CLINTON RIVER WATERSHED COUNCIL

Clinton River Watershed Council
Stream Leaders
Water Quality Monitoring Guide

Section I Chemical
Section II Physical
Section III Biological

Section I: Chemical

Safety Considerations

1. Read the safety information on the label of each module. These labels provide very specific first aid and chemical information.

2. Ensure that students and others understand the danger of treating reagents casually or endangering others through “horseplay”.

3. Wear safety goggles particularly when running water quality tests that require shaking a chemical mixture.

4. Wash hands after performing water quality tests. Avoid placing hands in contact with eyes or mouth during monitoring.

5. Follow the general safety guidelines for your particular school.

6. Ensure a safe monitoring experience by using the following:
    - safety goggles
    - plastic gloves
    - clean pail or bucket for washing hands
    - jug of clean water for washing hands
    - soap (biodegradable, if possible)
    - towels
    - trash bags for litter and for spent test kit foil packets
    - waste container for liquid chemical waste
    - eye wash bottle
    - first aid kit

After testing, all reacted test samples, except coliform bacteria, can be disposed of by flushing down a sink drain with excess water. While in the field, reacted samples can be poured together into a waste container for later disposal. See the coliform bacteria procedure for coliform test disposal.

Collecting a Sample:

- Collect water sample in a sterile, wide mouthed jar that has a cover. Rinse container with sample water before taking the sample and avoid touching the inside of the container or cover. The water sample should be collected upstream from where you are standing so that your clothing or contact with your skin does not contaminate the sample. Handle all water samples as little as possible.
- Hold the container near the bottom and plunge it, opening downward, below the surface of the water, then turn the submerged container into the current away from you. Allow the water to flow into the container for 30 seconds. The container should be filled completely with the water sample and capped to prevent the loss of gasses.
- Perform tests as soon as possible or within one hour of collection. The shorter the amount of time between sample collection and sample testing, the more accurate the results.
- Collect a water sample that is representative of the water body being tested. Collect samples away from the shore and avoid sampling from the surface of the water or from the bottom sediments. Several samples from each water sampling site will assure the reliability of the data.

Dissolved Oxygen & Biochemical Oxygen Demand:

- Perform Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) procedures immediately after collecting water sample to keep dissolved gases from escaping.
- DO and BOD tests are ‘contaminated' by artificially changing the percent saturation of oxygen in the sample.
  - ⇒ Changing the temperature of the water sample can increase or decrease the percent saturation of your water sample. For example, if there are 8 ppm of dissolved oxygen in your sample and the actual temperature of the river you took it from is 22°C, the percent saturation should be 92%, but if you let your water sample warm up to 28°C before running a dissolved oxygen test, the percent saturation would register as 102% saturation.
  - ⇒ Gently pour water into testing jars. Splashing water into the jars will mix atmospheric oxygen into the sample. If you fill a DO jar from another container, rinse out the bottle and container with the sample water. If you have a syringe with a hose attached, rinse it thoroughly with the sample water, fill the syringe, set the tip of the hose in the bottom of the bottle and slowly fill the bottle.
  - ⇒ If you take a sample from running water, gently lower the jar into the water opening down, turn the bottle so it is facing upstream, let the water flow into the jar for 1 minute, and cap the bottle under water.
  - ⇒ Fill sample jars to the very top, so that there is a dome of water above the edge, then gently twist on covers.
  - ⇒ Make sure there are no air bubbles in the DO testing jars, if there are, start over. Keep in mind that air bubbles and a precipitate will form during the chemical reactions.

Nitrates:

- Touching the inside of the tubes or sampling equipment will contaminate the sample.

Phosphates:

- Don't touch the inside of the tubes or sampling equipment. Phosphates from the soap you used to wash your hands can cause a huge increase in the phosphate level you detect.

Change in Temperature:

- Bend down to the surface of the water to read the thermometer or try to read the thermometer before removing it from the water, otherwise the recording might change by the time you get the thermometer up to the level of your eyes.

Water Quality Indicators

Dissolved Oxygen:

General Information

- Dissolved oxygen is essential for supporting fish habitat in rivers. It is an important component of the following processes: respiration of aerobic plants and animals, photosynthesis, oxidation-reduction processes, solubility of minerals, and decomposition of organic matter.
- The accumulation of organic wastes and accompanying aerobic respiration by microorganisms as they consume the wastes depletes dissolved oxygen in rivers.
- The amount of oxygen an organism requires varies according to species and stage of life. Dissolved oxygen (DO) levels below 3 ppm are stressful to most aquatic organisms. DO levels below 1 or 2 ppm will not support fish. DO levels of 5 to 6 ppm are usually required for growth and activity. See Table 1.
- Low DO levels encourage the growth of anaerobic organisms and nuisance algae (which usually cause the water to smell bad and aren't necessarily a good food supply for fish and other organisms).
- High levels of bacteria from sewage pollution and high levels of organic matter in the water can lead to low DO levels.
- Dissolved oxygen is reported in milligrams of dissolved oxygen per liter of water (which is also referred to as parts per million or ppm).

% Saturation*

Water Temp °C	0 ppm	4 ppm	8 ppm
2	0	29	58
4	0	31	61
6	0	32	64
8	0	34	68
10	0	35	71
12	0	37	74
14	0	39	78
16	0	41	81
18	0	42	84
20	0	44	88
22	0	46	92
24	0	48	95
26	0	49	99
28	0	51	102
30	0	53	106

*Calculations based on solubility of oxygen in water at sea level, from Standard Methods for the Examination of Water & Wastewater, 18th edition.

Sources

- Oxygen is produced by aquatic plants, algae, and phytoplankton as a by-product of photosynthesis. Oxygen also dissolves readily into water from the atmosphere until the water is saturated. Once dissolved in water, oxygen diffuses very slowly and distribution depends on the movement of the aerated water.
- DO levels naturally fluctuate throughout the day in bodies of water with extensive plant growth. DO levels rise from morning through late afternoon as a result of photosynthesis, reaching a peak in late afternoon. Photosynthesis stops at night, but plants and animals continue to respire and consume oxygen, therefore causing DO levels to fall to a low point just before dawn.

