STREAM TEAM FIELD GUIDE

Water Quality Edition

Photo Credit: Louis Cousino

Edited by Amanda Buday and Tara Kneeshaw

Welcome to the *Stream Team Field Guide*, your roadmap for collecting, understanding, and reporting stream monitoring data. Michigan's abundant freshwater is vital for agriculture, but few monitoring programs focus on farming communities and their watersheds. This guide helps fill that gap by connecting hands-on stream monitoring to agricultural learning.

Water is essential for growing crops and raising livestock. It moves through the water cycle, topography, and soil, shaping how nutrients and sediments travel. Good land management keeps soil and fertilizers in the field, protecting nearby streams from pollution. But when soil erodes or runoff carries nutrients away, it can cause problems like excess algae growth. That's why conservation practices – like grassed waterways, buffer strips, and cover crops – are so important for farmers.

By testing water quality and observing aquatic life, you'll build a record of your stream's health and learn how topography, point and non-point source pollution, and land use interact. This data helps answer questions such as: *Are conservation practices working? Where are the greatest pressures on water quality? What actions make the biggest difference for agriculture and our communities?*

As FFA members, you can take the lead as stewards of land and water. Your Stream Team's data and observations may support local conservation, inform neighbors, or even shape your Supervised Agricultural Experience (SAE) or Agriscience Fair project. Whether you're working toward a career in agriculture or natural resources, the skills you build here – research, critical thinking, and stewardship – will help you make decisions that balance farm productivity and water quality.

Every stream has a story. Monitoring helps you tell it: how water flows, changes, and recovers over time. This guide will walk you through observing physical features, measuring water chemistry, sampling macroinvertebrates, and analyzing for *E. coli*. You'll learn why each measurement matters and how to share your findings. Thank you for leading the way on water in Michigan's farmland.

CONNECTING LAND AND WATER: UNDERSTANDING YOUR WATERSHED

A. Buday, T. Kneeshaw, and S. Bowman

Objectives

- Explain the connection between land and water in a watershed.
- Create a visual of your study site.
- Identify potential point and non-point sources of pollution.

As residents living within the Great Lakes Basin (Figure 1.1), we enjoy the rewards and responsibilities of stewarding the largest freshwater system on the planet. All water flowing across land within the basin eventually makes its way into 21% of the world's unfrozen freshwater supply. Great Lakes land and its management are therefore critically connected to Great Lakes water.

