon which an organism lives or is attached. The material making up the bottom of the streambed.

Suspended load. Sediment that is transported in suspension.

Thalweg. Area of concentrated flow in a stream channel.

Thermal pollution. The raising of water temperatures by artificial means that interferes with the functioning of aquatic ecosystems. Sources of thermal pollution include removal of trees along streams, introduction of cooling water from power plants or other industrial facilities, and runoff from hot paved surfaces.

Tile lines. Drainage pipes used to remove water from an area.

Tolerant species. An organism that can exist in the presence of a certain degree of pollution.

Topographic map. A map representing the surface features of a particular area. Features illustrated include streams, lakes, roads, cities, and elevation.

Topography. What the surface of the earth looks like.

Total coliform bacteria. A group of bacteria that is used as an indicator of drinking water quality. The presence of total coliform bacteria indicates the possible presence of disease-causing bacteria.

Transparency. The measure of water clarity. Transparency is affected by the amount of material suspended in water (i.e., sediment, algae, and plankton).

Trophic status. The level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration.

Turbidity. The presence of sediment in water, making it unclear, murky, or opaque.

Universal Transverse Mercator (UTM). A grid system that divides the globe into 60 north-south zones, each covering a strip 6° wide in longitude. In each zone, coordinates are measured north and east in meters. The coordinates, known as UTM coordinates, are made up of one 6-digit X number and one 7-digit Y number, which describe how far north the point is from the equator and how far east it is from the next zone to the west.

Velocity. The speed at which water moves.

Vertebrates. Animals with backbones.

Vertical stratification. Incomplete mixing of water in a water body.

Water cycle. The continuous circulation of water in systems throughout the earth involving condensation, precipitation, runoff, evaporation, and transpiration.

Water ecology. The study of aquatic environments and the relationships among the living and nonliving things associated with those environments.

Water quality. The condition of the water with regard to the presence or absence of pollution.

Watershed. A region or area of land that drains into a body of water such as a lake, river, or stream.

Wetland. Shallow body of water that may not have water in it year round.

Zooplankton. Microscopic aquatic organisms.

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Appendix I
Equipment Request Form

Send your requests to:
$IDAH_2O$, University of Idaho Extension, 1031 North Academic Way #242, Coeur d'Alene, Idaho 83814, or email your request to idah2o@uidaho.edu.

Name: ____

ID: ________________________Site Number(s): _____________________________________

Address: ____
Street City State Zip

Equipment (*please fill in quantities needed)*:
______Not applicable
______CHEMets dissolved oxygen refills
______CHEMets dissolved oxygen color comparator
______Hach pH test strips
______Hach chloride titrators
______Other: ____

Appendix II

Calculating stream flow, average depth, and average stream velocity

During the IDAH$_2$O workshops, a number of people have requested that we provide the formulas used for calculating average stream depth, average stream velocity, and total flow.

The calculations include the following abbreviations and symbols:

SD = stream depth (in meters). SD_1 is the stream depth at spot 1, SD_2 is the stream depth at spot 2, and so on along the stream transect.

n = number of spots along the transect

W = width of box at each spot; 1 m is used in IDAH$_2$O measurements

SV = stream velocity (1 meter divided by seconds measured; in meters per second)

∗ = multiply

÷ = divide

Average stream depth *(meters)*

Average stream depth = $[SD_1 + SD_2 + \cdots + SD_n] \div n$

Note: Be sure to convert the measurement from centimeters to meters.

Total flow *(cubic meters per second or m^3/s)*

Imagine a box placed around each spot on your stream transect. Flow is determined for each box and summed for all boxes.

Flow associated with each box is calculated by multiplying the width of the box at each spot (1 meter) by stream depth (which you measure) by the velocity at the spot. In the field you measure the number of seconds it takes for the tennis ball to travel 1 meter; velocity is 1 meter divided by the number of seconds. The flow of each box is added together to give total flow:

Total flow = $(W_1 * SD_1 * SV_1) + (W_2 * SD_2 * SV_2) + \cdots + (W_n * SD_n * SV_n)$

Average stream velocity *(meters per second or m/s)*

Average stream velocity is calculated by dividing total flow by the cross-sectional area of your transect. The cross-sectional area is determined by calculating a cross-sectional area for the box at each spot of your transect and then summing the cross-sectional areas:

Average stream velocity = Total flow $\div [(W_1 * SD_1) + (W_2 * SD_1) + \cdots + (W_n * SD_n)]$

Example

Sally and Bill measure stream width, depth, and velocity for Jack Creek. Jack Creek is 4.2 meters wide.

	Stream depth (meters)	Stream velocity (meters ÷ seconds)
Spot 1	0.21	1 meter/8 seconds (0.125)
Spot 2	0.45	1 meter/4 seconds (0.25)
Spot 3	0.62	1 meter/3 seconds (0.33)
Spot 4	0.35	1 meter/7 seconds (0.143)

Average stream depth = (0.21 m + 0.45 m + 0.62 m + 0.35 m) ÷ 4
= 0.41 m

Total flow = (1 m ∗ 0.21 m ∗ 0.125 m/s) +
(1 m ∗ 0.45 m ∗ 0.25 m/s) +
(1 m ∗ 0.62 m ∗ 0.33 m/s) +
(1 m ∗ 0.35 m ∗ 0.143 m/s)
= 0.39 m^3/second

Average stream velocity = 0.39 m^3/second ÷
[(1 m ∗ 0.21 m) + (1 m ∗ 0.45 m) +
(1 m ∗ 0.62 m) + (1 m ∗ 0.35 m)]
= 0.24 m/s

Appendix III

Making and using an IDAH2O-approved sampling device

Using a number 2 plastic jug (1/2 gallon milk jugs work great), cut from the opening down a few inches to the neck, then across and back up to the opening. Cut a V-shaped notch directly across from the handle. Tie a rope to the handle and your sampling device is complete.

To sample with this device, follow these steps:

1. Avoid contamination by not allowing the sampling device or rope to touch the ground.

2. Lower the sampling device down to the stream on the upstream side of the bridge. If there are safety concerns, sampling may occur on the downstream side, but note the location in your comments.

3. Partially fill the sampling device. You may need to bounce the sample device up and down a few times to allow water to enter. Be careful not to disturb the bottom sediments during this process.

4. Retrieve the sampling device, swish the water around, and empty it on the road behind you, not into the stream. Repeat this process a total of three times.

5. Fill the device a fourth time and begin monitoring. Refill the device as needed to complete all of the assessments.

Contact Information

IDAH2O
University of Idaho Extension
1031 North Academic Way #242
Coeur d'Alene, ID 83814
Phone: 208-292-1287
E-mail: *idah2o@uidaho.edu*
Web: *www.uidaho.edu/cda/idah2o*

University of Idaho Extension