Table 1: Examples of life supported at various levels of dissolved oxygen in ppm

3 ppm	catfish, carp
3 - 5 ppm	smallmouth bass, largemouth bass, bluegill, sunfish, black crappie, walleye
< 5 ppm	rainbow trout, brown trout, lake trout

Fecal Coliform:

General Information

- Fecal coliforms are naturally present in the digestive tracts of humans and other animals. Their presence in water serves as a reliable indicator of sewage or fecal contamination. Although coliform bacteria themselves are not pathogenic, they occur with intestinal pathogens (other bacteria, viruses, and parasites) that are dangerous to human health. Pathogenic microorganisms are relatively rare in water, which makes them difficult and time-consuming to monitor directly, so fecal coliform bacteria are monitored instead.
- Fecal coliform bacteria are measured in terms of the number of colonies of bacteria per 100 milliliters of water (see Table 2).

Table 2: Coliform Standards (in colonies / 100 mL)

<table>
<tr><td>Drinking Water</td><td>1 TC</td></tr>
<tr><td>Total Body Contact (swimming)</td><td>200 FC</td></tr>
<tr><td>Partial Body Contact (boating)</td><td>1000 FC</td></tr>
<tr><td>Treated Sewage Effluent</td><td>Not to exceed 200 FC</td></tr>
<tr><td colspan="2">Total coliform (TC) includes bacteria from cold-blooded animals and various soil organisms. According to recent literature, total coliform counts are normally about 10 times higher than fecal coliform (FC) counts.</td></tr>
<tr><td colspan="2">Field Manual for Global Low Cost Water Quality Monitoring (11th Edition, William Stapp & Mark Mitchell)</td></tr>
</table>

Sources

- Fecal coliforms come from humans and other warm-blooded animals while other coliforms come from soil organisms and other cold-blooded animals

Note: E. coli is used in Michigan, and many other states, as the standard for beach closings.

Table 3: E. coli_Standards (in colonies / 100 mL) for Body Contact in Michigan

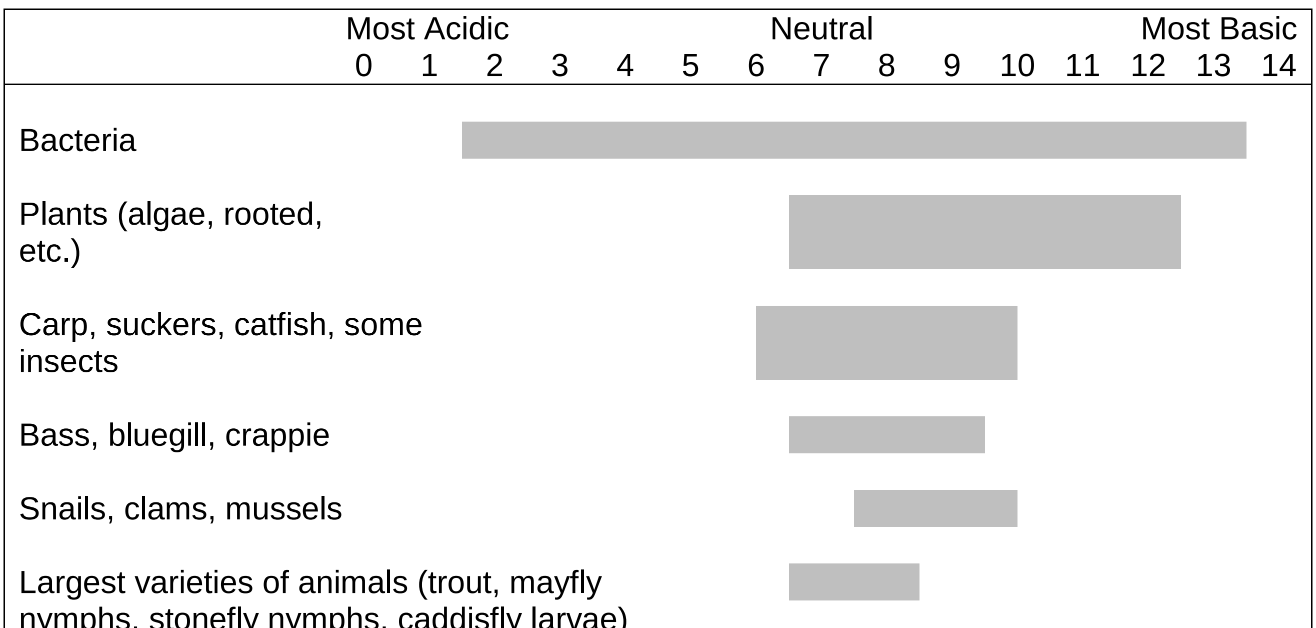
<300 count	suitable for full body contact
<1000 count	suitable for partial body contact
Macomb County Health Department	

pH:

General Information

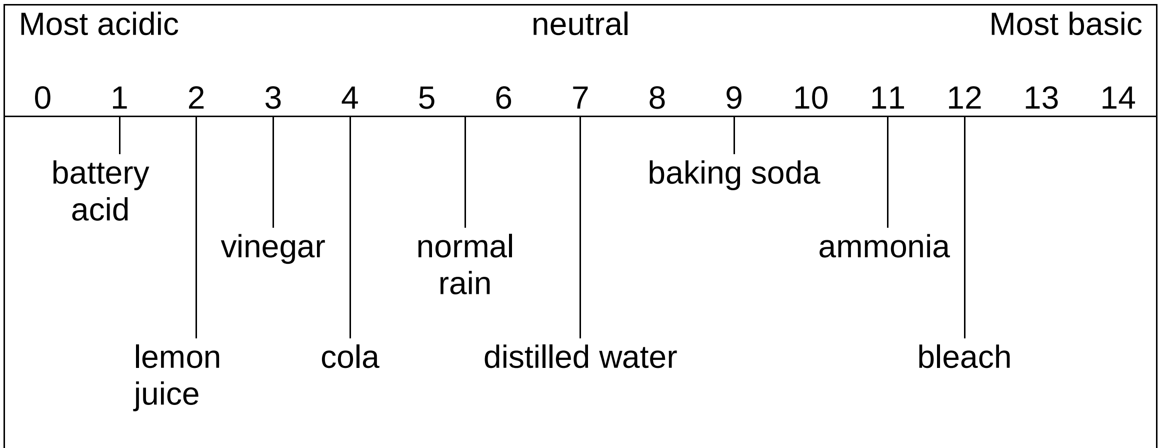
- pH is a measure of the hydrogen ion activity in a solution, and is important in determining the chemical speciation and solubility of various substances as well as regulating biological processes in rivers. pH is measured on a scale of 0 - 14, with zero indicating acid and 14 indicating base. Pure deionized water is 7 and is considered neutral (see Table 4).
- A pH of range 6.5 to 8.2 is optimal for most organisms. Rapidly growing algae and vegetation can remove carbon dioxide (CO_2) from the water during photosynthesis, which can result in a significant increase in pH levels. Most natural waters will have pH values ranging from 5.0 to 8.5. Sea water has a pH value close to 8.0.
- Low pH can cause heavy metals to become more mobile and be released into the water.
- Most organisms have adapted to life in water with a specific pH and may die if the pH changes even slightly. At extremely high or low p values (>9.6 or <4.5) the water becomes unsuitable for most organisms. Serious problems occur in lakes with a pH below 5 and in streams that receive a massive acid dose as acidic snow melts in the spring.

Table 4: pH Ranges that Support Aquatic Life



Field manual for Low Cost Water Quality Monitoring
(11th Edition, William Stapp & Mark Mitchell)

Table 5: pH of Common Liquids and Compounds



Field manual for Low Cost Water Quality Monitoring
(11th Edition, William Stapp & Mark Mitchell)

<u>Sources</u>

- Acid rain, industrial wastes, agricultural runoff, dredging from improper mining operations, etc. can cause fluctuations in pH levels.

Biochemical Oxygen Demand:

<u>General Information</u>

- Biochemical Oxygen Demand (BOD) is the measure of the quantity of dissolved oxygen used by bacteria as they break down organic wastes. The difference between the DO result and the BOD result is the amount of oxygen consumed by bacteria in the water sample. In slow moving and polluted rivers, bacteria consume much of the available dissolved oxygen.
- Protozoa, which also require oxygen, prey upon the growing population of bacteria.
- High levels of BOD indicate increased levels of nutrients which can result from both natural and human induced activities.
- BOD is reported as milligrams of oxygen used per liter (ppm).

Temperature:

<u>General Information</u>

- Water temperature directly affects many physical, biological and chemical characteristics of a river. Temperature affects: the amount of oxygen than can be dissolved in the water; the rate of photosynthesis by algae and larger aquatic plants; the metabolic rates of aquatic organisms: and the sensitivity of organisms to toxic wastes, parasites, and diseases (see Table 6).

<u>Sources</u>

- Thermal pollution - discharge of heated water from industrial operations, runoff from impervious surfaces such as roads and parking lots etc., artificially increase water temperatures.
- Removing tree cover can also lead to increases in water temperature.
- Changes in water temperature affects the rate of photosynthesis by aquatic plants (higher temperatures = higher rates of photosynthesis, until temperatures become so high that tissue damage or death of the plant occurs).
- Affects the sensitivity of organisms to toxic wastes, parasites, and disease.

Affect on other tests

- Affects the percent saturation of dissolved oxygen in the water.

Table 6: Examples of Life Supported at Various Temperatures

>20°C	much plant life, warm water fish: bass, crappie, bluegill, carp, catfish
13 - 20°C	some plant life, cold water fish; salmon, trout, aquatic insects; stone fly nymphs
<20°C	cold water fish and aquatic insects: mayfly nymphs, caddisfly larvae, water beetles, and water striders; cold water fish: trout
Field manual for Low Cost Water Quality Monitoring (10th Edition, William Stapp & Mark Mitchell)	

Total Phosphate:

General Information

- Phosphorous is an essential nutrient required for plant growth which is often in short supply if left to natural availability.
- Phosphorus occurs in natural waters in the form of phosphates.
- Because phosphorous is often in short supply, it is rapidly taken up by algae and larger aquatic vascular plants as phosphate. Since algae need small amounts of phosphorous to live, excess phosphates causes accelerated algal growth.
- Increasing phosphate levels by 0.03 ppm through runoff, etc. will increase plant growth and thus eutrophication.
- Phosphate is measured as milligrams of phosphate per liter of water (ppm).

Sources

- Human and animal wastes, industrial pollution, fertilizers.

Affect on other tests

- Excess nutrients increase plant growth and decay (eutrophication), promote bacteria decomposition, and, therefore, decrease the amount of oxygen in the water.

Nitrates:

General Information

- Nitrogen is an essential nutrient required by all plants and animals for building protein.
- Nitrogen is very abundant in river ecosystems and is found in a number of forms including molecular nitrogen, ammonia, nitrates and nitrates.
- In excess, nitrogen can stimulate rapid algal and aquatic vascular plant growth.
- Unpolluted waters usually have a nitrate level below 4 ppm. Nitrate levels above 40 ppm are considered unsafe for drinking water. Drinking water containing high nitrate levels can affect the ability of our blood to carry oxygen, which is especially true for infants.
- Nitrate levels above 2.5 - 5 ppm can lead to accelerated plant growth and eutrophication
- Nitrates are combined with nitrites and measured in milligrams per liter.

Sources

- Decomposition of dead plants and animals, fertilizers, animal waste, sewage.

Affect on other tests

- Excess nutrients increase plant growth and decay (eutrophication), promote bacteria decomposition, and, therefore, decrease the amount of oxygen in the water.

Turbidity:

General Information

- Turbidity is a measure of the relative clarity of water and should not be confused with color, since darkly colored water can be clear without being turbid. It is the result of suspended solids in the water that reduce the transmission of light. Suspended solids range from clay, silt and plankton to industrial wastes and sewage.
- When water has a high turbidity it losses its ability to support a diversity of aquatic organisms. Suspended solids can clog fish gills, reduce growth rates and disease resistance, and prevent egg and larval development. Settled particles can accumulate on the stream bottom and smother fish eggs and aquatic insects, suffocate newly-hatched insect larvae and make river bottom micro-habitats unsuitable for mayfly nymphs, stonefly nymphs, caddisfly larvae and other aquatic insects.
- Turbidity is measured in Jackson Turbidity Units.