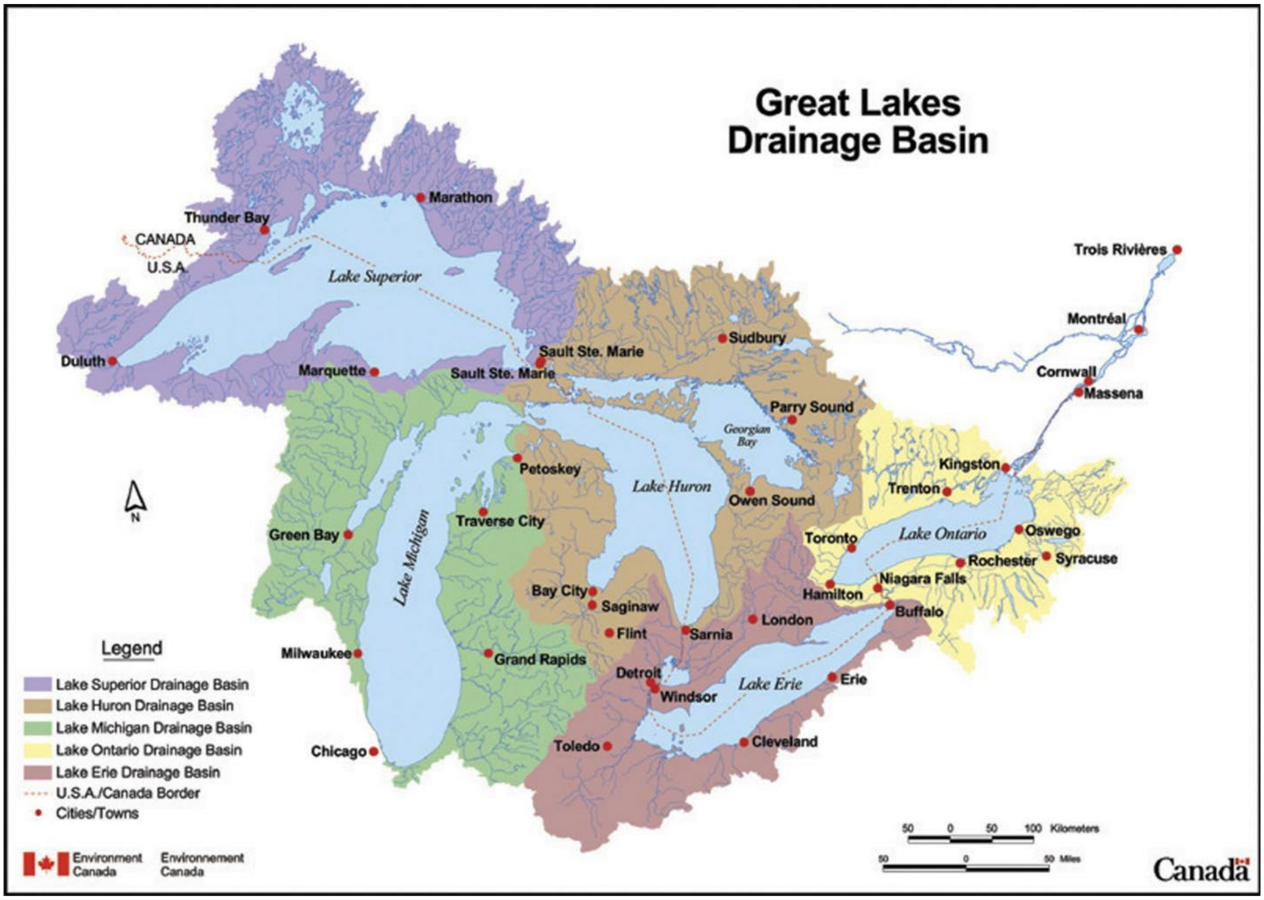

Figure 1.1 Watersheds of the Great Lakes, Environment Canada via Groundswell

To understand the link between land management and water quality, we'll examine water at the **watershed** scale. A watershed encompasses the area of land that drains into a common body of water, as well as the body of water itself (LGROW, N.d). For example, look at Figure 1.2. Water doesn't like to stay put; rather, it follows the force of gravity and the path of least resistance, flowing along from higher to lower elevation and through or across surfaces as their **permeability** permit or prohibit passage.

Watersheds can also be subdivided into smaller subwatersheds that flow together to form larger sub-basins and river or lake basins (Groundswell, N.d). It's too much for anyone to study all the components of a large watershed at once, but studying one subwatershed can inform both local issues and the bigger picture.

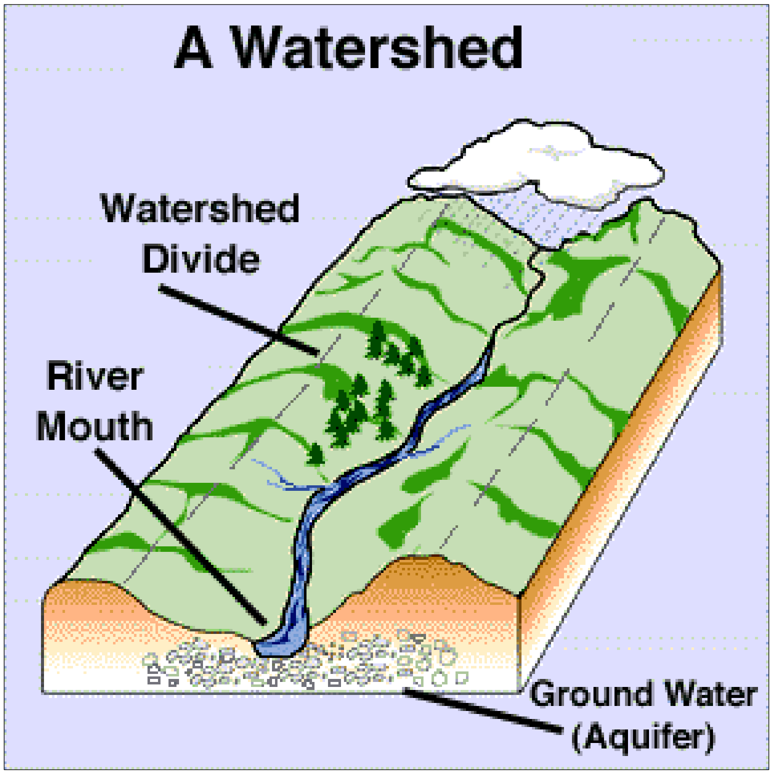

Figure 1.2 Watershed model, from SWMPC.org

Key Terms:

- *Best management practices (BMPs)* – actions watershed residents can take to reduce water pollution.
- *Non-point source pollution* – water pollution that comes from numerous, diffuse sources.
- *Permeability* – the degree to which a substance, such as water, can pass through the Earth's surface into soil or groundwater.
- *Point source pollution* – water pollution that has a single, identifiable source.
- *Watershed* – an area of land that drains into a common body of water, and the body of water itself.

Water is a vital resource, and it can also be a pain in the neck! Melting snow or heavy rainfall can cause water to flow with great force, carrying any pollutants in its path as it flows. This may include road salt, motor oil, sediment, fertilizer, bacteria, and pesticides. These pollutants are then deposited, untreated, to the nearest stream or lake through surface water runoff or storm sewers, or they infiltrate into groundwater (Groundswell, N.d.).

While **point source pollution** has a single, identifiable source, such as industrial or municipal wastewater discharge pipes, **nonpoint source (NPS) pollution** comes from numerous, diffuse sources in the environment as snowmelt and stormwater carry pollutants along their flow path. Figure 1.3 depicts common sources of pollution. The many sources that contribute NPS pollution to surface or groundwater bodies makes their management a major challenge.

