GUIDE TO

Volunteer Stream Monitoring

VOLUNTEER STREAM MONITORING

DEVELOPED BY THE

VOLUNTEER STREAM MONITORING PARTNERSHIP

FOR THE TWIN CITIES METROPOLITAN AREA, MINNESOTA

Volunteer Stream Monitoring Partnership

GUIDE TO

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Volunteer Stream
Monitoring Partnership

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VOLUNTEER STREAM MONITORING

kingfisher
frog
stonefly

The Role of Volunteers

In Minnesota and around the world, citizens are becoming increasingly concerned about water quality and water resources. Their interest may inspire community projects, political action, or water quality monitoring. Citizen organizations, individuals, and student and youth groups are involved in monitoring the health of streams, lakes, and wetlands across Minnesota. This guide to volunteer stream monitoring will provide direction for new volunteers as well as those looking to expand or enhance the monitoring they already do.

Volunteers have many interests and different reasons for becoming involved in monitoring water quality. You may feel that there is a problem with a nearby stream and want to investigate the cause. You may organize monitoring as part of an interdisciplinary school curriculum in environmental science, biology, chemistry, or social studies. Your group may simply want to 'see what's out there' for their own interest, or you may want to initiate a community action project. In some cases, volunteers may be recruited to provide baseline data or information that a government agency can use to improve decision-making in their watershed. Following proper sampling methods and analytical protocols, and ensuring quality assurance become more critical when the data will be used for decision-making or research.

Whatever your reasons for getting involved, there's a range of monitoring options that will match your goals, skill level, and available resources. Before beginning, it's important to determine what you want to find out through monitoring, and to consider when and how volunteers will monitor your chosen stream site. The monitoring activities described in this guide are examples to get you started assessing the physical, biological, and chemical characteristics of streams and their watersheds.

Designing a Monitoring Program

To make sure the time and effort you invest in monitoring is worthwhile, before setting out for the stream you should spend some time deciding what you want to accomplish. Consider the why, where, when, who, what, and how of monitoring. The *Volunteer Stream Monitoring: A Methods Manual* (EPA 841-B-97-003, Nov 1997) contains detailed protocols and a framework for developing a monitoring plan. You may download methods and data sheets from their website (www.epa.gov/owow/monitoring/volunteer).

WHY MONITOR?

The first step is to identify why you or your group is interested in monitoring. Are you interested in finding out about what lives in a nearby stream? Are you curious why fish or other aquatic organism have died recently? Do you want to help students learn more about water chemistry or analytical methods? Do you want to know more about the impact of stormwater runoff from your neighborhood? Would you like to know whether the water in your stream meets designated uses (fishing, swimming, or drinking)? Would you like to track whether the water quality in your stream is improving or diminishing?Any of those alternatives is possible, but you need to identify which types of measurements will allow you to answer your questions. Work with a local natural resource professional (e.g., SWCD or Watershed District), state agency staff, or a Volunteer Stream Monitoring Partnership (VSMP) coordinator to discuss which parameters you should measure, and when and how often you should sample. They can also help you identify which type of information would be most useful for local decision-makers and how rigorous your methods must be to ensure the data are meaningful.

By carefully considering, *in advance*, why you want to monitor, you'll be better able to use the information you collect to answer the questions you're asking. To make sure that the data you collect will suit your purpose, you'll need to determine the most appropriate parameters, select a suitable location, and determine the best time and frequency for your monitoring visits.

WHAT TO MONITOR

What you monitor for will depend on what you are trying to find out about your stream and its watershed. You might choose to monitor any of a suite of physical, chemical, or biological parameters that will provide information about the health of the stream.

Observing the physical characteristics of the watershed or riparian habitat can help document subtle changes in the stream and watershed over time. It can provide clues as to why some organisms live in your stream and others don't. It will also help you understand more about hydrology and water chemistry. Physical monitoring provides a helpful introductory assessment and usually requires less training, equipment, and time.

Chemical measurements are often said to provide a snapshot of a stream; they tell you what the water is like on a given day, and can allow you to track changes over time. In some respects, chemical sampling is more straight-forward than other monitoring, providing direct measures of water quality that may be easily compared with other sites and other streams. Measuring chemical parameters means using test kits, meters, or analytical equipment and detailed procedures. Thus, it can require more training, equipment, and time.

In some cases, chemical monitoring may not provide the most representative assessment of stream health. Some pollutants may appear in a stream only temporarily, but may have long-term effects on the biological communities. For example, if you are taking chemical measurements, you might not happen to take a sample while the salt concentrations from spring snow melt are high, but the effects of that salt might show up when you monitor macroinvertebrate populations.

Biological monitoring measures the effects of many factors that influence the organisms which live in a stream. Some macroinvertebrates spend years maturing in the stream. Thus, the size and diversity of their population reflect an integration of all stream conditions that occur during their life cycles, such as water chemistry, habitat characteristics, pollutant loading, and changes in water flow or velocity. Certain species are intolerant of pollution and won't be present in streams with degraded water quality or habitat. Biological monitoring adds a significant component to the overall assessment of stream health, and many volunteers find it more engaging. It requires training in proper sampling and identification, access to a microscope, specialized equipment, and interpretation of biological indices.

Choose a mix of biological, chemical, and physical monitoring activities to achieve the most comprehensive picture of the health of your stream.

WHERE TO MONITOR

Selecting the 'right' stream site may be more difficult than it seems. First, you have to decide which stream to sample. That choice may be predetermined if you know you want to test a nearby stream because it's accessible or has problems you want to investigate. If you haven't already chosen a specific stream, consult with local resource professionals. They may have a list of priority streams that lack baseline or current information. They may also be able to let you know if there are other volunteers or professionals monitoring 'your' stream, so that the data that you collect will complement what is collected by others. They may also be able to provide watershed or land use maps, flow levels, or chemical data collected by autosamplers.

Once you've selected the stream, choosing the 'right' spot to monitor also requires some thought. You'll want to find an area that is easily accessible, shallow enough for safety, and meaningful in relation to tributaries or storm inlets. If your site is on private land, it is essential to obtain permission from the landowner to gain access.

Especially for biological monitoring, the type of habitat at your stream site will determine which sampling methods to use. Protocols for sites with riffle and run areas will be different from those used on slower, deeper waters.

WHEN TO MONITOR

Being there at the 'right' time is almost as important as choosing an appropriate site. Determining when you should sample will depend on the questions you are asking. If you want to know what happens to aquatic organisms when water levels drop, you should monitor in the late summer or during a drought. To find out what impact stormwater runoff has on the quality of water in your stream, you may need to be there to sample before, during, and after storm events. To chart the health of a stream over a year, you must sample during more than one season. If you are interested in how the dissolved oxygen levels change overnight, you may need to visit the stream in the early morning hours and again in the late afternoon. To determine whether road salt is a problem for your stream, you would monitor during and after snow melt in the spring.

Your opportunities to monitor may be constrained by availability of volunteers (e.g., students), safety issues (e.g., not during spring flood), or water conditions (e.g., frozen or very low water). VSMP coordinators or a local resource professional can help you determine the most appropriate time for your stream visit and how often you should sample.

WHO SHOULD BE INVOLVED

When you consider 'who,' think about who will be doing the monitoring as well as who will be using the data you collect. Anyone with an interest can become a volunteer stream monitor. Students, senior citizens, church groups, or neighborhood groups can become monitoring teams, or individuals can work in pairs (working solo isn't recommended because of safety concerns). As you choose what and how often to monitor, keep in mind the age and skill level of your volunteers—if the work is too challenging or too simple, they may lose interest. The level of training required will depend, in part, on what you're monitoring and the experience of the volunteers.

The term ‘monitoring’ implies repeated observations, so try to enlist individuals or a volunteer group that will make a commitment to sampling a stream on an ongoing basis. A field trip to visit or clean up a stream is a good way to engage volunteers, but it wouldn’t be considered monitoring. Experienced volunteers can serve as mentors or trainers to enlist new members to keep the group active.

Another important consideration is who will use the data that volunteers collect and how the data will be presented to them. Local government agencies, elected officials, and citizen leaders may be interested in hearing about the health of the stream you are monitoring. Data about the impact of stormwater may influence decisions about new developments or ordinances. Evidence of erosion problems or excessive trash may lead to community projects such as streambank restoration or clean- ups. You may want to share the data or interpreted results with your city council, county board, Watershed District, or planning commission.

HOW TO MONITOR

This guide will help identify what methods you should follow for different physical, biological, or chemical assessments. It includes data forms for the VSMP program and outlines how important quality assurance requirements are for the various monitoring activities.

The guide IS NOT a methods manual: it references the methods that are most appropriate for Twin Cities streams. Most references are from the U.S. Environmental Protection Agency and are based on protocols approved of and used by professionals. VSMP encourages the use of standardized, accepted protocols to ensure consistency and reproducibility. If you are already monitoring or choose to use different protocols, the data you collect may not be compatible with that collected by other volunteers or professionals, but may still answer the questions you are asking.

One goal of VSMP is to gather stream data into a centralized database so it can be used for broader assessments and decision-making. If you want the data you collect entered into the VSMP database, you must follow proper protocols and quality assurance. For more assistance in fitting the proper sampling protocols to your stream site and becoming part of a larger effort, contact a VSMP coordinator or local resource professional.

All monitoring involves some fundamental assurance of quality. It might be as simple as making sure you’re at the correct stream location or as complex as taking replicate water samples and maintaining a custody log for quality assurance/quality control (QA/QC) purposes. QA/QC procedures range from averaging multiple field measurements, choosing and calibrating the right equipment, and using clean sample bottles, to correct macroinvertebrate identification, proper labeling techniques, and sample storage. Different professionals may have slightly different definitions for QA/QC, so before developing your plans for quality assurance consult with a VSMP coordinator or local resource professional.

The Matrix

The matrix (page 17) offers a range of activities for different purposes and skill levels. It provides a framework for potential volunteers or those looking to expand the monitoring they already do. The activities are examples of the types of monitoring that volunteers may choose; it is not an exhaustive list. Each box in the matrix includes activities to monitor physical, biological, and chemical parameters.

As you move downward in the matrix, the activities become more complex, requiring greater skills, resources, and commitment. Four boxes in the lower right hand of the matrix are highlighted in a darker shade: data collected through activities in this area can be included in the VSMP database, provided appropriate QA/QC measures are followed.

The three columns indicate three primary motives that might inspire volunteers to monitor a stream:

AWARENESS AND EDUCATION:

Introduces volunteers to the processes of stream ecology and the connection between land use and water quality. Data aren't intended for decision-making or building a long-term record.

CONTINUOUS RECORD:

Establishes a baseline and provides information about changes in stream conditions over time. Requires repeated observations of physical, chemical, and/or biological indicators.

PROBLEM INVESTIGATION:

Examines the effects of a known or suspected source of pollution or impairment. Targets sampling efforts to link the impacts of land use practices on stream health.

Monitoring may also be designed for regulatory purposes, such as determining whether point source discharges are exceeding permitted levels. However, volunteers are usually not involved in this type of monitoring. If your group is interested in compliance monitoring, contact a VSMP coordinator or local natural resource professional to help you connect with the appropriate agency.

The three rows in the matrix represent skill levels:

FROG (INTRODUCTORY):

Volunteers are able to occasionally observe and record indicators of stream health by measuring physical, biological, or chemical parameters. The quality of results may not be consistent over time.

STONEFLY (INTERMEDIATE):

Volunteers are able to routinely observe and record indicators of stream health by measuring physical, biological, or chemical parameters. They receive professional training, use proper protocols and equipment, and conduct basic data analyses. The quality of results should be consistent over time.

KINGFISHER (MASTER):

Volunteers are able to routinely observe and record indicators of stream health by measuring physical, biological, or chemical parameters. They should be able to draw and present inferences and conclusions about the evidence provided by recorded results. The quality of results should be consistent over time.

A basic activity introduced at the Frog level can be repeated more frequently or with more rigorous quality assurance as the commitment and skill of volunteers improve. Even simple measurements can become an integral and important piece of a monitoring program, if they are performed carefully. With proper quality assurance, these basic measurements can be added to the VSMP database.

The Activity Sheets

Each activity identified in the matrix is further described on its own page. Pages are color-coded to reflect the skill level: Frog is green, Stonefly is purple, and Kingfisher is blue. At the upper left and lower right of each page, the purpose for monitoring is represented by a circle, triangle, or diamond.

Each page includes consistent information and guidance.

ACTIVITY:

A short description of the activity. The shape at the left edge of this colored band indicates the monitoring purpose (circle, triangle, diamond).

CONCEPT:

Describes the concept that participants explore in this activity.

PROCEDURE:

A short summary of what is involved in this activity. **It is NOT a complete description of the protocol;** this section is intended to introduce the activity. For complete methods and further details, see the Source listed on the left side of each page.

HOW TO USE YOUR DATA:

Suggestions for how to put your data to work, what questions you might ask, and where to share your results.

The left column on each sheet provides additional information about each activity.

EQUIPMENT:

A guide to what equipment will be needed. This is not a complete list, so please check the source for specific equipment needs.

TIME:

Describes approximately how much time will be required for the activity and how often to make observations.

QUALITY ASSURANCE/QUALITY CONTROL:

Quality Assurance/Quality Control (QA/QC) varies from activity to activity. In many cases, explicit QA/QC requirements are not necessary and activities may be performed without guidance or input from technical advisors. For the activities in this guide that list QA/QC as a requirement, participants must be involved with a coordinator from their local governmental unit, a state agency, nonprofit, or VSMP to have the data included in the VSMP database. Only activities in the lower right four boxes of the matrix include a QA/QC component.

SOURCE:

Lists the source for more detailed protocols and contact information for other programs. A complete resource list is included at the end of the activity guide.

SKILL SET:

Identifies the skills that participants will develop and sharpen when they carry out this activity.

SAFETY: Always A Concern

Working in or around water presents many risks. Safety should always be a primary concern when selecting a stream site, assessing stream bank habitats, collecting samples, and working in the lab. **Consider the following BEFORE heading out to the streamside:**

- Always work with a partner. Never work alone.
- Bring along a cell phone. Let someone know where you are going and when you should be back.
- Never wade in swift or high water. Do not monitor if the stream is at flood stage.
- Anyone entering the water must wear a life jacket and waders. Have a rescue plan in place in case someone slips into the water.
- Dress appropriately for the weather and the conditions. This should include gloves, hats, waders, and a change of clothes, shoes, and socks.
- Listen to weather reports; don't go if severe weather is forecast.
- Keep a first aid kit available.
- Never drink the water from a stream.
- Secure the permission of the landowner to access the river from his or her property, or find a spot that is publicly owned.