Sources

- Suspended and colloidal matter such as clay, silt, organic and inorganic matter, and microscopic organisms.
- Soil erosion, urban runoff, algal blooms, bottom sediment disturbances which can be caused by boat traffic and abundant bottom feeders such as carp.

Affect on other tests

- If the suspended matter is organic, it can lead to a decrease in Dissolved Oxygen levels.
- Turbid water absorbs heat from the sun resulting in less oxygen in the water. Warmer water holds less oxygen then cooler water.
- Suspended solids decrease light penetration resulting in decreased photosynthesis.

Total Solids:

General Information

- In addition to suspended solids, river water includes dissolved solids. The dissolved solids are that portion of materials in the water column which pass through a filter.
- Dissolved solids are inorganic materials which include calcium bicarbonate, nitrogen, phosphorous, Iron, sulfur, and other ions. A constant amount of these materials is essential for maintaining aquatic life because the density of total solids determines flow of water in and out of organisms' cells.
- Total solids includes both suspended and dissolved solids.
- Total solids is reported as milligrams per liter of water.

Section II: Physical

All data to be completed for a 100 ft reach (area of water body approximately 25 ft upstream of road crossing/bridge to approximately 125 ft further upstream) facing upstream. Shorter reaches (due to access or safety concerns) should be noted on data form (include approximate length of reach monitored).

Air Temperature
Hold thermometer for 2 minutes record the results on you data form. Be sure to record Celsius.

Water Temperature
Submerge the thermometer in a representative location within your reach, placing it inside a container. The thermometer and the container should be held horizontally in the stream, with the mouth of the container facing upstream. Hold both underwater for one minute keeping them level at the point between the stream's surface and bottom.

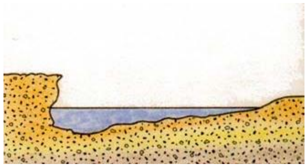
Remove the container from the stream, keep the thermometer bulb in the water-filled container, and read the water temperature as quickly as possible.

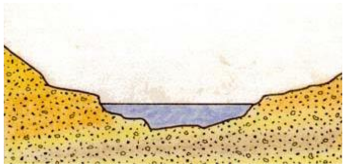
Record the results on you data form. Be sure to record Celsius.

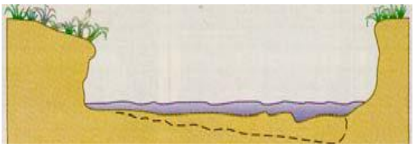
3.1 Stream Width
Stream width is the distance from the water's edge on one side to the water's edge on the other side. Check the box that best represents the average stream width in feet. Make this observation using best judgment of the distance. This can be done by pacing off the distance (counting the number of steps taken) on the road crossing from one edge of the stream to the other. There is no need to measure the distance with a tape measure or similar device; however, it is best to have previously paced off distances of 10, 25 and 50 feet so that the number of strides is known to these category endpoints.

Stream Depth
Check the box on your data form that best represents the average reach depth in feet. If the water is turbid and the depth cannot be determined, check "Unknown". This observation is for the average depth of the stream that is consistently observed. In other words, if the stream is mostly shallow, but is 5ft deep in the channel, the >3ft category should be circled. However, if the stream is generally shallow (<1ft), but has a pool that is 3ft deep, circle the <1ft category since a pool is not representative of the average depth of <1ft observed over most of the stream. Remember that water often looks shallower than it is.

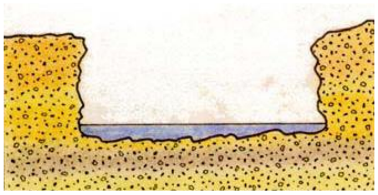
3.4 Channelization
Natural Stream- A natural stream has not been altered from its defined pattern, dimension and profile by artificial means, which includes straightening and widening. It is not necessarily stable, however. The stream has a non-uniform cross section with distinct pool and riffle sequences, although in large rivers these sequences may be difficult to identify. Mild to extreme meanders are often visible. The banks are vegetated and there are no signs of spoil piles or dikes along sides. The stream is not channeled or artificially controlled.







Channelized stream is a maintained stream channel is one that is actively controlled through dredging, widening, straightening, or the formation of dikes along the stream channel. The stream channel is straight, wide and shallow at low flow, and has a uniform cross section. Bank vegetation is typically sparse or very young. Pools and riffles are not existent or very sparse.



3.5 Soil
Watershed Soil type can be found at http://websoilsurvey.nrcs.usda.gov/app/

3.6 Coloration & Odor
Examine the water in the reach for color and odor. The most common color options are Clear, Gray, Brown, Black, Green Check the color that is most similar to that of the water in your reach. To the extent possible, try to describe any unusual odors. (e.g. fishy, sulfur, etc.)

3.8 & 3.9 Substrate
Substrate composition is “what the bottom of the river/stream/drain is made of”. It is a critical factor in determining what aquatic macroinvertebrates will be present. In general, good quality substrates (from an aquatic habitat perspective) contain a large amount of course material—such as gravels and cobbles—with a minimal amount of fine particles (silt, sand, muck).

Estimate the relative abundance of various substrate types (listed on the data form) in the stream reach. Round off to the nearest 10% increment. For example, do not record 25%, use either 20% or 30%. The composition estimate should include the entire area of the stream/river/drain bottom that is visible in the reach. Sometimes it is not possible to determine the substrate type all the way across a river because it is too deep or the water is turbid. In these cases, assign the appropriate percentage amount to the “unknown” category. The total percentage should add up to 100%,

Sand: feels “gritty” to the touch. Individual grains can usually be seen with the eye.
Silt/Detritus/Muck: very fine substance. Smooth to the touch, can be the result of decomposing plant matter or simply very fine “rock” particles.
Artificial/Human made-Examples include concrete piers, sheet piling or rock riprap (that portion of shoreline erosion protection structures that extends below the water surface is considered substrate).