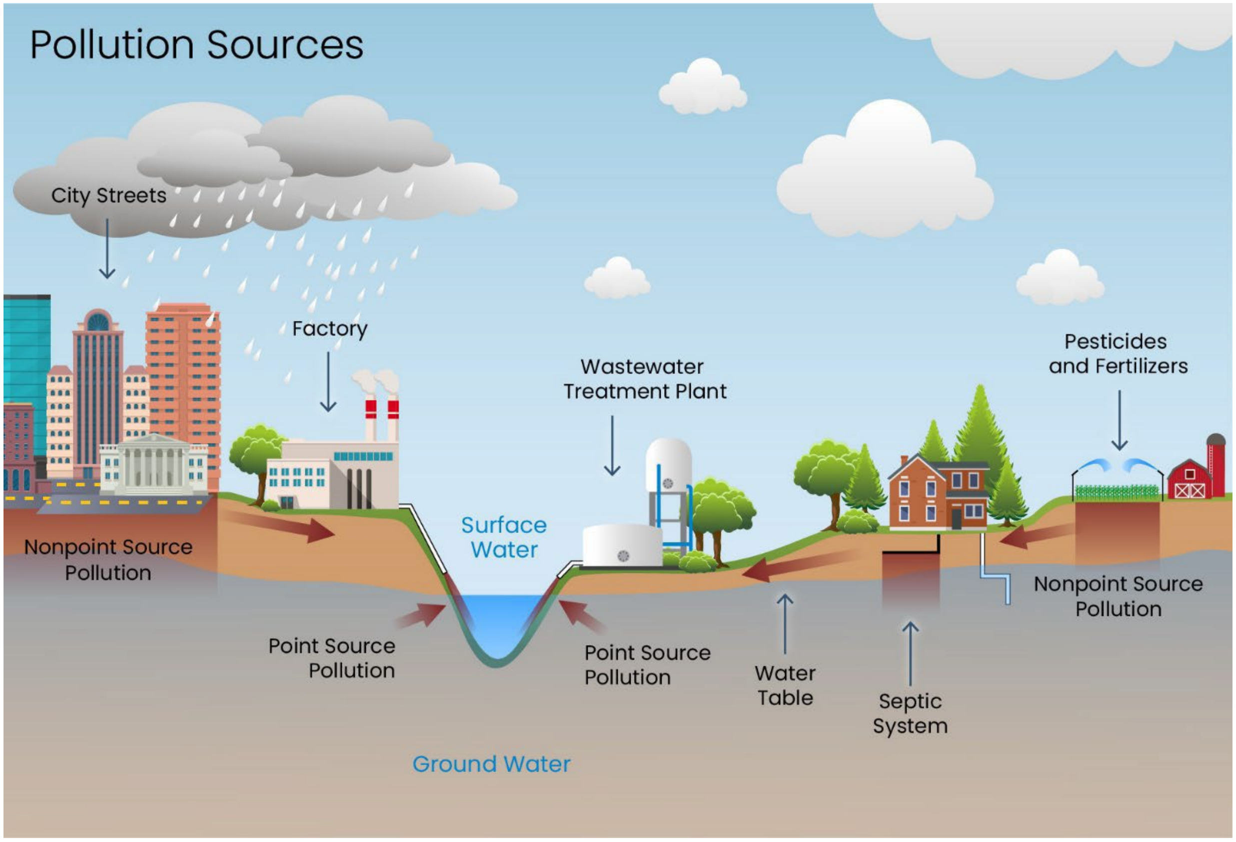

Figure 1.3 Point and nonpoint source pollutants, Battle Creek Area Clean Water Partnership

NPS pollution has negative impacts on water quality.

- Sedimentation occurs when soil with clay, silt, or fine matter erodes into a stream. This particles cloud the water (turbidity), block sunlight, clog fish gills, and interfere with fish spawning.
- Nutrient loading happens when too much nitrogen or phosphorus fertilizer runs off the land into water. These nutrients feed algae, causing it to grow rapidly. Large amounts of algae reduce oxygen levels as they die and decompose, harming fish and water quality.
- Bacterial pathogens like *E. coli* can spread disease to people and animals. They usually enter waterways through untreated sewage, manure runoff, or runoff from livestock operations.

There are several **best management practices (BMPs)** that watershed residents can use to reduce NPS pollution:

- Test your soil before fertilizing to better understand your needs. Use phosphorus-free products and follow the manufacturer's directions.
- Don't dump anything down a storm drain.
- Wash your car on a grassy area, use soap sparingly, or take your car to a car wash where the water can be recycled.
- Make sure your car is working properly and not leaking fluids.
- Pick up after your pet(s)!
- Have your septic system pumped every 3-5 years.
- Plant/maintain vegetation on erosion prone areas – especially the banks along rivers, ponds, and lakes.
- In cropping systems, consider using reduced or no-till methods to minimize soil disruption. Consider planting cover crops after harvest to protect the soil surface.
- Restrict livestock access to shorelines to reduce erosion and provide an off-stream watering source to prevent livestock from depositing manure in waterways.