When working in a lab, follow these precautions:

- Work in a clean, well-ventilated area.
- When using chemicals, always wear eye protection, gloves, and lab apron.
- Carefully follow the guidelines for storage, use, and disposal of chemicals provided in the "material safety data sheets" that come with reagents.
- Avoid contact between chemical reagents and skin, eyes, nose, and mouth.
- Be familiar with your equipment and follow recommended safety guidelines.

Leaving The Matrix, Entering The Stream

This activity guide will help volunteers continually evaluate their goals, monitoring methods, and results as their interests and resources change and their skills and experience evolve. It will help guide and support volunteers, and challenge them to become watershed stewards.

By moving from the activity guide into the stream, volunteers can apply these concepts and methods to a real-world situation. Gathering data becomes an experience and not just an idea. Increasing our ties with the natural world and increasing our awareness of impacts that affect the ecosystem can lead to increased protection and stewardship.

By moving from the stream into the community, individuals and groups can use their motivation and monitoring results to make a difference in their communities. Speaking to the city council about a proposed development, working with the neighborhood association to restore native plants along the shoreline, talking to a school group about the impacts of phosphorus fertilizer on streams, or holding a community-wide festival or celebration are all activities that will enable volunteers to turn data into action.

Volunteer Stream Monitoring Partnership

Monitoring Matrix

	AWARENESS & EDUCATION	CONTINUOUS RECORD	PROBLEM INVESTIGATION
frog  INTRODUCTORY	Measure Stream Water Level Streamside Cleanup Bio Bingo Measure pH with Test Strips	Measure Stream Width and Depth Measure Water Temperature Stream Habitat Walk Chemical Survey with Test Kits	Measure Stream Velocity Watershed Survey Targeted Chemical Survey Targeted Streamside Biosurvey
stonefly  INTERMEDIATE	Measure Stream Flow Habitat Assessment Inventory Biological Communities Longitudinal Chemical Survey	Transparency Tube Measurements Quantitative Habitat Assessment Intensive Biological Survey Bi-Weekly Chemical Survey with Meters	Measure Event-Based Stream Flow Targeted Biological Survey Event-Based Chemical Measurements
kingfisher  MASTER	Delineate Watershed Boundaries Determine Stream Order and Calculate Stream Gradient Identify Functional Feeding Groups Lab Analysis of Grab Sample	Determine GPS Monitoring Coordinates Biological Survey to Genus Level with QA/QC Compare Field Chemistry with Lab Analysis Develop a Quality Assurance Project Plan	Compare Past and Present Conditions Compare Biosurvey Protocols Event-Based Sampling for Nutrients or Bacteria

Measure Stream Water Level

Activity:

Measure water level at a stream gauge. If a gauge is not available, locate a fixed point where stream level readings can be taken on each visit, such as a bridge, or benchmark, or top of a culvert.

Equipment

Tape measure
Stream gauge
Yard or meter stick
Rain gauge
Field data sheets

Time

15 minutes on a monthly or weekly basis

Source

Minnesota Pollution Control Agency: Citizen Stream Monitoring Program, www.pca.state.mn.us/water/csmp.html (800) 657-3864

Skill set

Observing, measuring, recording, relating, comparing, calculating, hypothesizing

DON'T FORGET ABOUT **SAFETY**

Concept:

Storm events and runoff influence stream levels.

TAKING MEASUREMENTS

Measure the water level using stream gauge or fixed point. Estimate the change in cross-section as the water level rises or falls. You may want to make permanent marks at one foot or six inch intervals on the bridge abutment or culvert so you can easily compare changes. If possible, determine how deep the stream is at this point and measure stream width. Be sure to indicate your unit of measure (feet or meters). Note the weather conditions and recent precipitation events on the data sheets.

STREAM NAME:

DATE	MEASUREMENTS		WEATHER CONDITIONS

How to use your data:

Record the changes in water level over time and relate them to weather conditions. Consider the amount of impervious surface in the watershed. How would an increase in impervious surface affect the water level in your stream after a storm? Hypothesize as to what effect higher or lower water levels may have on the plant and animal communities that live in the stream.

Streamside Cleanup: "Adopt A River"

Activity:

Hold a cleanup day on a section of stream. Keep track of the types and amount of garbage found to share with area businesses, nearby landowners, and community groups. Work with them to think of ways to keep trash out of the stream.

Concept:

Human activities can influence stream health and aesthetics.

Equipment

"How To" kit from the Minnesota DNR

Time

One morning or afternoon to conduct the annual cleanup; two years in a row.

Source

Minnesota DNR
www.dnr.state.mn.us

Skill set

Observing, collecting, describing, communicating, categorizing, relating, recording

DON'T FORGET ABOUT
SAFETY

Volunteers can choose their own site from unregistered sites and will be given assistance, free trash bags, and gloves. The program records results and keeps track of information such as amount of trash collected, volunteer hours and descriptions of the debris found.

GETTING STARTED

When you contact the Minnesota Department of Natural Resources (DNR) program they will send you a "How-To" kit that will describe how to organize a cleanup. More specific details in the "How-To" kit include:

- How to get your cleanup group together
- How to promote your cleanup
- How to document your cleanup
- How to work with landowners
- How to keep your group safe
- What to do with the refuse

The kit contains a registration form for you to "adopt" a specific piece of shoreline.

HOW "ADOPT A RIVER" WORKS

If a volunteer registers for a particular piece of shoreline, that person or group must do an annual cleanup two years in a row. The reason for requiring a two-year commitment is to allow enough time for the volunteers to see a change as a result of their efforts. To become involved in the Adopt A River program contact the Project Coordinator, at (651) 297-5476.

How to use your data:

Report your findings to the "Adopt A River" Project Coordinator. Work with your group to come up with a plan for sharing what you found with the nearby community, and carry out your plan.

“Bio Bingo”

Activity:

Observe and record the organisms and communities you find while near a stream.

Concept:

The riparian habitat should include a diversity of organisms and communities.

Equipment

Net
Magnifying glass
Sorting pan
Binoculars
Bingo sheet

Time

One or two hours in the field.

Source

For picture keys:
Water Action Volunteers, http://clean-water.uwex.edu/wav/index.html

Izaak Walton League, www.iwla.org/sos/sostools.html

Skill set

Observing, recording, categorizing, relating, comparing, communicating

DON'T FORGET ABOUT SAFETY

LET'S PLAY!

Observe the environment around you using your eyes, a magnifying glass, or binoculars, or sample the water with a net. Mark each square as each item is observed. Have players use Polaroid cameras to take photos or have them draw pictures of what they observe as they fill in the Bingo card.

B · I · O B · I · N · G · O

FROG	ALGAE	WATER STRIDER	SCUD	TADPOLE
MOSQUITO	SNAKE	DEER	BEETLE	HUMAN
TREE	HERON	**FREE**	EGRET	GRASS
SQUIRREL	CRAYFISH	REED	TURTLE	SPIDER
SNAIL	DRAGONFLY	LEECH	SHRUB	FISH

(Continued)

How to use your data:

Discuss possible relationships between organisms you've observed. Does the relationship have a positive or a negative effect on each organism? How does their environment affect them?

Measure pH with Test Strips

Activity:

Collect a water sample in a clean container. Use pH test strips to determine the acidity or alkalinity of the water by color comparison. Measure three times per year.

Concept:

pH influences the water quality and biological communities in a stream and may change seasonally during the year.

Equipment

Sample bottle
pH strips
Waders & life jackets

Time

10-20 minutes

Source

Fisher Scientific:
www.fishersci.com

Hach:
www.hach.com

LaMotte:
www.lamotte.com

Skill set

Measuring, observing, averaging, calculating, relating, recording, comparing, graphing, hypothesizing

DON'T FORGET ABOUT SAFETY

MEASURE THE pH

pH indicates how acid or basic the water is by measuring the relative concentration of the balance of positive hydrogen ions (H+) and negative hydroxide ions (OH-). The pH scale ranges from 0 (high concentrations of positive hydrogen ions, strongly acidic) to 14 (strongly basic). Most fish can tolerate pH values of about 5.0 to 9.0, but the optimum range is between pH 6.5 and 8.2. The majority of rivers, lakes, and streams in the Midwest fall within this range.

To use the test strips, dip a strip into the water, wait until color develops, and compare the color of the reacted strip to the pH chart printed on the bottle. Test strips are available for a wide selection of parameters and from a variety of suppliers.

THE pH SCALE

pH	
2.0	LEMON JUICE
2.2	VINEGAR
3.0	APPLES
5.6	NORMAL RAIN
6.6	MILK
7.0	NEUTRAL
8.2	BAKING SODA
8.0-8.5	SEA WATER
10.5	MILK OF MAGNESIA
11.0	AMMONIA

Source: *Downwind, The Acid Rain Story*

How to use your data:

Record the pH value from each visit and plot the data over time as a line graph. Hypothesize why there are changes in pH between seasons or years, or following precipitation events.

Measure Stream Width and Depth

Activity:

As part of the watershed survey, measure the width and depth of your stream.

Concept:

The width and depth of a stream influence stream flow and biological communities.

Equipment

100-ft. tape measure
Yard or meter stick
Waders & life jackets
Field data sheets

Time

10-20 minutes

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 135

Skill set

Measuring, recording, counting, calculating, hypothesizing, comparing

DON'T FORGET ABOUT **SAFETY**

TAKING MEASUREMENTS

Select an accessible section of stream and stretch a tape measure across it from bank to bank. Measure from the edge of the water rather than from the top of the bank, and record this on data sheet as "width". Create a table and record depth with a yardstick at two-foot intervals across the stream. Be sure to indicate your unit of measurement (feet or meters). Calculate an average depth by adding together all the values and dividing by the number of depth measurements. Calculate cross-sectional area of the stream by multiplying stream width by average water depth.

	SPRING	SUMMER	FALL
DEPTH (feet or meters)			
DEPTH			
DEPTH			
DEPTH			
DEPTH			
AVERAGE DEPTH			
WIDTH (feet or meters)			
CROSS-SECTION (width x depth)			

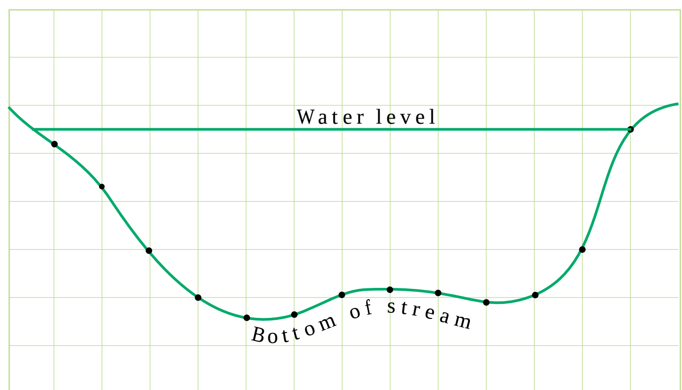
(Continued)

How to use your data:

Draw a cross-section of your stream using information from your data sheet. Compare seasonal changes and hypothesize what may have caused them. Discuss natural and human induced factors that can alter the width and depth of the stream channel. How can these changes affect stream organisms?

Example of what a cross-section might look like:

LEFT BANK (looking downstream)



RIGHT BANK (looking downstream)

1 square = 1 foot

Sketch out your cross-section on this graph. Be sure to include units of measure.

LEFT BANK (looking downstream)

RIGHT BANK (looking downstream)

Measure Water Temperature

Activity:

Take the temperature in the main current of the stream and see how it compares with the air temperature. Measure both air and water temperature monthly during ice-free seasons.

Equipment

Waders & life jackets
Thermometer or temperature probe
Field data sheets
Watch with second hand

Time

15 minutes

Source

Rivers Council of Minnesota, *River Monitors Manual*, pages 62-63

Skill set

Observing, measuring, recording, graphing, comparing

DON'T FORGET ABOUT SAFETY

Concept:

Air and water temperature are related and will vary daily and seasonally. Temperature may be affected by the season, runoff, land use characteristics, and depth of the stream. Water temperature affects the rate of chemical reactions and biological processes, such as photosynthesis and respiration.

TAKING MEASUREMENTS

Place the thermometer in shadow at least four inches below the surface of the water. Keep the thermometer underwater for at least two minutes to get an accurate temperature. Repeat three times and average the results. Record water temperature, air temperature, and weather conditions monthly on the data sheet.

SITE NAME:

DATE	READING 1	READING 2	READING 3	AVERAGE

(Continued)

How to use your data:

Plot the data on a line graph or compare changes in values between seasons or years. Ask questions such as, “Why is the water temperature warmer than the air temperature?” and “How does temperature affect the rate of chemical and biological processes in the stream?”

Stream Habitat Walk

Activity:

Identify and assess the stream's habitat and conduct a biological survey both in and around the stream including plants, animals, and macroinvertebrates.

Equipment

Aquatic nets
Waders & life jackets
Buckets
Sorting trays
Magnifying glass
Clipboards
Tweezers
Wash bottles
Field data sheets

Time

One-to-two hours sampling in the field; once or twice a year.

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, pages 43-60

Skill set

Observing, categorizing, identifying, classifying, recording, counting, comparing

DON'T FORGET ABOUT
SAFETY

Concept:

The physical habitat and biological community of a stream can tell us much about the overall health of that stream.

CONDUCTING THE ASSESSMENT

This project includes two components; the first is a characterization of habitat and the second is a biological survey of the organisms that live in or around the stream. Consult the EPA *Volunteer Stream Monitoring: A Methods Manual* (pages 43-60) for guidelines and data sheets.

First conduct the habitat assessment, making note of instream characteristics, stream bank and channel characteristics, and local watershed characteristics.

Once the assessment is complete, conduct the visual biological survey. Look for wildlife, plants, and macroinvertebrates that live in the water or in the area adjacent to the stream. You can search for macroinvertebrates by removing rocks, sticks, or leaf packs from the stream and rinsing them in a bucket. Some of the macroinvertebrates you may find include snails, crayfish, and insects.

Complete all data sheets and return all organisms to the water. To get copies of the data sheets contact your local coordinator or visit www.epa.gov/volunteer/stream

How to use your data:

Recording observations over time will allow you to draw comparisons between years, identify changes in land use over time, and identify water quality problems.

Chemical Survey with Test Kits

Activity:

Use simple and inexpensive test kits to sample water chemistry for a basic water quality assessment. This activity introduces volunteers to chemical parameters and procedures.

Equipment

Test kits available from scientific suppliers
Water sample bottles
Waders & life jackets
Safety goggles
Field data sheets

Time

If performed at the site: approximately two hours to conduct the tests

Source

Fisher Scientific, www.fishersci.com

Hach, www.hach.com

LaMotte, www.lamotte.com

Skill set

Observing, categorizing, measuring, recording, comparing, referring, graphing

DON'T FORGET ABOUT SAFETY

Concept:

Water chemistry influences biological communities and is used to evaluate water quality.