3.10 Embeddedness
Embeddedness is the degree to which rocks and snags are covered or sunken into silt, sand, or mud in the stream/river bottom. Embeddedness is a result of large-scale sediment

movement and deposition and is a parameter typically evaluated in the riffles and runs of high-gradient streams. The more the substrate (river/stream bottom) is embedded the less its surface area is exposed to water and available as habitat by macroinvertebrates.

Check the category that best describes the bottom of your water body. Using your best judgment, indicate the extent to which the gravel, cobble, or boulders are embedded. If no rocks are visible, dig down a few inches to see if the natural streambed is rocky. Your water body may be naturally sandy or clay-based so no rocks will be present. Indicate if there are no rocks present.

Four embeddedness readings should be taken; two downstream and two upstream. Begin in the downstream area. If your site has riffles, this is where you should take your readings. Make one observation in the riffle (or other midpoint of water body as measured from stream bank to stream bank) and one observation in an area to the left of the midpoint, when looking downstream. Observe the tops and the sides of all rocks greater than three inches across within an approximately two foot squared area. Gently pick up several rocks, one at a time, from the observation area and watch for “plumes” of sediment to rise into the water column as you move the rocks. Record the average embeddedness value for the four observations.

3.11 Riparian Vegetation

The riparian vegetative width is the natural vegetation (plant) area along the stream/river/drain banks. ” (within the first 20 feet or so of the water’s edge)
Bare - bare ground. No, or almost no, streamside vegetation.
Herbaceous plants - grasses, wildflowers, ferns, sedges
Shrubs - woody vegetation less than 15 feet high.
Trees -Woody plants 15 feet or taller

3.13 Bank Erosion

Bank erosion occurs when soils are removed from the banks of the water body. Bank erosion may occur as a result of natural flow conditions, or may be caused by human activities.

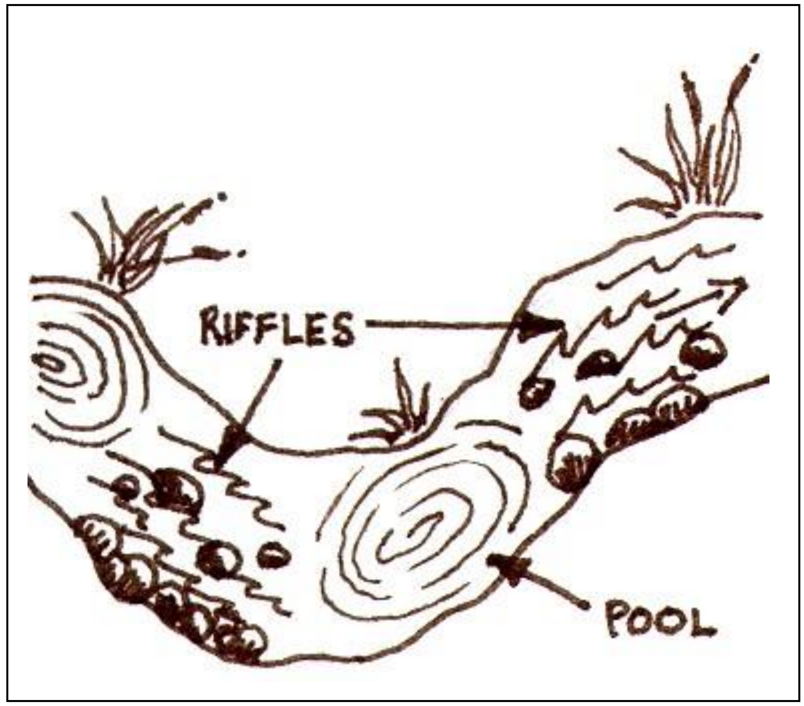
Determine the severity of erosion that has taken place and check the appropriate category.
<u>Record the most severe examples of erosion observed on either bank within your site reach.</u>

None Banks appear stable; no evidence of erosion. These banks are most likely well vegetated or structurally stabilized, and have no evidence of exposed tree roots or leaning trees due to eroded soil. They are not being altered by water flows, livestock access, or recreational access.

M - Moderate evidence of erosion. At least 75% of the stream bank is in stable condition. 10%-25% of the stream bank is sloughing, broken down, or actively eroding.

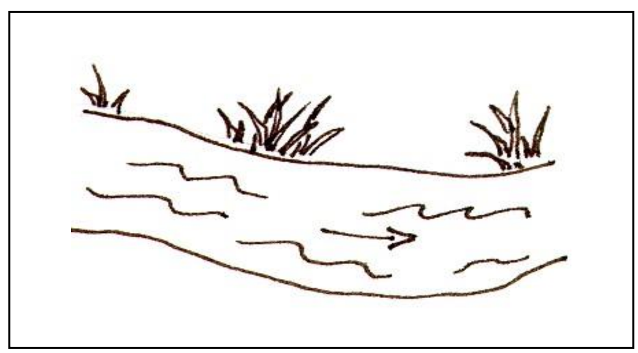
H - High evidence of erosion. Less than 75% of the stream bank is in stable condition. Over 25% of the stream bank is sloughing, broken down, or actively eroding. Stream bank sidewalls may have been scraped by machinery or scouring flows. Banks may be slumped; banks may be severely undercut. Tree roots may be exposed or fallen/leaning trees may be present.

3.15 Stream Habitat
For the items below, check those that are present in your site reach.



Riffles
Riffles are areas of naturally occurring, short, relatively shallow, zones of fast moving
water followed by a pool. The water surface is visibly broken (often by small standing
waves) and the river bottom is normally made up of gravel, rubble and/or boulders.
Riffles are not normally visible at high water and may be difficult to identify in large rivers.

Pools
Pools are areas of relatively deep, slow moving water. The key word here is "relatively".
Water depth sufficient to classify an area as a pool can vary from around 8 inches in small streams, to several feet in wadable streams, to tens of feet in large rivers. Pools are often located on the outside bend of a river channel and downstream of a riffle zone or obstruction. The water surface of a pool is relatively flat and unbroken. The presence of pools in large rivers may be difficult to identify because of an increase in relative scale, and an often limited ability to see to the bottom of deep or turbid stream reaches.