References

Groundswell. N.d "Watersheds and Nonpoint Source Pollution." Lower Grand River of Watersheds. Accessed 23 Aug., 2023 B36CECEF76D8D026/nps_lesson_one.pdf).

LGROW. N.d. "What is a Watershed?" Lower Grand River Organization of Watersheds. Accessed 23 Aug., 2023 (https://www.lgrow.org/watersheds).

Understanding the Study Location

Before beginning data collection, work with your monitoring team to document information about your stream study site. Think about where your water comes from, what land uses surround it, and any pollution risks. Use these questions to map your site, spot possible problems, and shape a good driving question for your study.

Answer each question in complete sentences. Use the "Think About" prompts to add detail.

1. **What general information do you know about the location you will be studying?**

   Think About:
   - What is the watershed for the location?
   - What types of land use are found in this watershed?
   - What are the potential sources of point source and nonpoint source pollution?

   Your Response:

2. **What do you know about the streambed and streambank of the field site?**

   Think About:
   - What materials are present in the streambed?
   - What are the characteristics of the streambank?
   - Is there any evidence of erosion or best management practices (BMPs)?
   - Describe the plant community in the water and along the streambank.

   Your Response:

3. **How do you think that the features of the study location you described above will impact water quality and aquatic life?**

   Your Response:

4. **Driving Question or Phenomenon: After completing questions 1-3, what is a big picture question you have about the water quality at this study location?**

   Think About / Discuss:
   - What do you wonder about this driving question or phenomenon?
   - What type of information do you need to gather to answer this question?
   - What will your criteria be for collecting data and information?
   - What constraints might you face?

   My Driving Question:

5. **What additional information do you need to know about the study location or phenomena before you begin data collection?**

   Your Response:

6. **Draw or Diagram Your Study Location**

Label: land uses, possible point or nonpoint sources of pollution, best management practices (BMPs), topography, and stream flow direction.

Your Drawing:

DIVING INTO WATER CHEMISTRY

T. Kneeshaw, A. Buday

Objectives

- Use multi-meters to measure water chemistry parameters.
- Explain how water chemistry affects water quality.

Stream chemistry affects an organisms' ability to survive in water and may affect the suitability of water for consumption or crop irrigation. Recording baseline conditions is an important first step in understanding the status of water quality and developing an effective management plan that protects water for recreation, irrigation, and consumption.

Numerous natural and anthropogenic (human) factors influence the chemical composition of water. Consistent, long-term monitoring can help establish normality parameters so that we can quickly spot when something is out of sorts. We will therefore review techniques for collecting water chemistry data on several key measures impacting water quality in streams.

Remember, it's important to use consistent sampling techniques and to thoroughly document your work so that the measurements can be repeated year after year and during different seasons. Our goal is to be able to compare conditions over time and under differing weather conditions, to understand what is "normal" for the creek and identify sudden changes that warrant deeper investigation.

We'll start with definitions of each measurement we'll collect. Next, we'll practice a lab exercise that gets you familiar with using multi-meters probes to measure water chemistry and interpret measurement results. Finally, there are instructions for collecting and recording measurements in the field and a few questions to help tie it all together.

General Stream Water Quality Parameters

This table describes the parameters we will document. (Adapted from globe.gov).

Temperature	**Definition:** The measure of the hotness or coldness of an object or liquid.	**Measurement Unit:** Degrees Fahrenheit (F) or Celsius (C)
Water Quality Impact	Water temperature controls the rate of all chemical reactions, and the metabolic activities and life cycles for aquatic organisms. Warm temperatures accelerate reactions, while reactions happen more slowly in cold temperatures. Even small changes (lasting more than a couple days) effect water chemistry and, ultimately, life.	
Conductivity	**Definition:** The ability of water to conduct electrical current, which depends on dissolved ions from salts and inorganic chemicals.	**Measurement Unit:** MicroSiemens per centimeter (µS/cm)
Water Quality Impact	Water with more ions will conduct electricity better, which is an indicator of dissolved minerals or other impurities in the water. Conductivity is relatively constant for a given water body. Significant changes (usually increases) in conductivity indicate a potential pollutant discharge. Warmer temperature also results in higher conductivity.	
Salinity	**Definition:** The amount of dissolved salts in water.	**Measurement Unit:** Parts per thousand (ppt)
Water Quality Impact	Salts can be chemical stressors causing toxicity to freshwater plants and animals. Fresh water usually has a salinity level of 0-0.5 ppt. Higher salinity can make water unsafe for drinking, irrigation, and livestock watering. Seasonal fluctuations occur due to applications of road salt, and evaporation (dry periods) and dilution (wet periods).	