SELECTING CHEMICAL TESTS

When choosing a parameter to monitor, focus on environmental issues specific to your area, or concerns that you may want to investigate further. If you are concerned about the survival of fish in your stream, you may want to sample for dissolved oxygen. If your area has severe winters and salt is used to reduce icing problems on local roads, you may want to test for chloride. Kits can also be used to analyze for pH, nutrients, color, and a variety of other parameters. You can test for a single parameter or a suite of chemical measurements to get a more complete picture of water chemistry. A local high school or your Soil and Water Conservation District may have test kits you can borrow.

To find out more about which chemical measurements you should make to evaluate the health of your stream, use the EPA *Volunteer Stream Monitoring: A Methods Manual* (pages 125-186) or check with VSMP staff or your local monitoring coordinator. The EPA manual provides good information on what the different chemical parameters can tell you about water quality.

TAKING MEASUREMENTS

Follow the proper procedures when using a test kit and make sure to calibrate it. Each kit will come with directions and safety guidelines. Be sure to use safety goggles and dispose of waste properly.

At the stream, collect a sample where the water is running freely, away from the edge of the stream and not in a pool. Push the container below the surface to avoid getting floating debris or surface scum.

If you use the kits at the stream site, collect a representative sample in a large, clean, unbreakable container and then pour into smaller bottles or beakers for the different tests. If you use the kits in a lab or classroom, collect your water sample in a clean, unbreakable container that can be closed. Fill the sample

(Continued)

bottle completely with no air space and keep it cool until analysis.

If you want to be able to compare the results of your initial analysis with later monitoring data, be sure to record your data in a permanent record, such as a notebook. When you visit the stream, observe and record information such as date, time of day, weather conditions, and who collected the sample. Be sure to include the name of the stream and the location where you sampled.

How to use your data:

Chemical measurements provide a snapshot in time of water quality. You can develop an initial picture of the water quality in your stream with even a single set of measurements that can serve as baseline information. Repeated measurements during different seasons or different conditions will allow you to identify changes or trends. Create line graphs by plotting the data for individual parameters against time.

Measure Stream Velocity

Activity:

Measure the time it takes a float to travel twenty feet downstream. Record times and calculate the average of the three measurements to determine velocity.

Concept:

The rate of water flow in a stream reflects the watershed conditions, stream-channel characteristics, and stream gradient. Velocity affects biological communities that live in the stream.

Equipment

Float, such as an orange
Stopwatch
Waders & life jackets
Tape measure
Field data sheet

Time

Approximately one hour to conduct the test

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 134

Skill set

Measuring, observing, calculating, recording, comparing, hypothesizing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT SAFETY

MEASURING VELOCITY

Decide whether you will make measurements in metric or English units. You will calculate velocity as either meters per second (m/s) or feet per second (ft/s). Select an appropriate "float." An orange works well because of its density: it floats partially submerged and isn't affected by wind.

Measure out 20 feet or 10 meters along the bank. Select a stretch of stream where the water is a least 6 inches deep and does not contain a pool or area of very slow-moving water. Clearly mark the upper and lower ends of the measured section.

Have one person stand in the water at the upper end of the measured section and, on command from the person with the stopwatch, gently release the float into the water. A second person stands in the water at the downstream end of the measured section to catch the float. The third person records the time, in seconds, that it takes the float to reach the downstream person. Repeat the process three times and calculate an average 'time of travel.'

SITE	DATE	TIME I	TIME II	TIME III	AVG TIME

How to use your data:

Compare velocity over time or in different areas of the stream. Form a hypothesis about the reasons for different velocity measurements related to the time of year, stream habitat, and amount of impervious surface. Discuss how high or low stream flow can affect aquatic organisms.

Measuring Stream Velocity Field Data Sheet

Volunteer Stream Monitoring Partnership

SITE (include county)		SITE NUMBER
INVESTIGATOR	DATE	TIME
LOCAL COORDINATOR / ORGANIZATION	GPS ☐ YES ☐ NO	GPS COORDINATES

EQUIPMENT LIST

100-ft. tape measure	Yardstick	2 stakes or flags
Stopwatch	Float, such as an orange	Field data sheet
Waders & life jackets	Calculator	

SITE SELECTION AND PREPARATION

Select a stretch of stream where the water is at least 6 inches deep and does not contain a pool or area of very slow moving water. Measure out 20 feet (or 10 meters) along the bank. Clearly mark the upper and lower ends of the measured section with a stake or flag.

MEASURE VELOCITY

Have one person stand in the water at the upper end of the measured section and, on command from the person with the stopwatch, gently release the float into the water. The float should have no momentum other than the water velocity. A second person stands in the water at the downstream end of the measured section to catch the float. The third person records the time, in seconds, that it takes the float to reach the downstream person. If the float drags on the bottom of the stream or brushes overhanging vegetation, redo the trial.

Repeat the process five times and calculate an average “time of travel”. Divide the distance (20 feet or 10 meters) by the average time (seconds) to determine the velocity in feet/meters per second.

TRIAL #

1 __________ sec. __________ ft.

2 __________ sec. __________ ft.

3 __________ sec. __________ ft.

4 __________ sec. __________ ft.

5 __________ sec. __________ ft.

Average Time of Travel =
Total Time divided by # of Measurements ____________ sec.

Velocity =
Distance divided by Average Time ____________ ft. or meters/sec.

Watershed Survey

Activity:

Investigate the concept of watershed. Collect and explore maps to identify potential problem areas along your stream.

Equipment

Maps
Aerial photos
Magnifying glass

Time

Several hours to collect and interpret maps

Source

VSMP

Skill set

Mapping, measuring, categorizing, comparing, interpreting

DON'T FORGET ABOUT **SAFETY**

Concept:

The natural characteristics and land use in the watershed significantly affect the water quality, habitat, and biological communities in a stream.

DIRECTIONS

Collect topographic, geologic, soil, street, storm sewer, and land use maps for the area around your stream monitoring site. Contact your local Soil & Water Conservation District (SWCD) or Watershed District (WD), municipal offices, public library, Minnesota Geologic Survey, or the Minnesota Bookstore (www.comm.media.state.mn.us/bookstore/) for assistance. The SWCD or WD may also have aerial photographs that you can copy.

Identify your monitoring site on the maps using roads, bridges, or other landmarks. Note where tributaries enter the stream, both upstream and downstream of your site. Note road crossings and bridges. Identify storm sewer inlets and retention ponds that discharge to your stream. These features can affect both the quantity and quality of water in the stream.

Categorize what type of land use predominates in the area around your monitoring site. Is it primarily urban or suburban residential? Industrial? Agricultural? Parkland? What kind of roads or highways pass near your site? Is most of the land around your stream covered by impervious surfaces, such as roads and driveways, parking lots, rooftops, or buildings?

Use a hydrologic atlas and bedrock geology or soil maps to explore the natural characteristics of the landscape that your stream runs through. What type of rock does the stream flow through? How deep are the glacial sediments that overly bedrock in your area? Is the soil sandy or clayey? Can you find information about ground water recharge to your stream? These characteristics can affect how much water reaches the stream as well as the natural geochemistry of the water.

Hypothesize how different characteristics could affect your stream's health. Does salt from the roads reach your stream? Are there rapid changes in water level because of storm sewer inlets? Do nearby wetlands help stabilize water levels and filter water before it reaches the stream? Consider which parameters you should monitor to provide the most information about the impacts of land use around your stream?

(Continued)

How to use your data:

Draw a generalized map of your stream and the region around your monitoring site, highlighting features that might affect the health of the stream—tributaries, storm sewers, soil type, ground water connections, and land use patterns. Add your monitoring results to the map and display it in a community location to share the information you've collected.

You might expand your study area to include the entire watershed and then compare land use patterns around different tributaries. This will help you identify additional monitoring sites, or potential problem areas for targeted monitoring activities. "Ground truth" your map by visiting these areas and seeing if what you found on maps is actually there.

Delineate sub-watersheds for tributaries, calculate the percentage of different land use types or miles of roads within sub-watersheds, and compare monitoring results for water chemistry or biological monitoring from different sites.

Targeted Chemical Survey

Activity:

Examine the effects of an input, such as a tributary or storm sewer, on the water chemistry of your stream. Use simple, inexpensive test kits to measure water chemistry upstream and downstream of the input. Compare the upstream sample to the downstream sample.

Equipment

Test kits available from scientific suppliers
Water sample bottles
Waders & life jackets
Safety goggles
Field data sheets

Time

If performed at the site: approximately two hours to conduct the tests

Source

Fisher Scientific, www.fishersci.com

Hach, www.hach.com

LaMotte, www.lamotte.com

Skill set

Observing, categorizing, measuring, recording, comparing, referring, graphing

DON'T FORGET ABOUT SAFETY

Concept:

Inputs cause change in flow or water quality. These changes can affect the water chemistry of the stream. Sampling above and below an input can help pinpoint significant impacts on stream health.

SELECTING CHEMICAL TESTS

When choosing a parameter to monitor, focus on environmental issues specific to your area, or concerns that you may want to investigate further. Kits can be used to analyze for pH, nutrient, color, and a variety of other parameters. You can test for a single parameter or a suite of chemical measurements to get a more complete picture of water chemistry.

To find out more about which chemical measurements you should make to evaluate the health of your stream, use the EPA *Volunteer Stream Monitoring: A Methods Manual* (pages 125-186) or check with VSMP staff or your local monitoring coordinator. The EPA manual provides good information on what the different chemical parameters can tell you about water quality.

TAKING MEASUREMENTS

Locate an area on your stream where a tributary, ditch or storm sewer, stream crossing, dam or erosion problem may be affecting your stream. Sample the chemistry upstream and downstream of this feature. Follow proper procedures when using a test kit and make sure to calibrate it. Each kit will come with directions and safety guidelines. Be sure to use safety goggles and dispose of waste properly.

At the stream, collect a sample where the water is running freely, away from the edge of the stream and not in a pool. Push the container below the surface to avoid getting floating debris or surface scum.

If you use the test kits at the stream site, collect a representative sample in a large, clean, unbreakable container and then pour into smaller bottles or beakers for the different tests. If you use the kits in a lab or classroom, collect your water sample in a clean, unbreakable container that can be closed. Fill the sample bottle completely with no air space and keep it cool until analysis. Be sure to record your data in a permanent record, such as a notebook. When

(Continued)

you visit the stream, observe and record information such as date, time of day, weather conditions, and who collected the samples. Be sure to include the name of the stream and location where you sampled.

How to use your data:

Compare your data from above and below the potential problem source. Does the concentration of the chemicals increase or decrease downstream of the feature? Why? What are some of the possible causes for the changes in water chemistry? What are the potential impacts from these changes?

Targeted Streamside Biosurvey

Activity:

Collect, identify, and return macroinvertebrates to the stream where there is a significant change in the quality or quantity of stream flow, such as a tributary, ditch, drainage pipe, stream crossing, dam, or erosion problem. Sample above and below the inflow or structure to assess what impact it has on the biological community in the stream.

Equipment

Aquatic nets
Waders & life jackets
Buckets
Sorting trays
Tweezers
Identification keys
Wash bottles
Calculator
Field data sheets

Time

One-to-two hours sampling in the field; once or twice a year.

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 61;

Water Action Volunteers, http://clean-water.uwex.edu/wav/index.html

Izaak Walton League, www.iwla.org/sos/sostools.html

Skill set

Collecting, observing, identifying, calculating, hypothesizing

DON'T FORGET ABOUT SAFETY

Concept:

Changes in flow or water quality can affect the populations, diversity, and survival rate of biological communities. Sampling upstream and downstream of these changes can help pinpoint significant impacts on stream health.

STREAMSIDE BIOSURVEY

Before beginning the survey, determine what type of stream you are sampling. Does it have a rocky bottom or muddy bottom? Does it have riffle segments or does it appear slow and deep? This determination will dictate what method and data sheets you use. Instructions in the EPA manual can assist you with the determination.

Picture keys will help identify the macroinvertebrates. Once they have been collected, sorted, and identified, the organisms are returned to the stream.

This activity will also allow you to calculate the stream quality rating. This rating takes into account the pollution sensitivity on the organisms and their relative abundance. The numerical result will represent the overall “health” of the stream.

Know your site!

It is important to choose the right sampling method for your specific site. Read the EPA instructions carefully. For additional help, contact your local stream monitoring coordinator or VSMP staff.

How to use your data:

Results of biosurveys can be compared between different seasons and different years. Conducting surveys at problem areas will allow you to evaluate impacts and the eventual recovery or decline of the biological communities through time. Record any disturbances you see and hypothesize how they may be affecting the types of macroinvertebrates that live in the stream.

Measure Stream Flow

Activity:

Measure and calculate stream flow using the float method. Calculate the average cross-sectional area of the stream, measure velocity, and calculate the flow.

Concept:

Stream flow, or discharge, is the volume of water that moves past a designated point over a fixed period of time and is directly related to the amount of water moving off the watershed into the stream channel.

Equipment

100-ft. tape measure
Waders & life jackets
Yardstick
Stopwatch
Calculator
A float: tennis ball or orange
String, stakes
Field data sheets

Time

Approximately 30 minutes

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 134

Skill set

Measuring, organizing, observing, recording, interpreting, calculating

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT **SAFETY**

MEASURING VELOCITY

Decide whether you will make measurements in metric or English units. You will calculate flow as either cubic meters per second (m^3/s) or cubic feet per second (ft^3/s). If you intend to relate stream volume with the concentration of chemical parameters measured in metric units (e.g., mg/L), you may want to make volume measurements in metric also. Select an appropriate "float." An orange works well because of its density: it floats partially submerged and isn't affected by wind.

Measure out 20 feet or 10 meters along the bank. Select a stretch of stream where the water is at least 6 inches deep and does not contain a pool or area of very slow-moving water. Clearly mark the upper and lower ends of the measured section by running a transect line across the stream using string and stakes. The string should be taut and near the surface of the water. The upstream transect is #1 and the downstream #2.

Have one person stand in the water at transect #1 and, on command from the person with the stopwatch, gently release the float into the water. A second person stands in the water at transect #2 to catch the float. The third person records the time, in seconds, that it takes the float to reach the downstream person. Repeat the process three times and calculate an average 'time of travel.'

MEASURING CROSS-SECTION

At some point within the measured section, measure the width of the stream at a place where a person can walk across safely. Next, measure the depth of the water at two-foot intervals across the entire stream, using a yardstick or meter stick. Record the width and depths.

CALCULATING STREAM FLOW

First calculate the cross-sectional area of the stream. You can average all the depth measurements and do a simple calculation of average depth times average

(Continued)

width. Or you can plot the cross-section of the stream and use more advanced math to calculate a more accurate area.

Multiply the cross-sectional area by the average time of travel to calculate stream flow, or volume, in m^3/s or ft^3/s.