Run
Deeper faster flowing water that has a smoother looking surface.

3.16 Logs or Woody Debris
Logs and woody debris (small or large branches, leaves, roots or trunks) in the stream or along the water's edge can slow or divert water to provide important habitat for fish and aquatic macroinvertebrates. Excessive amounts of debris or logs can cause localized flooding.

3.18 Aquatic Plants
This category refers to aquatic vascular plants—plants with a vascular system that typically includes roots, stems and/or leaves. This includes duckweed, as it is a floating vascular plant. Aquatic Plants have roots and can be submerged under, floating on, or extending out above the water. Examples include pondweed (submerged under), water lilies (floating on) and cattails

(extending above). While aquatic plants in the stream can serve as an excellent food source for aquatic organisms, excessive plant growth may indicate excessive amounts of nutrients.

Floating Algae Floating algae has no root structure and no structure to hold it to the stream bottom. The presence of suspended algae (single celled organisms that may or may not form colonies) or floating algae mats/bundles should be recorded here. This includes algae mats/bundles, whether floating on the surface, suspended in the water column, or present at the bottom.

Filamentous Algae Filamentous Algae has no roots. However it is made up of long stringy or “ropy” strands that may or may not be attached to other objects in the waterbody.

3.19 Surrounding Land Use

When looking along your site reach and UPSTREAM, check the bank (left or right) where the specific land use is found. Check the appropriate left or right stream bank designation for the following land uses that are adjacent to the stream. If the land use is not present, check “none”.

Wetland A Wetland may have standing water part or all of the year, “hydric” or wetland soils and vegetation that is common to wetlands. Riparian (river) wetlands, marshes, swamps, fens, vernal pools, and bogs are examples of wetlands. Be cautious about indicating areas of land unnaturally flooded by stormwater.

Open field Meadow or field that has not been recently cultivated or grazed often represented by tall grasses and shrubs.

Woodland An area of land covered primarily by trees; includes small woodlots. May be a natural forest or a forest planted by people.

Farmland A field that is showing signs of being recently or actively grazed by livestock (vegetation is cropped close to the ground).Or an area of land that has been recently used to grow crops. Remnants of corn stalks, grains, or other vegetable crops can be seen. An agricultural crop residue remains, after harvest which covers 30% or more of the field surface.

3.20 Obvious pollution sources

Look at the way land is used near your site. Which of these land uses might be a potential source of pollution for your stream/river/drain? Think about how pollution might travel from each land use source to the water then rank each source on the severity of impact it might have on water quality at your site. Use your best judgment; remember this is designed to provide general information on land use over time.

None=no impact/not present, S=slight, M=moderate, H=high

Potential Source	Description
Crop Related Sources	… there is a reasonably clear pathway for pollutants to enter the water body from the farmed area.
Grazing Related Sources	… there is clear evidence that grazing of animals near or in the water body has resulted in the degradation of stream banks or stream beds, increased sediment in the water body, nutrient enrichment , and/or potential bacterial contamination (animal wastes).
Intensive Animal Feeding Operation	… there is a reasonably clear pathway for pollutants to enter the water body from either runoff from the operation or land application of animal manure.

Transportation Runoff (i.e. highways, bridges)	…there is clear evidence that transportation infrastructure is creating increased flow, runoff of pollutants, or erosion areas in or adjacent to the water body.
Channelization	… there is clear evidence that the natural river channel has been straightened to facilitate drainage.
Dredging	… there is clear evidence that a water body has been recently dredged (bottom dug out). Evidence might include: spoil piles on side of water body, disturbed bottom, disturbed banks.
Removal of Streamside Vegetation	… there is clear evidence that vegetation along the water body has been recently removed (within the last few years).
Bank & Shoreline Erosion/ Changes/Destruction	… there is clear evidence that the banks or shoreline of a water body have been modified through either through human activities or natural erosion processes.
Human Regulation of Water Flow	… there is reasonably clear evidence that flow modifications in the watershed have created unstable flows resulting in stream bank erosion
Upstream Impoundment (i.e. dam, lake level control structure)	... there is reasonably clear evidence that an upstream impoundment has contributed to impacts on downstream sites. Impacts may be: nuisance algae, increased temperatures, stream bank erosion from unstable flows.
Construction: Highway/Road/Bridge	… there is clear evidence that on-going or recent construction of transportation infrastructure is contributing pollutants to the water body.
Construction: Land Development	… there is clear evidence that on going or recent land development is contributing pollutants to the water body.
Urban Runoff (incl. residential runoff, geese/ nuisance wildlife)	… there is a reasonably clear pathway for pollutants to enter the water body from an urban/residential area. Possible pathways: gully erosion, pipe/storm sewer discharge, wind erosion, runoff from lawns or impervious surfaces.
Land Disposal	… there is a reasonably clear pathway for pollutants to enter the water body from an area where waste materials (trash, seepage, hazardous waste, etc.) have been either land applied or dumped. Possible pathways: gully erosion, pipe discharge, wind erosion, or direct runoff.
On-site Wastewater Systems	… there is reasonably clear evidence of nutrient enrichment and/or sewage odor or waste is present, and there is reason to believe the area is unsewered.
Potential Source	**Description**
Forestry	…there is a reasonably clear pathway for pollutants to enter the water body from the forest management area. Possible pathways: logging to the edge of the water body, gully erosion, pumped drainage, erosion from logging roads, wind erosion.
Mining	… there is a reasonably clear pathway for pollutants to enter the water body from the mined area. Possible pathways: gully erosion, pumped drainage, runoff from mine tailings, wind erosion.
Recreation/Tourism (General)	… you are unable to clearly identify the recreational source as related to a golf course, or recreational boating activity. Foot traffic causing erosion would fall into this category.
-Golf Courses	… there is a reasonably clear pathway for pollutants to enter the water body from the golf course area. Possible pathways: overland runoff, gully erosion off course, wind erosion.
-Marinas/Recreational Boating: boat access via water	… if you can reasonably determine that releases of pollutants to a water body such as seepage of oil/gasoline are due to recreational boating activities.
-Marinas/Recreational Boating: bank erosion	…. you can reasonably determine that stream bank erosion is due to wake from recreational boating activities.
Debris in Water	… debris in the water either is discharging a potential pollutant, or is causing in stream impacts due to modifications of flow. Possible examples: Leaking barrel, Refrigerator, Tires, etc. This does not include general litter

	(e.g. paper products).
Industry Source	… there is reasonably clear evidence that an upstream industrial point source has contributed pollutants.
Municipal Source	… there is reasonably clear evidence that an upstream municipal (city, governmental) point source has contributed pollutants.
Natural Sources (i.e. log jams)	… there is reasonably clear evidence that natural sources are contributing pollutants. Possible examples: stream bank erosion, pollen, foam, etc.
Source(s) Unknown	… if you see an impact but are unable to clearly identify any likely sources.