pH	**Definition:** A measure of the acid content of water, ranging from 0 (acid) to 14 (base) with a neutral point of 7.	**Measurement Unit:** 0.0-14.0 pH units
Water Quality Impact	pH affects what can live in water as well as the solubility of minerals. Solubility, in turn, affects other water quality parameters and suitability for human use. The pH of most lakes and streams is 6.5 - 8.5.	
Total Dissolved Solids (TDS)	**Definition:** The amount of solid material that has been dissolved into the water, including minerals and salts.	**Measurement Unit:** Parts per million (ppm)
Water Quality Impact	TDS provides an estimate of how many units of dissolved matter exist per million units of water. The TDS standards for household use are less than 500 ppm. The TDS standards for agricultural use are less than 1,200 ppm.	
Turbidity	**Definition:** A measure of the clarity of water.	**Measurement Unit:** Centimeters (cm)
Water Quality Impact	Water clarity is reduced by suspended particles in water. Water with reduced clarity may limit light needed for photosynthesis, reduce the aesthetic appeal for recreation, change algal growth patterns, and smother ecosystems.	
Flow Rate	**Definition:** The speed water moves past a given point in 1 second.	**Measurement Unit:** Counts per minute (C) recorded by flow meter, converted to Feet per second (ft/s) by data entry form
Water Quality Impact	Water flowing at a high velocity can increase pollutant and sediment loading to water bodies and contribute to erosion of streambanks. A stream's rate of flow can be impacted by characteristics of the stream, (i.e., width and depth), as well as weather events.	

Field Protocol

Working in teams, one stream scientist will use the pole sampler to collect a beaker of stream water, either wading into the center of the stream or reaching as far towards the center as possible off the bank. Another stream scientist will operate the Oakton multiparameter pocket tester, recording measurements on the data sheet, below. Make sure everyone on your team has a job and trade jobs at each site visit.

Caution: Always evaluate the depth of your stream site before wading in. If you can't see the bottom of the stream, find a long stick and make sure the water does not exceed waist depth. If using a pole sampler, ensure that you have secure footing and balance while reaching to collect your water sample.

Temperature/Conductivity/Salinity/TDS/pHProtocol

1. Carefully remove the cap of the tester and rinse the tester probes in stream water.
2. Press ON/OFF (⏻) to power on the tester.
3. Dip the tester about 2 – 3 cm into the beaker of water. The tester will default to the parameter last selected.
4. Stir and let the reading stabilize. The timer icon will blink during this time. The reading is stabilized when the timer stops blinking and a check mark appears.
5. Press HOLD to freeze the reading and record it. Press HOLD again to release the reading.
6. To change to the next parameter, select MENU. The Key Info window will appear momentarily. When you should see the option MEASURE, select HOLD.
7. Use the MENU button to scroll through the list of parameters and press HOLD to select the next parameter. A check mark will display.
8. Select CAL/ESC to return to the tester display screen.
9. Dip the tester into the sample water again and repeat the procedure for each parameter, recording your results for each parameter on your data sheet.
10. Turn off the tester by pressing ON/OFF for 3 seconds.

Turbidity Protocol

1. Collect a surface water sample using a bottle. Be careful not to stir up sediment from the bottom of the stream.
2. Stand with your back to the sun so that the transparency tube is shaded.
3. Pour sample water slowly into the tube. Look straight down into the tube with your eye close to the tube opening. Stop adding water when you cannot see the pattern at the bottom of the tube.
4. Rotate the tube slowly as you look to make sure you cannot see any of the pattern.
5. Record the depth of the water in the tube on your data sheet to the nearest cm. **Note: If you can still see the disk on the bottom of the tube after the tube is filled, record the depth as >120 cm.**
6. Pour the water from the tube back into the sample container.
7. Repeat the measurement two more times with a different observer using the same sample water. Calculate the average.

Flow Protocol

1. Assemble the flow rate sensor by connecting the impeller and riser rods.
2. Start the data collection software.
3. Submerge the impellor in the water to about 40% of the stream depth, **facing upstream**.
4. Hold the impeller in position for **60 seconds** and record the counts per minute (number of revolutions made by the impeller) on your data sheet.

References

Global Learning and Observations to Benefit the Environment (GLOBE) Program. "Hydrosphere." Accessed 23 August 2023, globe.gov.

Project WET. 2006. *Healthy Water, Healthy People.* Project WET Foundation.

Stream Team Field Data Sheet

Team Members:	
Stream Name:	
Stream Site:	
Date and Time:	

Current Weather
☐ Clear
☐ Partly sunny
☐ Partly cloudy
☐ Overcast
☐ Foggy
☐ Drizzly
☐ Light rain
☐ Heavy rain
☐ Sleet
☐ Snow
☐ Other:

Air Temperature
__________ ˚F

Wind Conditions
☐ Calm
☐ Slight breeze
☐ Moderate wind
☐ Gusty
☐ Storm winds
☐ Strong gusts

Water Color
☐ Clear/blue
☐ Grayish
☐ Light yellow/tan
☐ Dark tan
☐ Light green tint
☐ Green
☐ Brownish
☐ Blue green
☐ Reddish
☐ Blackish
☐ Other:

Instrument Data

Water Temp. (˚F)	pH	Cond (µS/cm)	TDS (ppm)	Salinity (ppt)	Turbidity (cm)	Flow (C)

Habitat Conditions
☐ Riffles
☐ Rocks
☐ Aquatic plants
☐ Leaf packs
☐ Pools
☐ Undercut banks
☐ Submerged wood

Observed Uses
☐ Swimming
☐ Boating
☐ Fishing
☐ None
☐ Other:

Potential Pollution
☐ Yes (describe ↓)
☐ No

Wildlife Sightings
☐ Fish
☐ Crayfish #_______
☐ Mammals
☐ Birds
☐ Reptiles
☐ Waterfowl
☐ Amphibians
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STREAM BUGS TELL THE STORY: MACROINVERTEBRATES

A. Buday, J. Kroft

Objectives

- Identify the abundance and diversity of macroinvertebrates at your study site.
- Estimate the quality of water resources at your study site.