How to use your data:

Water velocity and volume can influence biological communities, as well as erosion and sedimentation in a stream. Are there different organisms living in different reaches of the stream? Is there evidence of erosion along the bottom or banks of the stream? Is sediment being deposited in other areas? How is this related to flow?

Stream flow data can be especially useful if you monitor flow every month during the ice-free season and identify trends or changes. Stream flow data can be entered into the VSMP database if it is part of a monitoring program with a quality assurance plan.

Create graphs to compare changes in stream flow during one year or over many years. Hypothesize how changes in flow are related to seasons of the year, precipitation, or changing landuse in the watershed.

Stream Flow Measurement Field Data Sheet

Volunteer Stream Monitoring Partnership

SITE (include county)		**SITE NUMBER**
INVESTIGATOR	**DATE**	**TIME**
LOCAL COORDINATOR / ORGANIZATION	**GPS** ☐ **YES** ☐ **NO**	**GPS COORDINATES**

INSTRUCTIONS

EQUIPMENT LIST

100-ft. tape measure	Yardstick	4 stakes or flags
Stopwatch	Float, such as an orange	Field data sheet
Waders & life jackets	Calculator	String or rope

SITE SELECTION AND PREPARATION

Select a stretch of stream where the water is at least 6 inches deep and does not contain a pool or area of very slow moving water. Measure out 20 feet or 10 meters along the bank. Clearly mark the upper and lower ends of the measured section by running a transect line across the stream using string and stakes. The string should be taut and near the water surface. The upstream transect is #1 and the downstream, #2.

MEASURE CHANNEL WIDTH

Select an accessible section of stream and stretch a tape measure across it from bank to bank. Measure from the edge of the water rather than from the top of the bank. Record this as "total width" on the data sheet.

MEASURE CROSS SECTION

One person uses the yardstick to measure channel depth at regular intervals across the channel width. Calculate an average depth by adding together all the values and dividing by the number of depth measurements. Calculate cross-sectional depth area of the stream by multiplying stream width by average water depth.

MEASURE VELOCITY

Have one person stand in the water at transect #1 and, on command from the person with the stopwatch, gently release the float into the water. A second person stands in the water at transect #2 to catch the float. The third person records the time, in seconds, that it takes the float to reach the downstream person.

Repeat the process at least three times and calculate an average "time of travel".

To calculate surface velocity for each trial, divide the number of feet traveled by the number of seconds of travel time. Record and average the surface velocity measurements. Record Average Surface Velocity in feet/second.

Calculate Average Velocity by multiplying Average Surface Velocity by 0.8 for rocky bottom streams and 0.9 for muddy bottom streams. Record Average Velocity in feet/second.

SPECIAL INSTRUCTIONS

Person 1 must drop the float away from their body. Standing immediately upstream of the drop location will interfere with the measurement.

Person 1 must DROP the float, not toss it. The float should not have momentum other than the water velocity. Release the float ABOVE transect #1 and start the stopwatch as it reaches the string.

If the float drags on the bottom of the stream or brushes overhanging vegetation, redo the trial. Do not use a measurement if there was any interference of flow of the float.

Calculating Flow Field Data Sheet

Volunteer Stream Monitoring Partnership

SITE (include county)	SITE NUMBER

INVESTIGATOR	DATE	TIME

Solving the equation:

FLOW $= \frac{A\,L\,C}{T}$

Where:

A = Average cross-sectional area of the stream
L = Length of the stream reach measured (usually 20 feet)
C = Coefficient or correction factor (0.8 for rocky bottom streams; 0.9 for muddy bottom streams)
T = Time, in seconds, for the float to travel the length of L

TRANSECT #1 (UPSTREAM)

Interval Width (feet):		Depth (feet):	
A to B	________	(at B)	________
B to C	________	(at C)	________
C to D	________	(at D)	________
D to E	________	(shoreline)	________
		Total	________ ÷ 4
Total Width	[ ] ft	= Avg. Depth	[ ] ft

CROSS-SECTIONAL AREA OF TRANSECT #1:

Total Width [ ] X Avg. Depth [ ] = [ ] ft²

TRANSECT #2 (DOWNSTREAM)

Interval Width (feet):		Depth (feet):	
A to B	________	(at B)	________
B to C	________	(at C)	________
C to D	________	(at D)	________
D to E	________	(shoreline)	________
		Total	________ ÷ 4
Total Width	[ ] ft	= Avg. Depth	[ ] ft

CROSS-SECTIONAL AREA OF TRANSECT #2:

Total Width [ ] X Avg. Depth [ ] = [ ] ft²

A AVERAGE CROSS-SECTIONAL AREA

(Cross-sectional Area of Transect #1 + Cross-sectional Area of Transect #2) ÷ 2

[ ] + [ ] = [ ] ÷ 2 = [ ] ft²

L LENGTH OF STREAM REACH [ ] ft

C COEFFICIENT [ ]

0.8 for rocky bottom streams
0.9 for muddy bottom streams

T TRAVEL TIME

Travel time of float in seconds:

Trial 1 ________
Trial 2 ________
Trial 3 ________

TOTAL ________ ÷ 3 = Avg.Time [ ] sec

FLOW $= \frac{A\,L\,C}{T}$ [ ] x [ ] x [ ] ÷ [ ] = [ ] ft^3/sec

A L C T FLOW

VSMP 2002 adapted from EPA, Volunteer Stream Monitoring: A Methods Manual

Habitat Assessment

Activity:

Observe and record in-stream and bank characteristics at your site at least once per year. This activity is usually conducted in conjunction with the biological survey.

Equipment

USGS topographic map
Field data sheet
100-ft. tape measure
Thermometer to measure water temperature

Time

One-to-two hours once a year.

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual.* pages 92, 99

Skill set

Observing, measuring, mapping, recording, estimating, communicating, categorizing, relating, inferring, comparing, hypothesizing

DON'T FORGET ABOUT SAFETY

Concept:

The health of a stream is a product of its watershed.

CONDUCT VISUAL ASSESSMENT

Measure out a 100-yard stream section using landmarks that will let you reassess the same section each time you visit the site. Delineate and sketch your site including bridges, land use, vegetation such as trees or shrubs, pipes draining into the stream, roads and pathways, riprap, wetlands, etc.

Complete the EPA data sheets including sections on stream and watershed characteristics and land use (www.epa.gov/owow/monitoring/volunteer).

Review data sheets. If your survey identifies problems such as fish kills, leaking chemical drums, failing culverts, or serious erosion problems, contact your local Soil and Water Conservation District office. If you see what appears to be hazardous waste, do not touch or handle it; contact the Minnesota Pollution Control Agency at (651) 297-2274 or (800) 657-3864.

How to use your data:

By visiting the same section of stream once a year, you'll be able to identify seasonal changes and trends over time. Compare data sheets annually to track changes and hypothesize as to why the changes occurred (changes in land use or the amount of impervious surface, different observers completing the data sheets, etc.). Photographic records will enhance your comparisons.

Inventory Biological Communities

Activity:

Select a biological community of interest, such as frogs, dragonflies, or fish for further investigation. Inventory populations using field surveys, angler diaries, or historical records.

Concept:

Some biological communities are especially sensitive to alterations in habitat or water quality. Shifts in populations can indicate changes in the environment.

Equipment

Nets
Identification keys
Field data sheets

Time

Varies depending upon project. Consult with professional staff for details.

Source

1,000 Friends of Frogs: http://cgee.hamline.edu/frogs/index.html

Angler Diary: Minnesota DNR - Metro Region Fisheries Office: (651) 772-7990

Skill Set

Collecting, observing, categorizing, recording, comparing, hypothesizing

DON'T FORGET ABOUT SAFETY

By conducting an inventory of biological communities, such as dragonflies, frogs, and fish species like trout, that are sensitive to disturbance, you can get an idea of the density and diversity of these important communities and how humans affect their presence and abundance. Some species are especially sensitive to changes in landuse or habitat and some are very tolerant.

The inventory may be as simple as recording the location, type, and size fish you have caught, or attending a training session to properly identify different families of dragonflies, or learning the calls of frogs to accurately identify populations.

Several programs throughout the state may be able to assist you with training, materials to become familiar with identification techniques, and databases to store your information.

How to use your data:

By monitoring changes in populations through time, you'll be able to form questions regarding habitat suitability or water quality. You may notice a decline in a certain species or you may record a rare occurrence of another. Referring to historic records will also give you an idea of what has been observed in your area. Comparing that information with current records will help you to track noticeable changes in populations that may indicate problems or improvements.

Longitudinal Chemical Survey

Activity:

Use simple and inexpensive test kits to sample water chemistry at least once per year and identify trends over time. Compare water chemistry at different reaches of the stream and investigate changes that occur longitudinally..

Equipment

Test kits available from scientific suppliers
Water sample bottles
Waders & life jackets
Safety goggles
Gloves
Field data sheets

Time

If performed at the site: approximately two hours to conduct the tests plus travel time to site.

Source

Fisher Scientific, www.fishersci.com

Hach, www.hach.com

LaMotte, www.lamotte.com

Skill set

Observing, categorizing, measuring, recording, comparing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT SAFETY

Concept:

Water chemistry will vary along the length of a stream. Comparing chemical values at different sites can indicate potential problems from non point source pollution.

SELECTING ADDITIONAL SITES

After having completed a basic chemical survey at one site, you may want to expand your monitoring and compare water chemistry at sites farther upstream or downstream of where you regularly monitor. Identify places along the stream that might reflect changes in land use patterns, increased flow (from a tributary or storm drain), or other changes. Make sure the sites are safe and accessible, and that you will be able to return in the future if you want to sample again.

Select chemical parameters for which you already have some baseline information. To find out more about what different chemical measurements can tell you about water quality use the EPA *Volunteer Stream Monitoring: A Methods Manual* (pages 125-186) or check with VSMP staff or your local monitoring coordinator.

TAKING MEASUREMENTS

Follow the proper procedures when using the test kits and make sure to calibrate it. Each kit will come with directions and safety guidelines. Be sure to use safety goggles and dispose of waste properly.

You can use the kits to analyze samples at the stream side or can collect samples for later analysis at the lab. At the stream, collect a sample where the water is running freely, away from the edge of the stream and not in a pool. See ▲7 for tips on collecting a water sample.

How to use your data:

Graph chemical measurements versus location along the stream to see how water quality changes with stream conditions. Plot each parameter separately or overlay multiple measurements. Why do chemical values change as you move downstream? Which concentrations increase? Which decrease? Why don't all the parameters act the same way?

Transparency Tube Measurements

MPCA Citizen Stream Monitoring Program

Activity:

Volunteers who enlist in the MPCA Citizen Stream Monitoring Program will take five measurements: transparency, appearance, recreational suitability, precipitation, and stream stage.

Equipment

Transparency tube
Rain gauge
Field data sheets
Instructions
Bucket and rope

Time

15 minutes once per week plus after heavy rainfalls through the ice-free season.

Quality Assurance

Follow guidelines by MPCA

Source

Minnesota Pollution Control Agency, www.pca.state.mn.us/water/csmp.html

Skill set

Observing, categorizing, measuring, recording, comparing

DON'T FORGET ABOUT
SAFETY

Concept:

Records of these five parameters can help identify trends or changes in water clarity over time, and determine where runoff may be contributing sediment and other pollutants to streams.

TAKING MEASUREMENTS

Once a week during the ice-off season and after large rainfalls, volunteers visit an established site on a nearby stream and measure the following parameters:

MEASURE	MEASUREMENT TOOL	WHAT IT TELLS US
TRANSPARENCY	Transparency tube - clear, 60 cm-long tube with colored disk on the bottom for measuring depth at which disk is visible	The clarity of stream water: sediment, algae, and other materials suspended in the water reduce water clarity
APPEARANCE	Observation of stream-water color	Potential causes of low transparency readings (e.g., sediment, algae, bog stain)
RECREATIONAL SUITABILITY	Visual assessment on a scale of 1-5 (1=Very Good, 5=Very Poor)	The perceived suitability of a stream for fishing, swimming or boating
PRECIPITATION (MONITORED DAILY)	Rain gauge	How rainfall events and runoff affect stream transparency, appearance and stage
STREAM STAGE	Visual estimate (Low, Normal, High) OR Measurement from benchmark above the stream (bridge or culvert) to water surface	Changes in water level, affect transparency, appearance, and survival of biological communities.

(Continued)

There is a one-time fee of $20 to cover the cost of equipment. Volunteers will receive a transparency tube, rain gauge, data sheets, instructions for taking measurements, and a copy of the annual report on statewide stream conditions. For more information and to register contact:

MPCA
Citizen Stream Monitoring Program
520 Lafayette Road
St. Paul, MN 55155
(651) 296-7187

How to use your data:

Graph weekly changes in transparency and compare with rain events. Correlate how the recreational suitability and appearance compare with the transparency measurements. Compare your results with other streams in your area.

Quantitative Habitat Assessment

Activity:

Observe and record in-stream and bank characteristics at your site. This activity is conducted in conjunction with the biological survey at least twice per year.

Concept:

The health of a stream is a product of its watershed.

CONDUCT VISUAL ASSESSMENT

Measure out a 100-yard stream section, using landmarks that will let you reassess the same section each time you visit the site. Delineate and sketch your site including bridges, land use, vegetation such as trees or shrubs, pipes draining into the stream, roads and pathways, riprap, wetlands, etc.

Complete the VSMP data sheets including sections on stream and watershed characteristics and land use while at the site.

Review data sheets. Taking photographs of the site and the habitat assessment area will provide a confirmation of the conditions. Return photos along with the completed data sheets to your local coordinator.

How to use your data:

By visiting the same section of stream two or more times per year, you'll be able to identify seasonal changes and trends. Compare data seasonally and annually to track changes and hypothesize why the changes occurred (changes in land use or the amount of impervious surfaces, different observers completing the data sheets, etc.).

The habitat assessment can also be used in conjunction with your identified biological sample to track changes in the aquatic community and surrounding habitat. Monitoring habitat characteristics two or more times per year allows you to identify subtle or seasonal changes in habitat that may affect biological communities.