3.21 & 3.22 ADDITIONAL COMMENTS

Write any other pertinent observations that were made during the survey. These may include the presence of wildlife in or along the stream, people using the stream for recreation (boating, swimming, fishing), or some unusual event or observation. Indicate whether observations are made upstream or downstream of the road crossing.

Digital pictures of your site and the adjacent upstream and downstream sections or land uses are welcome. Please provide them to CRWC on CD (medium or high quality images preferred).

Section II Benthic Macroinvertebrate Monitoring Procedures

1) Survey a 100 foot stream stretch. If it is at a road crossing, sample upstream of the road.

2) Because macroinvertebrates have adapted to survive in a variety of stream conditions, all habitats need to be sampled. Macroinvertebrate samples should be collected using nets supplied by the CRWC Habitats to be sampled include:

Most Diverse Habitat	Riffles
	Leaf packs
⇳	Tree roots, snags, and submerged logs
	Undercut banks, overhanging vegetation
	Submerged and Emergent Vegetation (aquatic plants)
Least Diverse Habitat	Sediments

3) The sampling effort should be sufficient to ensure that all types of benthic macroinvertebrate habitats are sampled in the site reach. **<u>This should take about 30 minutes of total sampling time. If you have multiple types of habitat, spend equal amounts of time collecting from each habitat type.</u>**

4) Determine a plan of attack for collection sites based upon the above habitat chart.

5) **<u>Start at the downstream-most point, and work upstream</u>** so you always work into undisturbed water. Habitat and substrate types from which macroinvertebrates were collected (or collections were attempted) should be recorded on the data form. The Quality Assurance Coordinator is responsible to fill out the data sheet.

6) To make collection easier, the samples from multiple habitats may be collected in the same net load. For example, a sample from an undercut bank can be held in the net while overhanging vegetation is sampled, then organisms collected from both habitats can be dumped into a collection bucket at the same time. **Do what is easiest for you, but be very careful not to loose your samples.**

7) The composite sample (all samples five-gallon bucket) should be divided into several sub samples (by pouring into various white pans) to make location of macros easier and quicker. Organisms should be removed from the white pans by the “pickers” and placed in “like groups” in plastic sorting trays.

8) Once organisms have been placed in sorting trays, the team’s “identifier” will use the identification keys provided to identify the organisms found, record information on data forms and place labeled samples in sample jars

9) During the macroinvertebrate survey, students should take note of any fish or wildlife (frogs, turtles, ducks, etc.) that may be visible in/near the stream and document these observations on the “Additional comments” section of the data form.

10) Fill-out the information on the top of the "Benthic Macroinvertebrate Identification" data sheet. Sort the bugs into "look-alike" groups. Using the taxonomic keys and magnifying glass provided, identify the bugs and regroup them. Estimate the abundance of each type of bug. Use the appropriate letter codes (R = 1-10 and C = 11+) next to the organisms listed on the data sheet to indicate the number of each organism. Count the number of different types of organisms found for each group (not the total number of bugs). Fill-in this number on the data sheet. Multiply out each group and add the values. Add the totals from Groups 1, 2, and 3. Mark this value on the data sheet. Rate the site as excellent, good, fair, or poor using the total stream quality score.

Crayfish, **live** clams, and **live** snails should be **counted and released**.
Empty shells should not be counted. DO NOT COLLECT FISH.
Take photos if you would like CRWC to verify identification.

Riffles

1. When selecting a riffle, select the fastest (white water present, larger rocks) and slowest (no white water, smaller gravel sized rocks) moving areas of the riffle to take your samples in an attempt to find different types of organisms. Organisms collected from both these sites will constitute one riffle sample.

2. With the net opening facing upstream, place the bottom of the net flush on the stream bottom immediately downstream from the riffle. Position the handle perpendicular to the stream flow.

3. While the first volunteer ("collector") holds the net, the second ("collecting assistant") picks up large rocks (2 inch or greater diameter) within a 1 foot by 1 foot area directly in front of the net opening and gently rubs them in the net opening to remove any clinging organisms. Be sure to hold the rocks under water in front of the net. Gently place the cleaned rocks outside the sampling area. (Usually takes less than one minute.)

Note: If the water level is too deep or sharp objects don't allow the "collecting assistant" to safely/easily pick up rocks from the stream/river/drain bottom, then the "collecting assistant" should spend two minutes kicking the 1ft square area directly in front of the net. Use a kicking/shuffling motion with your feet to dislodge rocks. You're trying to shake organisms off rocks and kick up organisms that are hiding under the rocks. Kick down approximately two inches while moving toward the net.

4. When all the stones (or as many as possible) are removed from the sample area, the "collecting assistant" stands approximately one foot upstream of the net opening and kicks the stream bed vigorously to dislodge any remaining organisms into the net.

5.Kick down approximately 2 inches (approximately one minute) while moving toward the net.

6.When done kicking, the "collector" sweeps the net in an upward fashion to collect the organisms. Return all the rocks to their 1st square area.

Note: If the net is relatively empty after sampling at the first station, steps 8 - 11 may be skipped and the net emptied (according to steps 8 - 11) only as necessary.

7.Carry the net to the shoreline. Have team members on the shore assist with rinsing/dumping.