The macroinvertebrates present in waterways have a story to tell about water quality, and what they have to say is really important! **Benthic macroinvertebrates** are small aquatic animals without backbones that live at the bottom of waterways, deep in the sand and sediment (U.S. EPA, 2022). They spend a lot of time in the water and therefore have maximum exposure to any contaminants present. Healthy waterways will support a wide variety of macroinvertebrates, while contaminated waterways may support a limited amount and variety of pollution-tolerant species. What story do your bugs have to tell?

We will use the Michigan Clean Water Corps (MiCorps) volunteer stream monitoring protocol to conduct a macroinvertebrate assessment at your monitoring sites. According to MiCorps, the varying tolerances macroinvertebrates have for physical and chemical conditions makes them an indicator of the ecological condition of a stream. We will use our macroinvertebrate data to calculate a **Water Quality Rating (WQR)** for your stream site, which allows us to summarize stream conditions and compare those conditions over time and across sites.

Key Terms:

- *Benthic macro-invertebrates* – small aquatic animals with no backbones living in the streambed.
- *Water Quality Rating* – a score representing the quality of water for supporting macroinvertebrate life, particularly pollution-sensitive organisms.

Your assessment should include approximately 300 feet of stream length at your monitoring site. Below you will find directions for sampling and definitions relating to each section on the MiCorps macroinvertebrate assessment data sheet, followed by the macroinvertebrate data sheet itself. These materials are adapted from the MiCorps 2020 Stream Monitoring Procedures handbook.

Michigan Clean Water Corps

Sampling Protocol

Thorough macroinvertebrate sampling requires considerable time at your stream monitoring site. Therefore, we will spend time collecting macroinvertebrates each time you visit your field sites. Divide your 300-foot monitoring site into three sections. You will sample each section for a minimum of twenty minutes over three separate site visits. Set a timer to ensure that you spend a consistent amount of time sampling each section of your study site. **Your aim is to collect at least 100 organisms total over the three sampling events.**

One team member will serve as the **collector,** wading into the stream with a dip net and collecting debris from all habitat types present at your 300-foot monitoring site. Collectors will:

1. Begin at the downstream end of the stream and work upstream. This means that you will be walking against the current.
2. Kick along the streambed as you walk. Skim your dip net along the streambed, lifting carefully in sweeping motions to collect debris and bugs.
3. Point the opening of your dip net upstream so that the current does not wash out your net.
4. Shake the organisms loose from rocks, branches, and leaves.
5. Do not collect mussels, crayfish, or any other large fish. If found, note their presence and release.

A second team member will serve as the **picker**, sorting through the debris gathered by the collector. Pickers will:

1. Dump the debris gathered by the collector onto a tray.
2. Use forceps to sort through the debris.
3. Place macroinvertebrates into jars of ethanol/alcohol for preservation.
4. The picker may also remove macroinvertebrates from under rocks or tree bark and add them to their collection jars.

Important: Clean your net and pans before leaving your site to avoid transporting organisms or plants.

Techniques for Specific Habitat Types

Riffles/Runs: Shallow, fast-moving water with rock/gravel bottoms; high oxygen, course substrate, supports more pollution-sensitive species (mayflies, stoneflies, caddisflies).

1. Put net on bottom of stream, stand upstream, hold net handle upright.
2. Use kicking/shuffling motion with feet to dislodge rocks. Attempt to shake organisms off rocks and kick up organisms hiding under the rocks. Dig down with your toes or use your hands to rub organisms off rocks. Beware sharp objects.

Pools: Deep pools, slow-moving water with sand/silt/clay bottoms; fine sediment, lower oxygen, supports more pollution tolerant species.

1. Scoop some sediment in your net to dislodge animals burrowed in muck.
2. Clean excess muck off net by keeping the top of the net out of the water (to avoid losing specimens) and swaying the net back and forth. Massage the bottom of net with hand.
3. Process one or two nets worth of muck, then do not return to this habitat.

Undercut Bank/Overhanging Vegetation or Roots: Streambanks with overhanging plants/roots; provide shelter for insects that attach to roots and feed on algae or debris.

1. Jab net into undercut bank while pulling net up. Move in quick bottom-to-surface motion, scraping macroinvertebrates from roots. Repeat several times.
2. Put net under the base of roots or overhanging vegetation. Shake vegetation with net to dislodge organisms. Use your hands if you are sure the plants are not poisonous.

Submerged or Emergent Vegetation: Rooted aquatic plants; offer food and cover for insects that feed on algae or plant material.