Equipment

100 ft tape measure
Field data sheets
Pen/pencil
Camera

Time

Approximately 30 minutes, two times per year

Quality Assurance

Yes, for inclusion in the VSMP database

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual.* pages 92, 99

Skill set

Observing, measuring, mapping, recording, estimating, communicating, categorizing, relating, comparing, hypothesizing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT
SAFETY

Habitat Assessment Field Data Sheet

Volunteer Stream Monitoring Partnership

SITE (include county)	SITE NUMBER

INVESTIGATOR	DATE	TIME

LOCAL COORDINATOR / ORGANIZATION	GPS	GPS COORDINATES
	☐ YES ☐ NO	

WEATHER

In past 24 hours:	Now:
☐ Storm (heavy rain)	☐ Storm (heavy rain)
☐ Rain (steady)	☐ Rain (steady)
☐ Showers (intermittent)	☐ Showers (intermittent)
☐ Overcast	☐ Overcast
☐ Clear/Sunny	☐ Clear/Sunny

TEMPERATURE READINGS (Take in the shade)

Water temperature: ____________ Air temperature: ____________

WATER APPEARANCE (check one)

☐ Clear	☐ Green	☐ Brown
☐ Blue-green	☐ Yellow	☐ Milky

WATER ODOR (check one)

☐ None	☐ Musty	☐ Septic
☐ Fishy	☐ Rotten eggs	

LOCAL LAND USE

Land use in the local watershed within approx.1/4 mile of the site. Check all that apply. Circle the dominant feature.

☐ Residential	☐ Paved roads or bridges
☐ Commercial	☐ Unpaved roads
☐ Agricultural	☐ Construction
☐ Natural/Preserve	☐ Recreational use
☐ Lawns	☐ Industry
☐ Wooded	☐ Land fill
☐ Crop land	☐ Waste treatment plant
☐ Grazing land	☐ Evidence of past alteration
☐ Feed lot	

TYPE OF SAMPLING (check one)

☐ ROCKY BOTTOM

☐ MUDDY BOTTOM
Record the number of jabs taken in each habitat type:

- Vegetated bank margins ____________
- Snags and logs ____________
- Aquatic vegetation beds ____________
- Silt/sand/gravel substrate ____________

STREAM WIDTH

3 Measurements (in feet)

1 ____________

2 ____________

3 ____________

Average Stream Width: ____________

STREAM DEPTH

Minimum of 10 measurements (in feet)

Measure the depth across the stream, from right bank to left bank in one-foot intervals for a minimum of 10 measurements.

1 ______	2 ______	3 ______	4 ______
5 ______	6 ______	7 ______	8 ______
9 ______	10 ______	11 ______	12 ______
13 ______	14 ______	15 ______	16 ______
17 ______	18 ______	19 ______	20 ______
21 ______	22 ______	23 ______	24 ______
25 ______	26 ______	27 ______	28 ______
29 ______	30 ______	31 ______	32 ______
33 ______	34 ______	35 ______	36 ______
37 ______	38 ______	39 ______	40 ______

NOTE: Conduct all habitat assessments IN THE FIELD. Complete all data sheets before leaving the site.

SKETCH OF SITE

On your sketch, note features that affect stream habitat, such as: riffles, runs, pools, ditches, wetlands, dams, riprap, outfalls, tributaries, landscape features, vegetation, and roads. Include all pipes draining directly into the stream and indicate direction of flow.

Were photos taken?

FIELD NOTES

Include notable observations such as any major landscape changes (including construction projects, bridge projects, etc.) upstream or adjacent to your site.

Habitat Assessment Field Data Sheet

Rocky Bottom Sampling

Volunteer Stream Monitoring Partnership

SITE (include county)	DATE

HABITAT PARAMETER	CATEGORY: Optimal	Suboptimal	Marginal	Poor
1 ATTACHMENT SITES FOR MACRO-INVERTEBRATES	Well-developed riffle and run; riffle is as wide as stream and length extends 2 times the width of the stream; cobble predominate; boulders and gravel common.	Riffle is as wide as stream but length is less than 2 times width; cobble less abundant; boulders and gravel common.	Run maybe be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffle or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2 EMBEDDEDNESS	Fine sediment surrounds and fills in 0-25% of the living spaces around and in between the gravel, cobble, and boulders.	Fine sediment surrounds and fills in 25-50% of the living spaces around and in between the gravel, cobble, and boulders.	Fine sediment surrounds and fills in 50-70% of the living spaces around and in between the gravel, cobble, and boulders.	Fine sediment surrounds and fills in more than 75% of the living spaces around and in between the gravel, cobble, and boulders.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3 SHELTER FOR FISH	Snags and submerged logs, undercut banks, cobble and large rocks or other stable habitat are found in over 50% of the site.	Snags and submerged logs, undercut banks, cobble and large rocks or other stable habitat are found in over 30-50% of the site.	Snags and submerged logs, undercut banks, cobble and large rocks or other stable habitat are found in over 10-30% of the site.	Snags and submerged logs, undercut banks, cobble and large rocks or other stable habitat are found in less than 10% of the site.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 CHANNEL ALTERATION	Stream straightening, dredging, artificial embankments, dams or bridge abutments absent or minimal; stream with meandering pattern.	Some stream straightening, dredging, artificial embankments or dams present, usually in areas of bridge abutments; no evidence of recent channel alteration activity.	Artificial embankments present to some extent on both banks; and 40-80% of stream site straightened, dredged, or otherwise altered.	Banks shored with gabion or cement; over 80% of the stream site straightened and disrupted.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 SEDIMENT DEPOSITION	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected, slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at stream obstructions and bends; moderate deposition in pools.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom affected; pools almost absent due to substantial sediment deposition.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTE: Conduct all habitat assessments IN THE FIELD. Complete all data sheets before leaving the site. For complete directions and definitions, refer to EPA, *Volunteer Stream Monitoring: A Methods Manual,* Section 4.3

Rocky Bottom Sampling

HABITAT PARAMETER	CATEGORY Optimal	Suboptimal	Marginal	Poor
6 STREAM VELOCITY AND DEPTH COMBINATION	Slow (<1 ft/s)/deep (>1.5 ft); slow/shallow; fast/shallow combinations all present.	3 of the 4 velocity/depth combinations are present; fast current areas generally dominate.	Only 2 of the 4 velocity/depth combinations present. Score lower if fast current areas missing.	Dominated by 1 velocity/depth category (usually slow/shallow areas)
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7 CHANNEL FLOW STATUS	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 BANK VEGETATIVE PROTECTION (score each bank) Note: Determine left or right side by facing downstream)	More than 90% of the streambank surfaces covered by natural vegetation, including trees, shrubs, or other plants; vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by natural vegetation; some vegetative disruption evident; more than one-half of the potential plant stubble height remaining.	50-75% of the streambank surfaces covered by vegetation; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
Score (LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Score (RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
9 CONDITION OF BANKS (score each bank) Note: Determine left or right side by facing downstream)	Banks stable; no evidence of erosion or bank failure; little potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; up to 60% of banks in site have areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; “raw” areas frequent along straight sections and bends; obvious bank collapse or failure; 60-100% of bank has erosional scars.
Score (LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Score (RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
10 RIPARIAN VEGETATIVE ZONE WIDTH (Score each bank riparian zone)	Width of riparian zone >50 feet; no evidence of human activities (i.e. parking lots, road beds, clear-outs, mowed areas, or crops) within the riparian zone.	Width of riparian zone 35-50 feet.	Width of riparian zone 20-35 feet	Width of riparian zone <20 feet.
Score (LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Score (RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

TOTAL SCORE

VSMP 2002 adapted from EPA, Volunteer Stream Monitoring: A Methods Manual

Habitat Assessment Field Data Sheet

Volunteer Stream Monitoring Partnership

Muddy Bottom Sampling

SITE (include county)	DATE

HABITAT PARAMETER	CATEGORY Optimal	Suboptimal	Marginal	Poor
1 SHELTER FOR FISH AND MACRO-INVERTEBRATES	Snags, submerged logs, undercut banks, rubble or other stable habitat found over 50% of the site; logs/snags are old fall.	Snags, submerged logs, undercut banks, rubble or other stable habitat found over 30-50 % of the site; some old fall, but preponderance of new fall.	Snags, submerged logs, undercut banks, rubble or other stable habitat found over 10-30 % of the site; appears unstable; some new fall.	Snags, submerged logs, undercut banks, rubble or other stable habitat found less than 10% of the site; appears unstable; no old or new fall.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2 POOL SUBSTRATE CHARACTERIZATION	Pools have mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Pools have mixture of soft sand, mud, or clay substrate; mud may be dominant; some root mats and submerged vegetation present.	Pools have all mud or clay or sand substrate; little or no root mat; no submerged vegetation.	Pools have hard-pan clay or bedrock substrate; no root mat or vegetation.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3 POOL VARIABILITY	Even mix of large-shallow, large-deep, small-shallow, small-deep pools.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 CHANNEL ALTERATION	Stream straightening, dredging, artificial embankments, dams or bridge abutments absent or minimal; stream with meandering pattern.	Some stream straightening, dredging, artificial embankments or dams present, usually in areas of bridge abutments; no evidence of recent channel alteration activity.	Artificial embankments present to some extent on both banks; and 40-80% of stream site straightened, dredged, or otherwise altered.	Banks shored with gabion or cement; over 80% of the stream site straightened and disrupted.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 SEDIMENT DEPOSITION	Less than 20% of stream bottom affected by extensive sediment deposition; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% of stream bottom affected by extensive sediment deposition; moderate accumulation; substantial sediment movement only during major storm event; increase in bar formation.	50-80% of stream bottom affected by extensive sediment deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Greater than 80% of stream bottom affected by extensive sediment deposition; heavy deposits; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to deposition.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

NOTE: Conduct all habitat assessments IN THE FIELD. Complete all data sheets before leaving the site. For complete directions and definitions, refer to EPA, *Volunteer Stream Monitoring: A Methods Manual,* Section 4.3

Muddy Bottom Sampling

HABITAT PARAMETER	CATEGORY Optimal	Suboptimal	Marginal	Poor
6 CHANNEL SINUOSITY	The bends in the stream would increase the stream length 3 to 4 times longer than if it was in a straight line.	The bends in the stream would increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream would increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7 CHANNEL FLOW STATUS	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 BANK VEGETATIVE PROTECTION (score each bank) Note: Determine left or right side by facing downstream)	More than 90% of the streambank surfaces covered by natural vegetation, including trees, shrubs, or other plants; vegetative disruption, through grazing or mowing, minimal or not evident;almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by natural vegetation, but one class of plant is not well represented; some vegetative disruption evident; more than one-half of the potential plant stubble height remaining.	50-75% of the streambank surfaces covered by vegetation; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
Score (LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Score (RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 CONDITION OF BANKS (score each bank) Note: Determine left or right side by facing downstream)	Banks stable; no evidence of erosion or bank failure; little potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; up to 60% of banks in site have areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank collapse or failure; 60-100% of bank has erosional scars.
Score (LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Score (RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
10 RIPARIAN VEGETATIVE ZONE WIDTH (Score each bank riparian zone)	Width of riparian zone >50 feet; no evidence of human activities (i.e. parking lots, road beds, clear-outs, mowed areas, or crops) within the riparian zone.	Width of riparian zone 35-50 feet.	Width of riparian zone 20-35 feet	Width of riparian zone <20 feet.
Score (LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Score (RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

TOTAL SCORE

VSMP 2002 adapted from EPA, Volunteer Stream Monitoring: A Methods Manual

Intensive Biological Survey

Activity:

Macroinvertebrates are collected in the field and returned to the lab for analysis and identification to the taxonomic level of Family. Calculate a series of metrics to provide a broad range of information about the stream site. This activity is performed in conjunction with the habitat assessment, two times per year.

Concept:

Detailed information about macroinvertebrates at your site can help you evaluate stream health and water quality trends.

Equipment

Aquatic nets
Waders & life jackets
Buckets
Sorting trays
Tweezers
Sample bottles
Field data sheets
Denatured alcohol (preservative)

Time

Approximately four hours in the field, and eight hours in the lab; twice a year, in the spring and fall.

Quality Assurance

Yes, for inclusion in the VSMP database

Source

EPA, Volunteer Stream Monitoring: A Methods Manual, page 86

Skill set

Collecting, observing, identifying, calculating, comparing, hypothesizing

Data sheets available at www.vsmp.org

DON'T FORGET ABOUT SAFETY

PREPARING TO MONITOR

This project includes two components; the first is a characterization of available habitat and the second is a biological survey of the organisms that live in the stream. The habitat assessment includes recording observations of instream characteristics, stream bank and channel traits, and local watershed characteristics.

Once the habitat assessment is complete, the biological survey is conducted. Closely follow the instructions in the EPA manual, which will help you to determine what type of stream you are sampling and what specific method to use. Macroinvertebrates are collected and preserved at the stream and transported back to the lab where they are sorted and identified with the help of dichotomous keys. Organisms are identified to the Family taxonomic level. A trained stream biologist will verify all procedures and identifications and make sure that proper quality assurance measures are followed so the data is credible.

In this activity you will also calculate a stream quality rating. This rating takes into account the pollution sensitivity of the organisms and their relative abundance. The numerical result represents the overall "health" of the stream.

Know your site!

It is important to choose the right sampling method for your specific site. Read the EPA instructions carefully. For additional help, contact your local stream monitoring coordinator or VSMP staff.

Training:

Training is recommended for this activity and required if your data is to be included in the VSMP database. Please contact your local coordinator or the VSMP at (612) 624-7460 or (612) 625-6781 for available trainings.

(Continued)

How to use your data:

Results of biosurveys can be compared between different seasons and different years. Hypothesize what characteristics of the watershed affect the types of macroinvertebrates that live in the stream and identify changes in land use over time that may affect water quality.

SITE (include county)		SITE NUMBER
INVESTIGATOR	**DATE**	**TIME**
LOCAL COORDINATOR / ORGANIZATION	**GPS** ☐ YES ☐ NO	**GPS COORDINATES**

PROTOCOL USED: ☐ Multi-Habitat (Dip net) ☐ Riffles (Net) ☐ Artificial Multi-Plate Sampler

Subsampling Procedure

Randomly sample a square making sure ALL organisms have been picked from that square before you move to the next. Mark the estimated total number of individual organisms taken from each square. DO NOT STOP UNTIL YOU HAVE AT LEAST 100 INDIVIDUALS.

1	4	7	10
2	5	8	11
3	6	9	12

A. Total number of organisms picked: _______________

B. Number of squares selected: ____________________

C. Average organisms per square: __________________ (# of organisms / # of squares)

D. Estimated organisms in tray (C x 12): _____________ (organisms / tray)

SITE (include county)		SITE NUMBER
INVESTIGATOR	DATE	TIME
LOCAL COORDINATOR / ORGANIZATION	GPS ☐ YES ☐ NO	GPS COORDINATES

Order Ephemeroptera (Mayflies)		
Family	Tolerance Value	Total
Baetidae	4	
Baetiscidae	3	
Caenidae	7	
Ephemerellidae	1	
Ephemeridae	4	
Heptageniidae	4	
Leptohyphidae (Tricorythidae)	4	
Leptophlebiidae	2	
Metretopodidae	2	
Oligoneuriidae	2	
Polymitarcyidae	2	
Potamanthidae	4	
Siphlonuridae	7	
Unidentified		
Order Plecoptera (Stoneflies)		
Family	Tolerance Value	Total
Capniidae	1	
Chloroperlidae	1	
Leutridae	0	
Nemouridae	2	
Perlidae	1	
Perlodidae	2	
Pteronarcidae	0	
Taeniopterygidae	2	
Unidentified		

Order Trichoptera (Caddisflies)		
Family	Tolerance Value	Total
Brachycentridae	1	
Glossosomatidae	0	
Helicopsychidae	3	
Hydropsychidae	4	
Hydroptilidae	4	
Lepidosomatidae	1	
Leptoceridae	4	
Limnephilidae	4	
Molannidae	6	
Odontoceridae	0	
Philopotamidae	3	
Phryganeidae	4	
Polycentropodidae	6	
Psychomyiidae	2	
Rhyacophilidae	0	
Sericostomatidae	3	
Unidentified		
Unidentified		
Order Diptera (Midges, Gnats, Mosquitoes, and Flies)		
Family	Tolerance Value	Total
Athericidae	2	
Blephariceridae	0	
Ceratopogonidae	6	
Chironomidae (Red)	8	
Chironomidae (Other)	6	
Culicidae	8	
Dixidae	1	
Empididae	6	
Ephydridae	6	
Muscidae	6	

Order Diptera - continued		
Family	Tolerance Value	Total
Psychodidae	10	
Ptychopteridae	8	
Simuliidae	6	
Stratiomyidae		
Syrphidae	10	
Tabanidae	6	
Tipulidae	3	
Unidentified		
Order Megaloptera (Fishflies, Dobsonflies, Alderflies)		
Family	Tolerance Value	Total
Corydalidae	0	
Sialidae	4	
Order Coleoptera (Water Beetles)		
Family	Tolerance Value	Total
Dryopidae	5	
Elmidae (adults and larvae)	4	
Psephenidae	4	
Unidentified		
Order Odonata (Dragonflies, Damselflies)		
Family	Tolerance Value	Total
Aeshnidae	3	
Calopterygidae	5	
Coenagrionidae	9	
Cordulergastridae	3	
Corduliidae	5	
Gomphidae	1	
Lestidae	9	
Libellulidae	9	
Macromiidae	3	
Unidentified		

Order Lepidoptera (Aquatic Moths)		
Family	Tolerance Value	Total
Pyralidae	5	
Order Amphipoda (Scuds)		
Family	Tolerance Value	Total
Gammaridae	4	
Talitridae	8	
Order Isopoda (Aquatic Sowbugs)		
Family	Tolerance Value	Total
Asellidae	8	
Other		
Family	Tolerance Value	Total
Decapoda - Cambaridae (Crayfish)	6	
Class Oligochaeta (Aquatic Worms)	8	
Class Hirundinea (Leeches)	10	
Class Gastropoda (Snails)	7	
Class Pelecypoda (Clams)	7	
Family Hydracarina		
Class Arachnida		
Order Hemiptera		
Phylum Nematoda		
Unidentified		
Unidentified		
Unidentified		
Unidentified		
Unidentified		
Unidentified		
Unidentified		
Unidentified		

TOTAL	

Bi-Weekly Chemical Survey with Meters

Activity:

Measure various water quality parameters, such as dissolved oxygen, pH, temperature, and conductivity, with analytical equipment. Use standardized sampling procedures and equipment so data is comparable from site to site, and can be used as baseline data.

Equipment

Waders & life jackets
Field data sheets
Meters available from your local SWCD office, Watershed District office, or the VSMP office.

Time

Approximately one hour

Quality Assurance

Yes, calibration of meters is a critical step to ensure accurate results.

Source

Rivers Council of Minnesota, *River Monitors Manual*, page 58

Skill set

Observing, categorizing, measuring, calibrating, recording, comparing

Data sheets available at www.vsmp.org

DON'T FORGET ABOUT **SAFETY**

Concept:

Properly calibrated meters provide more accurate chemical analysis. Repeated measurements provide a picture of chemical responses to seasonal variations in light, temperature, and water volume.

SELECTING CHEMICAL TESTS

When choosing a parameter to monitor, focus on environmental issues specific to your area, or concerns that you may want to investigate further. If you are concerned about the survival of fish in your stream, you may want to sample for dissolved oxygen. If your area has severe winters and salt is used to reduce icing problems on local roads, you may want to test for chloride. Kits can also be used to analyze for pH, nutrients, color, and a variety of other parameters. You can test for a single parameter or a suite of chemical measurements to get a more complete picture of water chemistry. A local high school or your Soil and Water Conservation District may have test kits you can borrow.

To find out more about which chemical measurements you should make to evaluate the health of your stream, use the EPA *Volunteer Stream Monitoring: A Methods Manual* (pages 125-186) or check with VSMP staff or your local monitoring coordinator. The EPA manual provides good information on what the different chemical parameters can tell you about water quality.

USING METERS

Each meter works differently and it is important to follow specific directions for each meter. Training is essential to ensure proper use and care of the meters. Work closely with your local SWCD or watershed district office to make sure you know how to operate the meter correctly and interpret the results. The *River Monitors Manual* (Rivers Council of Minnesota) is a very good reference that provides step-by-step descriptions for several parameters. Replicate samples can be analyzed at a certified lab to verify results obtained with a meter or test kit.

How to use your data:

See how the measurements you made compare with typical values for streams in your area. In Minnesota check the website: www.pca.state.mn.us or contact your local Soil and Water Conservation District office for help in determining the typical values for your area.

SITE (include county)		SITE NUMBER
INVESTIGATOR	DATE	TIME
LOCAL COORDINATOR / ORGANIZATION	GPS ☐ YES ☐ NO	GPS COORDINATES
SITE DESCRIPTION		

FIELD MEASUREMENTS

Method	Rep	Calibrated? (Y or N)	D.O. (mg/L)	Chloride (mg/L)	Conduc-tivity (umho)	Nitrate/ Nitrogen (mg/L)	Ortho Phosphate (mg/L)	pH	Salinity	Temp (C)	Trans-parency (cm)	Turbidity (NTU)

For Method: enter “H” for Hach chemical kit, “L” for Lamott chemical kit. “M” for meter

FIELD OBSERVATIONS

WEATHER CONDITIONS				WATER CONDITIONS		
Cloud Cover	Wind	Precipitation	Air Temperature	Color	Odor	Algae

OBSERVATION CODES

Cloud Cover	Wind Conditions	Precipitation	Air Temperature (F)
1 = 0	1 = Calm	1 = None	1 = <40
2 = 25%	2 = Light Breeze	2 = Drizzle	2 = 41-60
3 = 50%	3 = Moderate Breeze	3 = Light Rain	3 = 61-80
4 = 75%	4 = Strong Wind	4 = Heavy Rain	4 = 81-90
5 = 100%		5 = Snow/Sleet	5 = >90

Water Color	Water Odor	Algae
1 = Clear	1 = None	1 = None
2 = Blue-green	2 = Fishy	2 = Some Present
3 = Green	3 = Musty	3 = Strong Presence
4 = Brown	4 = Rotten Egg	4 = Severe Bloom
5 = Yellow	5 = Septic	
6 = Milky		

NOTES

Measure Event-Based Stream Flow

Activity:

Measure and calculate changes in stream flow following a storm event or snow melt. Calculate a hydrograph to investigate the effect of runoff on stream flow.

Concept:

Rainfall and runoff can significantly increase stream flow for a short period of time after a storm event. This periodic increase in stream flow can affect water chemistry and biological communities.

Equipment

100-ft. tape measure
Waders & life jackets
Yardstick
Stopwatch
Calculator
A float: tennis ball or orange
Field data sheets

Time

Approximately 30 minutes

Quality Assurance

Yes, for inclusion in the VSMP database

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual,* page 134

Skill set

Measuring, organizing, observing, recording, interpreting, graphing, calculating, hypothesizing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT **SAFETY**

MEASURING FLOW

Use either the 'float' method of determining stream flow (see page **1**) or a flow meter. A meter measures water velocity at about 2/3 of the depth of the stream, rather than at the surface as the float method does. Measurements made at that depth are more representative of the true water velocity. You may be able to borrow a 'pygmy' flow meter from your local monitoring coordinator, Soil and Water Conservation District, or Watershed District. If you use a meter, be sure to follow directions carefully. Use the same method each time you measure flow to make sure the data you collect are reliable and consistent for comparison with other sites or streams, and with data collected by other volunteers.

At the stream, measure and record water velocity, stream width, and depth. Try to make several measurements following a storm or while snow is melting. You may want to measure flow just after it begins to rain, during the height of the storm, after the rain stops, and again 3, 6, 12, and 24 hours later. More measurements will provide more detail as you plot a hydrograph.

In addition, you need to measure rainfall or have access to daily rainfall records. If you are evaluating the impact of snow melt, you'll need to know how much snow fell during the year, initial snow pack depth, and changes in snow pack depth during the melt period.

SAFETY IS CRITICAL:

Safety is especially important when making event-based measurements because the water may be running unusually high, the water temperature may be very cold, there may be floating debris, and the banks may be extra slippery. Never sample under these conditions. As an alternative, while standing on the streambank, measure the time it takes a piece of floating debris to travel 20 feet. You may be able to suspend a meter from a bridge or overpass to measure velocity directly.

(Continued)

How to use your data:

Calculate stream flow, following directions on page **1**. Plot changes in stream flow against time for the period immediately after a storm event and back to more normal, or baseline flows. This is called a hydrograph. Compare how the stream flow varied depending on how much precipitation fell and how rapidly it returned to normal levels after a storm.

There has been considerable research on how hydrographs for streams in urbanized areas are different than for streams in more natural areas. Water levels in urbanized areas with high percentages of impervious surfaces peak faster and decline faster than in areas where rainfall has more opportunity to seep into the ground. Hypothesize how land use in the watershed of your stream affects the hydrograph.

Targeted Biological Survey

Activity:

Conduct a macroinvertebrate survey at an area where there is a significant change in the quality or quantity of stream flow, such as a tributary, ditch, drainage pipe, stream crossing, dam, or erosion problem. Sample above and below the inflow or structure to assess what impact it has on the biological community in the stream.

Concept:

Changes in flow or water quality can affect the populations, diversity, and survival rate of biological communities. Sampling above and below these changes can help pinpoint significant impacts on stream health.

SELECTING A SITE

Review topographical maps, diagrams of urban stormwater systems, or aerial photos to identify features that may potentially affect the water quality in your stream. Walk the watershed of the stream above your regular sampling site to locate where tributaries, ditches, or storm drains enter. Find a location where you can monitor above and below an input to compare and contrast the biological communities in the stream.

BIOLOGICAL SURVEY

Collect and preserve macroinvertebrates using guidelines set forth in the EPA *Volunteer Stream Monitoring: A Methods Manual*. Back in the lab, sort and identify macroinvertebrates to the Family taxonomic level using dichotomous keys. A trained aquatic biologist should verify all procedures and identifications to make sure that proper quality assurance measures are followed. This will ensure that data are reliable and consistent for comparison with other sites or streams, and with data collected by other volunteers. To be included in the VSMP database, your data must undergo quality assurance checks.

BIOLOGICAL INDEX

After identification is complete, calculating a biological index will allow you to determine a stream quality rating. This rating takes into account the pollution sensitivity of organisms and their relative abundance. The numerical result represents the overall "health" of the stream. There are several indices to select from including overall diversity, density, and presence of indicator families. Check with VSMP or a natural resource professional for more information about which index is most appropriate for your stream.

(Continued)

Equipment

Aquatic nets
Waders & life jackets
Buckets
Sorting trays
Tweezers
Sample bottles
Field data sheets
Denatured alcohol (preservative)

Time

Approximately four hours in the field and eight hours in the lab; twice a year, in the spring and fall.

Quality Assurance

Yes, for inclusion in the VSMP database

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 86

Skill set

Collecting, observing, identifying, calculating, comparing

Data sheets available at www.vsmp.org

DON'T FORGET ABOUT **SAFETY**

Know your site!

It is important to choose the right sampling method for your specific site. Read instructions in the EPA manual carefully. For additional help, contact your local stream monitoring coordinator or VSMP staff.

Training:

Training is recommended for intensive biological surveys. Training is required if your data is to be included in the VSMP database. Contact your local coordinator or VSMP staff for information on what training is available in your area.

How to use your data:

If the biological ratings indicate there is significant difference above and below the change in your stream, investigate further. How is the water chemistry different in the tributary than the main stream? How big an area is drained by the storm drain inlet and what type of land use occurs in the collection area? How far downstream do the effects of the erosion or stream crossing affect the biological communities in the main stream? Translate data into action to correct or reduce erosion problems or damage from recreational vehicles crossing the stream.

Event-Based Chemical Measurements

Activity:

Take measurements using meters or test kits, daily for up to five days following a significant rainfall or snow melt event. Monitor runoff and assess how stream water chemistry changes over time in response to the rain or snow melt.

Equipment

Waders & life jackets
Tape measure
Yard or meter stick
Test kits, sample bottles, or meters
Field data sheets

Time

One to two hours, depending on number of sampling locations.

Quality Assurance

Yes, calibration is a critical step to ensure accurate results.

Source

Rivers Council of Minnesota, *River Monitors Manual,* page 61

Skill set

Observing, measuring, recording, calibrating, graphing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT **SAFETY**

Concept:

Rainfall and runoff can significantly alter water chemistry. Changes caused by storm events or snow melt may last only a short time and may not be detected during monthly or annual sampling, but they can affect the health of biological communities.

SELECTING CHEMICAL TESTS

When choosing a parameter to monitor, focus on environmental issues specific to your area, or concerns that you may want to investigate further. If you are concerned about algae blooms or excessive plant growth in your stream, you may want to sample for nutrients and determine whether there is a large influx from the residential neighborhood surrounding your stream. If your area has severe winters and salt is used to reduce icing problems on local roads, you may want to sample for chloride in the stream water immediately after snow melt. You may choose to study changes in dissolved oxygen levels or turbidity after a major storm event to investigate the impact on fish populations.

TAKING MEASUREMENTS

You can test for a single parameter or a suite of chemical measurements to get a more complete picture of water chemistry. Choose either chemical test kits available from scientific suppliers, use meters at the stream side, or collect samples for analysis in a lab. Follow the proper procedures and take measurements the same way each time during your investigation to ensure consistency and make sure the results can be compared over the length of your study. If you use test kits or meters, make sure they are correctly calibrated. If you collect samples, make sure they are properly preserved and kept cool until analysis

To evaluate the effect of certain pollutants, you need to be able to determine not only the concentration (the level you measure when sampling), but also the total load of that pollutant carried by the stream. To calculate the load, you need to measure the stream volume each time you test the water chemistry or collect a sample for later analysis. Directions for measuring stream volume are described on page **1**.