1. Keeping the net opening pointing upstream, move net through vegetation. Shake the vegetation and catch any organisms.
2. Use your hands to agitate vegetation and dislodge organisms into net.

Rocks/Logs: Large rocks (10" diameter) or woody debris; provide shelter for sensitive species (like caddisflies) that build protective cases or live under bark.

1. Remove small logs and rocks from water and pass to picker for searching.
2. Check under the bark of logs for organisms.
3. Caddisfly homes often look like small piles of sticks, clumps of gravel, or tiny circular pieces of algae attached to rocks.

Leaf Packs: Clumps of decomposing leaves; provide food and cover for insects that break down organic matter.

1. Scoop a few leaves into your net and pass to picker.
2. Pull apart leaf clump and search for organisms.
3. Add a small amount of water to your tray to dislodge bugs.

Datasheet, In-Classroom Recording

We will use PocketMacros to identify your macroinvertebrates in the classroom. Download the free mobile app to begin.

PocketMacros has three main functions, located at the bottom of your screen (left to right):

1. Field Guide: provides an overview of insect/non-insect species and their pollution tolerance level **for known species**.
2. ID Key: walks user through **identifying unknown species**; upon identifying species, sends user to Field Guide species profile.
3. Flashcards: further study resources for maximizing macroinvertebrate knowledge.

In your classroom, fill in the second page on your datasheet.

Datum	Definition/ Description
Identifications Made	Record the name of the student(s) completing the macroinvertebrate identification.
Rate Confidence	Circle the number corresponding to how confident you feel about identifying macros.
Count	As you identify your macros, record the number you found for each type in the "Count" column.
Total Abundance	Add up the "Count" column to get a total abundance.
Count x Sensitivity	Multiply the "Count" by the given Sensitivity Rating for each taxa group.
Sum of (Count x Sensitivity)	Add the values in the "Count x Sensitivity" column.
Water Quality Rating (WQR)	Divide the "Sum of (Count x Sensitivity)" by the "Total Abundance."

Important:

1. The lower the WQR score, the more pollution sensitive insects are found, and the better the water quality.
2. If the total abundance is less than 30, the site is automatically given a WQR of 10 (very poor). If the abundance is less than 60, the site is automatically given a WQR of 7 (poor).

References

Steen, P. and Latimore, J. 2020. MiCorps Volunteer Stream Monitoring Program: Monitoring Procedures. *Michigan Clean Water Corps*. Accessed 23, Aug. 2023 (https://www.micorps.net/stream-monitoring/stream- documents).

U.S. EPA. 2022. Indicators: Benthic Macroinvertebrates. *United States Environmental Protection Agency*. Accessed 23, Aug. 2023(https://www.epa.gov/national-aquatic-resource- surveys/indicators-benthic-macroinvertebrates).

Site ID#:________________________

Reference Sheet

Use this chart to check pollution sensitivity for each bug. **Enter your counts online** – the WQR is calculated automatically. This helps you see what affects your score.

Count	Common Name	Scientific Taxa	Sensitivity Rating (0-10)	Count x Sensitivity
	Hellgrammite (Dobsonfly)	Megaloptera, Corydalidae	0.0	
	Clubtail Dragonfly	Odonata, Gomphidae	1.0	
	Sensitive True Flies (water snipe fly,net-winged midge, dixid midge)	Athericidae, Blephariceridae, Dixidae,	1.0	
	Stonefly	Plecoptera	1.3	
	Caddisfly	Trichoptera	3.2	
	Mayfly	Ephemeroptera	3.5	
	Alderfly	Megaloptera, Sialidae	4.0	
	Scud	Amphipoda	4.0	
	Dragonfly	Odonata	4.0	
	Beetle	Coleoptera	5.1	
	Somewhat Sensitive True Flies	Dipterans (those not listed elsewhere)	6.0	
	Crayfish	Decapoda	6.0	
	Bivalves/Snails	Pelecypoda, Gastropoda	6.9	
	True Bug	Hemiptera	7.7	
	Damselfly	Odonata	7.7	
	Sowbug	Isopoda	8.0	
	Tolerant True Fly (mosquito, rat-tailed maggot, soldier fly)	Culicidae, Syrphidae, Stratiomyidae	8.7	
	Leech	Hirudinae	10.0	
	Aquatic Worm	Oligochaeta	10.0	

	Total Abundance

Sum of (Count x Sensitivity):	

First: If your total abundance is
Less than 30 ➔ Automatically give it a WQR of 10 (Very Poor rating)
Less than 60 ➔ Automatically give it a WQR of 7 (Poor rating)

Water Quality Rating		Degree of Organic Pollution
0.0-3.50	excellent	Pollution unlikely
3.51-4.50	very good	Slight pollution possible
4.51-5.50	good	Some pollution possible
5.51-6.50	fair	Fairly substantial pollution likely
6.51-7.50	fairly poor	Substantial pollution likely
7.51-8.50	poor	Very substantial pollution likely
8.51-10.0	very poor	Severe pollution likely

Water Quality Rating =

Sum of (Count x Sensitivity)
Divided By
Total Abundance

= ______________________

TESTING FOR TROUBLE: *E. COLI* IN STREAMS

A. Porter and A. Buday

Objectives

- Measure bacterial concentrations at your study site.
- Explain how *E. coli* affects water quality and public health.
- Compare your *E. coli* results to state standards.