(Continued)

DATE/ TIME OF SAMPLE					
WATER VOLUME					
PH					
TURBIDITY					
CONDUCTIVITY					
CHLORIDE					
DISSOLVED OXYGEN					

SAFETY IS CRITICAL:

Safety is especially important when making event-based measurements because the water may be running unusually high, the water temperature may be very cold, there may be floating debris, and the banks may be extra slippery. Never enter the stream under these conditions. Collect a sample from the bank or a bridge instead.

How to use your data:

Graph concentration of the chemical parameter against time. Compare chemical concentrations immediately after a runoff event with levels you found at different times of the year. Were concentrations higher or lower? Does that indicate dilution or concentration during higher water levels?

Calculate total load by multiplying the chemical concentration (mg/L) times water volume (L or m^3). Calculate how many grams, pounds, or tons of phosphorus, chloride, sediment, or whatever you were monitoring, are being carried by the stream after a runoff event. Concentrations of certain chemical parameters may be lower during high water, but the total load carried by the stream may be considerably higher during runoff.

Plot changes in water chemistry together with a hydrograph (see ◆ **1**) to identify how chemical values varied with water volume.

Delineate Watershed Boundaries

Activity:

Use topographic maps to delineate watershed boundaries. Locate all water features, common land use practices, and cultural features within the watershed.

Equipment

Topographic maps
Aerial photos

Time

Approximately 4 hours

Source

EPA, "Volunteer Monitor" Fall, 1994;

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 27

Skill set

Mapping, measuring, comparing, hypothesizing

DON'T FORGET ABOUT SAFETY

Concept:

A watershed includes all the land that drains into your stream. The characteristics of the watershed will affect the water quality and biological communities in the stream. Delineating the watershed boundaries will allow you to calculate the drainage area, estimate the amount of impervious area, and identify land use patterns that can affect the health of your stream.

GATHERING MAPS

Because water flows downhill, watersheds are defined by topography. Using the high point and ridges on topographic maps, you can identify and draw a watershed boundary. Even though the concept appears simple, drawing a watershed boundary can be a challenge, especially in areas where natural drainage patters have been altered with ditches, storm water sewers, and development.

Before drawing your watershed boundaries on a map, check with your local Soil and Water Conservation District (SWCD) or Watershed District (WD). They may have already delineated the watershed you're interested in.

To determine water flow and watershed boundaries, you'll need a U.S. Geological Survey (USGS) topographic map at a 1:24,000 scale (also known as 7.5-minute maps). You can order one directly from the USGS at 1-800-USA-MAPS or online at www.usgs.gov. You can also buy maps from the Minnesota Bookstore and many outdoor or camping stores.

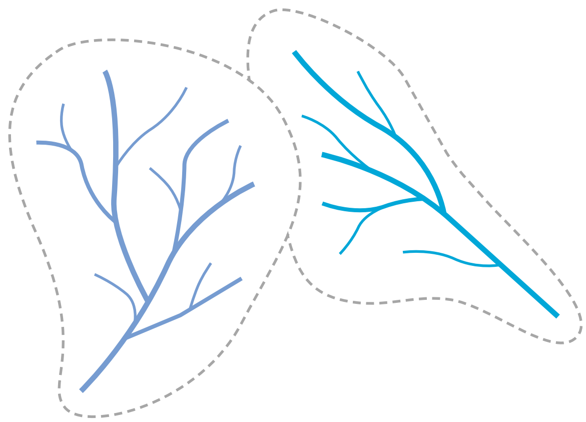
DELINEATING BOUNDARIES

First, identify your monitoring site on the stream, or, if you want to delineate the entire watershed, it will be the confluence of your stream with a larger river. Locate all water features that drain into your stream, including tributary streams, wetlands, storm sewers or retention ponds, and drainage ditches or diversions. Using a pencil, lightly draw arrows that mark the direction of flow into your stream. Also indicate the direction of other nearby streams or wetlands that don't end up in your stream. This will help as you separate adjacent drainage basins.

Next find high points such as ridges or hills that surround your stream. Again, using a pencil lightly connect those high points, following ridges and crossing

(Continued)

slopes at right angles to contour lines. This line forms the perimeter of your watershed. Make sure you are including all the water bodies that drain to your stream and excluding all those that flow into another one.



For some studies you may not need exact boundaries. You may approximate watershed boundaries to identify predominant land use types, major transportation influences, and hydrologic inputs to your stream.

How to use your data:

Using a digitizing computer or planimeter, calculate the watershed area (in square miles or square kilometers). Identify distinctive land uses within the watershed such as agriculture, open spaces, residential, commercial, industrial, etc. How have human activities altered the watershed boundaries for your stream? If the watershed area has been significantly changed, hypothesize what impacts those changes would have on the health of your stream.

Determine Stream Order and Calculate Stream Gradient

Activity:

Use topographic maps to determine stream order and stream gradient.

Equipment

Topographic maps
Calculator

Time

Approximately one hour

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 7.

Skill set

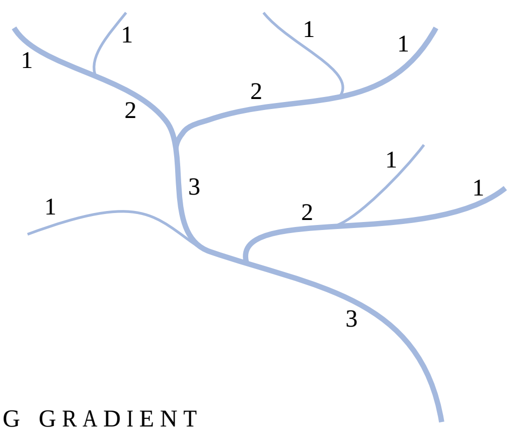
Measuring, mapping, calculating, comparing, hypothesizing

Concept:

Determining the order and gradient of your stream will provide a better understanding of the watershed and hydrologic factors that may impact the health of the stream.

DETERMINING THE ORDER

As a stream flows downhill it converges with other streams in the watershed. A branching network is formed as streams flow together. Streams that have no tributaries flowing into them are designated as "first order", with the number "1". Where two first order streams join together they form a "second order" stream; when two second order streams join together, they form a third order stream.



DETERMINING GRADIENT

Gradient is defined as the change in elevation from the head of the stream to the sampling site, divided by stream length. Use the topographic maps to determine the change in elevation. Measure stream length from the head of the stream to the sampling site, including any lakes the stream flows through. Divide the change in elevation by the stream length to give a gradient in feet/mile (or meters/km).

How to use your data:

Use your data to get a better understanding of how a stream is influenced by its watershed and how the watershed is interconnected. Compare your stream gradient to the gradient of other streams in your state, and hypothesize how gradient can influence stream health. Investigate the River Continuum Concept and see how it applies to your stream.

DON'T FORGET ABOUT SAFETY

Identify Functional Feeding Groups

Activity:

Macroinvertebrates are collected in the field and returned to the lab for analysis and identification to the taxonomic level of Family. The macroinvertebrates are then categorized into functional feeding groups.

Equipment

Aquatic nets
Waders & life jackets
Buckets
Sorting trays
Tweezers
Sample bottles
Identification keys and reference books
Field data sheets
Denatured alcohol (preservative)

Time

Approximately four hours sampling in the field, eight hours identifying and classifying macroinvertebrates.

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*

An Introduction to the Aquatic Insects of North America, Merritt and Cummins

Skill set

Observing, categorizing, classifying, recording, comparing

DON'T FORGET ABOUT SAFETY

Concept:

Identifying macroinvertebrates to the Family level and classifying them into appropriate functional feeding groups will increase understanding of how macroinvertebrates fit into the stream ecosystem and their important ecological function.

Collect macroinvertebrates and identify them to the Family level following the guidelines provided on page **11**. In addition to taxonomy, classify the macroinvertebrates by functional feeding groups. This approach classifies aquatic organisms in relation to how and what organic matter is broken down within the stream. This classification helps to illustrate complex food web relationships and interdependency between the stream and its watershed.

Functional feeding groups are defined by the type of food particles that organisms ingest (such as "fine" or "coarse"), where the food is collected (from a substrate or from the water column), and the particular feeding style of the organism (scraping, chewing, piercing, etc.). The functional feeding group classifications include: shredders, collector gatherers, collector filterers, scrapers, predators, and parasites/parasitoids.

Next apply the identified groups to the River Continuum Concept, a model that illustrates the progression of biological organisms from the headwaters to the mouth of stream and river systems. This concept relates functional feeding groups to stream order, available organic matter originating from the terrestrial environment, and the surrounding conditions including habitat. Many websites and reference books can assist you in defining functional feeding groups and the macroinvertebrate families that best represent each group.

Know your site!

It is critical to choose the right sampling method for your specific site. Read the EPA instructions carefully.

How to use your data:

Classifying macroinvertebrates into functional feeding groups increases understanding of the intricate ecosystem within our streams and rivers. Use the

(Continued)

information to enhance your Family level ID and to increase your understanding of the interrelatedness of habitat, biology, geology, and watersheds. Some of the questions you may ask: Does my data fit into the River Continuum Concept? Am I finding more individuals from one functional feeding group than others? Why? How do these groups relate to the order of stream I am working on? How do these groups fit into the specific habitat? What is the source for organic matter? What are some of the specific food items for these macroinvertebrates?

Lab Analysis of Grab Sample

Activity:

Collect a water sample and send it to a certified lab for analysis. Take samples weekly or following a storm event.

Concept:

Even a single sample can provide some useful data. Although one sample provides just a snapshot picture of water chemistry it can help identify problem areas, provide a basis for future monitoring, and allow for comparison with other sites or streams.

Equipment

Sample bottles
Labels and tape
Cooler with ice
Field data sheets
Map to lab
Waders & life jackets

Time

10-15 minutes

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual,* page 128;

Metropolitan Council Environmental Services

Skill set

Collecting, recording, comparing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT SAFETY

TO TAKE A GRAB SAMPLE:

Collecting a grab sample means that volunteers do not have to be trained in analysis, but they have to follow directions carefully when collecting the sample. Label the sample bottle with permanent marker BEFORE filling it. Include the stream name, location, date, and time.

Remove the cap from the bottle just before sampling. Avoid touching the inside of the bottle or the cap. If you accidentally touch the inside of the bottle use a different one.

If you are wading into the stream, try to disturb as little of the bottom sediment as possible. Be careful not to collect water that contains sediment from bottom disturbance. Stand facing upstream. Collect the water sample on your upstream side.

Hold the bottle near its base and plunge it (opening downward) below the water surface. If you are using an extension pole, remove the cap, turn the bottle upside down, and plunge it into the water, facing upstream. Collect a water sample 8 to 12 inches beneath the surface or mid-way between the surface and the bottom if the stream reach is shallow.

Turn the bottle underwater into the current and fill to within one inch of the top. Do not fill the bottle completely, except when taking DO, BOD, and pH samples. Recap the bottle underwater remembering not to touch the inside.

If your sampling site is too deep for wading, you can securely tape a sample bottle to an extension pole or lower a bucket from a bridge over the stream.

Complete the VSMP data sheet for each site. You will be handing in the sheet with the samples at the lab.

(Continued)

Store the samples in a cooler immediately and transport them to the lab for analysis within 24 hours.

BOTTLE LABEL INFORMATION

Location (including stream name)
Date
Time
Name

How to use your data:

See how the measurements you made compare with typical values for streams in your area. In Minnesota check the website: www.pca.state.mn.us or contact your local Soil and Water Conservation District office for help in determining the typical values for your area.

Grab Sample Field Data Sheet

Volunteer Stream Monitoring Partnership

INVESTIGATOR	DATE	COUNTY

LOCAL COORDINATOR / ORGANIZATION	GPS	GPS COORDINATES
	☐ YES ☐ NO	

SITE NAME	SITE NUMBER	METHOD (bucket from bridge, instream, from bank with pole)	SAMPLE DATE (MM/DD/YY)	SAMPLE TIME	STAGE READING (if avail.) FT.

CHECK WHICH PARAMETER TO BE TESTED BY THE LAB WITH AN "X"

REQUEST	ANALYSIS	REQUEST	ANALYSIS
	Alkalinity, Total		Boron
	Ammonia Nitrogen		Calcium
	Chloride Ion		Iron
	Chemical Oxygen Demand		Mercury
	Hardness		Sodium
	Nitrate / Nitrite		Metals (Cd, Cr, Cu, Pb, Ni, Zn)
	Ortho-Phosphate		CBOD 5-day
	Sulphate (SO4)		Fecal Coliform
	Total Kjeldahl N / Total Phosphorus		TBOD 5-day
	Total Organic Carbon		Turbidity
	Total Dissolved Phosphorus		Suspended Solids
	Viable Chl a and Pheophytin a		Volatile Suspended Solids
	Chlorophyll a, Total		Other
	Other		Other

Grab Sample Field Data Sheet

Field Observations

Fill in data sheets completely. Include a copy of the sheets with your grab sample for the Met Council Lab.

WEATHER CONDITIONS				**WATER CONDITIONS**		
Cloud Cover	Wind	Precipitation	Air Temperature	Color	Odor	Algae

OBSERVATION CODES

Cloud Cover	Wind Conditions	Precipitation	Air Temperature (F)
1 = 0	1 = Calm	1 = None	1 = <40
2 = 25%	2 = Light Breeze	2 = Drizzle	2 = 41-60
3 = 50%	3 = Moderate Breeze	3 = Light Rain	3 = 61-80
4 = 75%	4 = Strong Wind	4 = Heavy Rain	4 = 81-90
5 = 100%		5 = Snow/Sleet	5 = >90

Water Color	Water Odor	Algae
1 = Clear	1 = None	1 = None
2 = Blue-green	2 = Fishy	2 = Some Present
3 = Green	3 = Musty	3 = Strong Presence
4 = Brown	4 = Rotten Egg	4 = Severe Bloom
5 = Yellow	5 = Septic	
6 = Milky		

NOTES

Determine GPS Monitoring Coordinates

Activity:

Use a global positioning system (GPS) receiver to record accurate coordinates for monitoring sites.

Equipment

GPS unit
Map
Monitoring site location

Time

Approximately 30 minutes.

Quality Assurance

Yes, to understand how to properly use a GPS unit

Source

www.howstuffworks.com/gps.html

Skill set

Mapping, recording, communicating

DON'T FORGET ABOUT SAFETY

Concept:

By recording monitoring site coordinates into a GPS receiver, the exact monitoring location will be determined and the coordinates can be used to ensure accurate positioning during future monitoring activities. Coordinates can be easily shared and maps created to illustrate monitoring activities in a geographic area.

USING THE GPS RECEIVER

GPS is a navigation system that uses satellites to determine a point on the earth by measuring the distance from that point to the satellite. The coordinates are in latitude, longitude, and altitude above sea level. These coordinates can be easily transferred to a map or into a computer to create an electronic map for easy reference. Agencies, researchers, and natural resource professionals use the GPS system to record monitoring locations and to ensure accurate site identification and labeling.

Use the GPS receiver to record your own monitoring site or work with your local Soil and Water Conservation District (SWCD), or Watershed District (WD) office to identify sites that need recording and to learn how to transfer coordinates into maps. Your local SWCD or WD office can also explain how to use a GPS unit and may be able to loan one to you.

How to use your data:

Share your work with other local volunteer monitoring groups. If they are interested, train and assist them in using GPS to determine accurate locations for their own sites. Develop a map of your watershed identifying key features such as the mouth of a tributary, bridges, parks, road intersections, and other monitoring sites. Post the map at your school or community center, city hall, or

Biological Survey to Genus Level with QA/QC

Activity:

Collect macroinvertebrates in the field and return to the lab for analysis and identification to the taxonomic level of Family and Genus. After identification, calculate a series of metrics to provide a broad range of information about the stream site.

Equipment

Aquatic nets
Waders & life jackets
Buckets
Sorting trays
Tweezers
Sample bottles
Identification keys
Field data sheets
Denatured alcohol (preservative)

Time

Approximately four hours in the field and eight hours in the lab; twice a year, in the spring and fall.

Quality Assurance

Yes, for inclusion in the VSMP database.

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 86

Skill set

Observing, collecting, identifying, comparing, classifying, calculating, hypothesizing

Data sheets available at www.vsmp.org

DON'T FORGET ABOUT **SAFETY**

Concept:

Using a rigorous method for collecting habitat and macroinvertebrate data can provide useful information on stream impacts and water quality trends.

COLLECTING ORGANISMS

This project includes two components; the first is a characterization of available habitat and the second is a biological survey of the organisms that live in the stream. The habitat assessment consists of evaluating instream, stream bank, channel, and local watershed characteristics.

Once the habitat assessment is complete, the biological survey is conducted. Closely follow the instructions in the EPA manual which will help you to determine what type of stream you are sampling and what specific method to use. Macroinvertebrates are collected and preserved at the stream and transported back to the lab where they are sorted and identified with the help of dichotomous keys. Organisms are identified first to the Family taxonomic level and then to the Genus level. A trained aquatic biologist should verify all procedures and identifications and make sure that proper quality assurance measures are followed so the data can be used by agencies and water resource organizations.

After identification is complete, calculating a biological index will allow you to determine a stream quality rating. This rating takes into account the pollution sensitivity of organisms and their relative abundance. The numerical result represents the overall "health" of the stream. There are several indices to select from including overall diversity, density, and presence of indicator families. Check with VSMP for more information.

Training:

Training is required for this activity if your data is to be included in the VSMP database. Special dichotomous keys are needed to complete the identification to the Genus level. This requires working closely with a trained stream biologist who is familiar with identifying macroinvertebrates to this level.

Know your site!

It is critical to choose the right sampling method for your specific site. Read the EPA instructions carefully.

(Continued)

How to use your data:

Submit your data to a local agency or watershed organization. Results of biosurveys can be compared between different seasons and different years. Hypothesize as to what characteristics of the watershed affect the types of macroinvertebrates that live in the stream and identify changes in land use over time that may affect water quality.

Compare Field Chemistry with Lab Analysis

Activity:

Monitor specific water quality parameters using test kits. To confirm results, a grab sample is taken and sent to a certified lab for analysis.

Equipment

Sample bottles
Labels
Cooler with ice
Field data sheets
Waders & life jackets
Tape
Testing kits
Complete directions for both methods

Time

Two to three hours

Quality Assurance

Yes, for inclusion in the VSMP database

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual,* page 126;

For test kits:
www.fishersci.com
www.hach.com
www.lamotte.com

Skill set

Observing, categorizing, measuring, recording, interpreting, comparing, hypothesizing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT SAFETY

Concept:

Using a chemical test kit introduces volunteers to standardized sampling procedures and equipment so data is comparable from site to site. This information can then be used as baseline data. For quality control and quality assurance, duplicate samples are sent to a certified lab to verify results from field analysis.

FIELD MEASUREMENTS

When choosing a parameter to test, focus on environmental issues specific to your area, or concerns that you may have and want to investigate further. You can perform single parameter tests or do an entire suite of parameters to get an overall picture of water quality.

You may perform the tests streamside or in a lab setting. If you decide to conduct the tests in the lab, make sure you preserve and transport the sample properly. Sample bottles should be filled completely with no space and should be kept cool from the time they are collected until the time they are analyzed. Follow all directions included with each test kit, especially the safety measures.

Collect a grab sample by wading into the main current of the stream, using an extension pole from shore, or by boat without contaminating the sample (See page 7). Transport the samples to the lab as soon as possible for analysis.

How to use your data:

See how the measurements you made compare with the results from the lab analysis. Compare both to typical values for streams in your area and hypothesize what caused any atypical results. In Minnesota check the website: www.pca.state.mn.us or contact your local Soil and Water Conservation District office for help in determining the typical values for your area. Share your results with local water resource agencies.

Develop a Quality Assurance Project Plan

Activity:

Developing a Quality Assurance Project Plan (QAPP) will guide collecting, managing, and analyzing your data and is a critical step in ensuring quality data that can be used for research, regulatory actions, or decision-making.

Concept:

Developing a QAPP will improve the reliability, accuracy, and usefulness of volunteer collected data.

Equipment

QAPP guidelines from the EPA
Research materials including methods, requirements, and analysis

Time

Successfully completing a QAPP and obtaining final approval may take several days to several weeks. Consult the EPA website, your local coordinator, or VSMP for further information.

Source

EPA website; www.epa.gov/volunteer/qappcovr.html

Skill set

Designing, cooperating, comparing, writing

DON'T FORGET ABOUT SAFETY

The Environmental Protection Agency outlines the steps needed to complete a QAPP. By following these steps and obtaining approval of the final document, you establish quality assurance parameters for your data.

The process of developing a QAPP allows volunteers to be thoughtful and concise in defining the stages and details of their monitoring project. Once a QAPP has been approved, it can be used as the guidance document for your monitoring project and shared with other volunteer groups. It ensures the integrity of the data collected, and that future volunteers will follow the same methods for your site.

How to use your data:

After you have developed and implemented a QAPP, you may have more confidence in your data. You can present your findings to your neighborhood association, local unit of government, school board, city council, or county board. You can motivate others to become involved in monitoring within their community by sharing the experiences and data you've collected. Work with local or state agencies to have your data used for TMDL, 303d or other assessments.

Compare Past and Present Conditions

Activity:

Gather current and historic information about your site and draw comparisons of conditions through time.

Concept:

Investigate changes in the watershed resulting from human activities.

Equipment

Maps
Aerial photos
Current data
Historical documents and photos

Time

Several hours to collect and interpret information

Source

VSMP

Skill set

Mapping, measuring, researching, categorizing, comparing, interpreting

Collect topographic, geologic, soils, road, storm sewer, and land use maps for the area around your stream monitoring site. Delineate the watershed boundaries (see page **1**), locate and define land use within the watershed. Use a hydrologic atlas and bedrock geology or soil maps to explore the natural characteristics of the landscape that your stream runs through.

In addition to maps, compile data that local units of government (Soil and Water Conservation Districts or Watershed Districts) or volunteers have collected including land use practices, hydrologic conditions, precipitation, biological, chemical, and recreational uses. Use this information to get an overall picture of the current water quality of your stream.

After collecting the information about your stream, research historical documents and draw comparisons between its past and present conditions. Visit the Minnesota History Center, your local Historical Society, University, or local unit of government to get documents relating to the history of your site. Discover the history of your stream and notice its maturity through time. Compare its current state with historic documents.

How to use your data:

Describe changes in land use in the watershed and draw comparisons between historic water quality and how your stream is doing today. Has the water quality gotten better through time? What advances have we made in improving watershed conditions? What occurrences have affected water quality negatively? Identify changes in the data and hypothesize what the causes may be. Hypothesize possible solutions to potential problems.

DON'T FORGET ABOUT SAFETY

Compare Biosurvey Protocols

Activity:

Investigate the effectiveness of different biosurvey protocols by using multiple protocols to sample for macroinvertebrates at the same site. Collect and identify macroinvertebrates, calculate indices, and compare the results you find with different methods.

Concept:

Biosurvey protocols are designed to yield a representative sample from different habitats and stream conditions. Using inappropriate protocols may affect your results.

Equipment

Aquatic nets
Waders & life jackets
Buckets, Sorting trays
Tweezers
Sample bottles
Field data sheets
Denatured alcohol
(preservative)

Time

Approximately four hours in the field and eight hours in the lab; twice a year, in the spring and fall.

Quality Assurance

Yes, for inclusion in the VSMP database

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, page 86;

The River Network: *Benthic Macroinvertebrate Monitoring Manual*

Skill set

Collecting, observing, identifying, classifying, calculating, comparing

Data sheet available at www.vsmp.org

DON'T FORGET ABOUT SAFETY

Sampling for macroinvertebrates requires a bit of homework. You must be familiar with your site and stream to select the most appropriate protocol. If the stream at your site is fairly fast flowing with a predominance of riffle segments, it is a “high gradient” stream. If your site is slow flowing with few or no riffle segments it is a “low gradient” stream. In either case, choosing the most appropriate protocol is essential to collecting valid data.

Collect macroinvertebrates using at least two of the three recommended protocols: muddy-bottom, hester-dendy, or the kick net method (see ▲ **11**). Compare their suitability for your site. Also conduct a habitat assessment. Each protocol has a customized assessment that focuses on certain details such as riffle segments, the presence and abundance of woody debris, etc.

The conditions at your site, available habitat, water depth, stream width, and gradient will help determine which method is most appropriate. Once you have collected the macroinvertebrates, keep the samples from each protocol separate. Identify all macroinvertebrates to the Family level and perform the appropriate analyses.

Training:

Training is recommended for this activity and required if your data is to be included in the VSMP database. Please contact your local coordinator or the VSMP for available trainings.

How to use your data:

Compare your data from the different protocols and identify significant differences in population density and diversity. Hypothesize why one protocol worked better at your site and what factors influenced that. How does the surrounding habitat influence where you find macroinvertebrate? What emphasis does each protocol place on a specific habitat?

Event-Based Sampling for Nutrients or Bacteria

Activity:

Monitor your site for nutrients or coliform bacteria during and after storm events, by collecting a water sample for analysis or using field test kits.

Equipment

Sterile sample bottles
Field testing kit
Field data sheets
Pens/pencils

Time

Approximately 30 minutes to 1 hour

Quality Assurance

Yes, for both lab analysis and field testing kits, specific sample bottles and preservation are required.

Source

EPA, *Volunteer Stream Monitoring: A Methods Manual*, pages 158-170, 181-185;

Rivers Council of Minnesota, *River Monitors Manual*

Skill set

Collecting, recording, measuring, calculating, comparing, hypothesizing

DON'T FORGET ABOUT SAFETY

Concept:

Nutrients and bacteria are a normal part of a healthy stream; nutrients provide nourishment for living organisms and bacteria maintain the cycle of decomposition. However, negative impacts on water quality occur when excessive nutrients or harmful types of bacteria enter streams.

BACTERIA SAMPLING

Fecal coliform bacteria are microscopic organisms that live in the intestines of warm-blooded animals. Although not necessarily agents of disease, fecal coliform bacteria may indicate the presence of pathogens that live in the same environment. If fecal coliform bacteria are detected in a water sample, the water may be contaminated with waste from humans, pets, livestock, or wildlife.

Two methods may be used to monitor bacteria levels. You can collect a sample and have it analyzed by a certified lab. Proper collection, preservation, and transportation to the lab are necessary to obtain reliable results.

Or, you can collect a sample and process it yourself using a test kit. Some test kits use a micro filtration method that involves incubating the sample on a nutrient medium and then counting the bacterial colonies that grow there. Other test kits do not require incubation and can produce reliable results. Specific directions are included with each kit. To obtain accurate results and maintain safety, follow sterilization and disinfection procedures carefully.

NUTRIENT SAMPLING

While nutrients are critical to all living things, too much of a good thing can be a problem. Excessive phosphorus and nitrogen can significantly degrade water quality and are the most common nutrients measured.

In analyzing samples for nutrients, you may either send the water sample to an accredited lab for analysis, conduct the analysis yourself with test kits, or use a special piece of equipment such as a spectrophotometer or colorimeter that automatically analyzes the sample. Conducting the analysis yourself requires special containers, reagents, and careful measuring. There are specific quality

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assurance measures to follow for all of types of analysis. Follow directions carefully and work with your local coordinator for most accurate results. Replicates should be collected for 5-10% of the samples and sent to the lab.

How to use your data:

Track bacteria and nutrient levels over time, correlate land use with concentrations and storm events. Share your results with local agencies noting correlations with land use patterns, seasons, or storm events. Hypothesize how excessive nutrients or bacteria may be entering your stream site, and discuss potential solutions to reduce the inputs.

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(800) BUG-IWLA
www.iwla.org/sos/sostools.html

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www.lamotte.com

METROPOLITAN COUNCIL – ENVIRONMENTAL SERVICES

Mears Park Building,
230 East 5th Street
St. Paul, MN 55101-1626
www.metrocouncil.org/environment/environment.html

MINNESOTA DEPARTMENT OF NATURAL RESOURCES (MN DNR)

500 Lafayette Road
St. Paul, MN 55155
(651) 296-6157: General Information
(651) 297-5476: Adopt A River Program
www.dnr.state.mn.us

MINNESOTA POLLUTION CONTROL AGENCY

Citizen Stream Monitoring Program
520 Lafayette Road
St. Paul, MN 55155
(651) 296-7187
www.pca.state.mn.us/water/csmp.html

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St. Paul, MN 55104-1284
(651) 523-2812
http://cgee.hamline.edu/frogs/index.html

RIVER NETWORK

153 State Street
Montpelier, VT 05602
(800) 223-3840
www.rivernetwork.org

RIVERS COUNCIL OF MINNESOTA

100 Second Avenue South, Suite 101
Sauk Rapids, MN 56379-1409
(320) 259-6800
www.riversmn.org

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

www.epa.gov/owow/monitoring/vol.html

Volunteer Stream Monitoring: A Methods Manual
EPA 841-B-97-003
www.epa.gov/owow/monitoring/volunteer/stream/stream.pdf

The Volunteer Monitor's Guide to Quality Assurance Project Plans:
www.epa.gov/owow/monitoring/volunteer/qapp/qappcovr.pdf

USGS OFFICES IN MINNESOTA

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VOLUNTEER STREAM MONITORING PARTNERSHIP

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St. Paul, MN 55108
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www.vsmp.org

WATER ACTION VOLUNTEERS

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Madison, WI 53706-1562
(608) 265-3887, (608) 264-8948
http://clean-water.uwex.edu/wav/index.html