Bacterial pathogens are a concern in recreational waterways because they can cause disease in humans and animals. In rural and farming communities, bacterial pathogens can enter waterways through raw sewage discharges, failing home septic systems, or manure spills and pose a health risk if they contact people's skin or are consumed. ***E. coli bacteria*** tests are conducted to serve as an indicator of the presence of fecal contaminants in recreational water. *E. coli* itself is a concern, and it is also a red flag that other pathogens that can cause severe illnesses may be present.

We will collect three water samples for *E. coli* screening at your Crockery Creek stream sites during three separate field visits.

What You Need:

- ☐ Sterile gloves
- ☐ A cooler (size based on the number of samples collected)
- ☐ A permanent marker and pen
- ☐ 3 sterile Nalgene bottles, 100 mL
- ☐ Icepacks or ice to keep samples chilled during transport.
- ☐ Field survey to record site specific data such as:
  - ☐ Name of person collecting the sample
  - ☐ Time of sample collection
  - ☐ Air temperature
  - ☐ Water temperature
  - ☐ Turbidity
  - ☐ Conductivity
  - ☐ Salinity
  - ☐ Streamflow
  - ☐ Additional observations (see field survey)

Key Terms:

- *Bacterial pathogens* – microorganisms that can cause infection and disease.
- *E. coli bacteria* – a type of bacteria found in the digestive tract which is an indicator of fecal matter in recreational waters.

Remember, collecting additional environmental data could be helpful for interpreting *E. coli* results - the more the merrier!

Field Protocol for Water Sample Collection

1. **Put on gloves**. It's important to wear sterile gloves for sampling. Do not touch the rim or inside of the cap or bottle.

2. Place the bottle into the flow of water **facing upstream** so the current is flowing into your sample bottle.

- Place the bottle halfway down the water column, doing your best to avoid getting top water or sediment from the bottom in the sample bottle, which can skew results.

3. After filling the bottle (volume 100 mL), replace and tighten the cap to prevent leakage.

4. Dry off bottle and label sampling bottle lid and side with sample identification in permanent marker:

- Sample ID - i.e., CS 1 - L
- Location - i.e., Thatcher Park
- Date/time
- Name of collector

5. Repeat this procedure three times, drawing samples from the right, center, and left of the stream channel. Determine the direction (left or right) by facing upstream.

6. Place the bottle in the cooler with ice pack/ice, field sample collection blank, and transport back to laboratory within 6 hours.

Lab Protocol

1. Once arrived in the lab, put on gloves and shake and invert the sample bottle vigorously 25 times to distribute the bacteria uniformly. Pour off sample until level with 100 mL line.

2. Within the 100 mL sample bottle containing the poured off sample, add one packet of IDEXX Colilert-18 powder and shake vigorously to combine.

3. Let solution of sample+Colilert powder sit until fully combined, and no bubbles are present.

4. Pour combined solution of sample+powder into Quanti-Tray and seal using tray sealer.

5. Let the tray incubate at 35ºC for 18-22 hours.

6. In the dark and using a UV light, shine lamp over trays and count wells that glow, separating large and small wells.

- Yellow wells = **total coliforms**
- Glowing wells = ***E. coli***

Interpreting Your Results

The Michigan Department of Environment, Great Lakes, and Energy (MI EGLE) maintains the following standards for *E. coli* in recreational surface waters.

Total body contact - full submersion in water, as for swimming. Observed May 1 - Oct. 1.

- Daily maximum geometric mean: **300 *E. coli* per 100 milliliters (mL)**

Partial body contact - partial submersion in water, as for boating or fishing. Observed all year.

- Daily maximum geometric mean: **1,000 *E. coli* per 100 milliliters (mL)**

1. Using your Google data entry form, enter the number of glowing large wells, and then the number of glowing small wells.
2. The application will take the well counts and convert these values to a most probable number (MPN).
3. You can also do this manually by using the MPN worksheet and following the well counts to find the value.
4. The MPN value is your reported *E. coli* concentration in colony forming units (CFU) (*E. coli)* per 100 milliliters (mL).

Reporting Your Results

E. coli results are reported as geometric means rather than arithmetic means. The geometric mean is calculated by multiplying a set of values together and taking the square root that corresponds to the number of values in the set. Using the geometric mean minimizes the effect of outlier (very high or low) values.

References

Haugland, R., Rachmadi, A. T., Rhodes, G., Dreelin, E., Flood, M., Lane, M., & Briggs, S. (2023). Preparations for Beach Season 2023: Protocol Updates for qPCR Method C. Michigan State University. Accessed 14, Sep., 2023.

MI EGLE. 2023. E. coli in Surface Waters. The Michigan Department of Environment, Great Lakes, and Energy. Accessed 23, Aug., 2023. (https://www.michigan.gov/egle/about/organization/water-resources/assessment-michigan-waters/e-coli-in-surface- waters.)