8.Before emptying the collected material into the sample bucket/pan, have the “collection assistant” pour stream water through the net and its contents until the water runs clear. This is particularly important in streams with sediment problems and in pools. This should help reduce the murkiness of the water which can make finding and sorting macros difficult.

9.One volunteer should hold the sampling bucket/pan, while a second volunteer empties the net’s contents into the tray. Using the squirt bottle filled with stream water, rinse the inside of the net into the bucket/pan to collect all the organisms.

10.Remove any clinging organisms and place them directly into the sampling bucket/pan.

11.Turn the net inside out and rinse it with water, letting the water run through the net into the sample bucket/pan to dislodge any aquatic macroinvertebrates that are still attached to the net. Remove any remaining macros using forceps and place them in the sample bucket/pan.

Leaf Pack

1. Look for leaves that are about four to six months old. These old leaf packs are dark brown and slightly decomposed. Slimy leaves are an indication that they are decaying. Only a handful of leaves is necessary for sampling.

2. With the net opening facing upstream, place the bottom of the net flush on the stream bottom immediately downstream from the leaf pack. Position the handle perpendicular to the stream flow.

3. Have the “collection assistant” gently shake the leaf pack in the water to release some of the organisms, then quickly scoop up the net, capturing both organisms and the leaf pack in the net.

Note: If the net is relatively empty after sampling at the first station, steps 5 - 8 may be skipped and the net emptied (according to steps 5 - 10) only as necessary.

4. Before emptying the collected material into the sample bucket/pan, have the “collection assistant” pour water through the net and it contents until the water runs clear. This is particularly important in streams with sediment problems and in pools. This should help reduce the murkiness of the water which can make finding and sorting macros difficult.

5. Carry the net to the shoreline.

6. One volunteer should hold the sampling bucket/pan, while a second volunteer empties the net’s contents into the tray.

7. Using the squirt bottle filled with stream water, rinse the inside of the net into the bucket/pan to collect all the organisms.

8. Remove any clinging organisms and place them directly into the sampling bucket/pan.

9. Turn the net inside out and rinse it with stream water, letting the water run through th net into the sample bucket/pan to dislodge any aquatic macroinvertebrates that are still attached to the net. Remove any remaining macros using forceps and place them in the sample bucket/pan.

10. If using a smaller pan, dump the sample into the five-gallon bucket.

Tree Roots, Snags, and Submerged Logs

Snags are accumulations of debris caught or "snagged" by logs or boulders lodged in the stream current. Caddisflies, stoneflies, riffle beetles, and midges commonly inhabit these areas.

1. Select an area on the tree roots, snag, or submerged logs which is approximately 3 feet by 3 feet in size.

2. Scrape the surface of the tree roots, logs, or other debris with the net while on the downstream side of the snag. You can also disturb such surfaces by scraping them with your foot or large stick, or by pulling off some of the bark to get at the organisms hiding underneath. In all cases, be sure that the net is positioned downstream from the snag, so that dislodged material floats into the net.

3. You may remove a log from the water to better sample from it, but be sure to replace it when you are done.

Note: If the net is relatively empty after sampling at the first station, steps 5 - 8 may be skipped and the net emptied (according to steps 5 - 10) only as necessary.

4. Before emptying the collected material into the sample bucket/pan, have the "collection assistant" pour water through the net and it contents until the water runs clear. This is particularly important in streams with sediment problems and in pools. This should help reduce the murkiness of the water which can make finding and sorting macros difficult.

5. Carry the net to the shoreline.

6. One volunteer should hold the sampling bucket/pan, while a second volunteer empties the net's contents into the tray.

7. Using the squirt bottle filled with stream water, rinse the inside of the net into the bucket/pan to collect all the organisms.

8. Remove any clinging organisms and place them directly into the sampling bucket/pan.

9. Turn the net inside out and rinse it with stream water, letting the water run through th net into the sample bucket/pan to dislodge any aquatic macroinvertebrates that are still attached to the net. Remove any remaining macros using forceps and place them in the sample bucket/pan.

10. If using a smaller pan, dump the sample into the five-gallon bucket.

Undercut Bank and Overhanging Vegetation

Undercut banks are areas where moving water has cut out vertical or nearly vertical banks, just below the surface of the water. In such areas you will find overhanging vegetation and submerged root mats that harbor dragonflies, damselflies, and crayfish. .

1. Place the net below the surface under the overhanging vegetation.

2. Move the net in a bottom - up motion, jabbing at the bank five times in a row to loosen organisms. For overhanging vegetation, put the net under the bank edge at the base of the plants and shake the vegetation using your yet, trying to shake off the animals clinging to the plants.

Note: If the net is relatively empty after sampling at the first station, steps 3 - 6 may be skipped and the net emptied (according to steps 3 - 8) only as necessary.

3. Before emptying the collected material into the sample bucket/pan, have the “collection assistant” pour water through the net and it contents until the water runs clear. This is particularly important in streams with sediment problems and in pools. This should help reduce the murkiness of the water which can make finding and sorting macros difficult.

4. Carry the net to the shoreline.

5. One volunteer should hold the sampling bucket/pan, while a second volunteer empties the net’s contents into the tray.

6. Using the squirt bottle filled with stream water, rinse the inside of the net into the bucket/pan to collect all the organisms.

7. Remove any clinging organisms and place them directly into the sampling bucket/pan.

8. Turn the net inside out and rinse it with stream water, letting the water run through th net into the sample bucket/pan to dislodge any aquatic macroinvertebrates that are still attached to the net. Remove any remaining macros using forceps and place them in the sample bucket/pan.

9. If using a smaller pan, dump the sample into the five-gallon bucket.

Submerged and Emergent Vegetation (Aquatic Plants)

1. Keep the net opening pointed upstream and move the net through the vegetation trying to shake the plants and catch any animals.

Note: If the net is relatively empty after sampling at the first station, steps 3 - 6 may be skipped and the net emptied (according to steps 3 - 8) only as necessary.

2. Use your hands to agitate the vegetation and dislodge the animals into the net.

3. Before emptying the collected material into the sample bucket/pan, have the "collection assistant" pour water through the net and it contents until the water runs clear. This is particularly important in streams with sediment problems and in pools. This should help reduce the murkiness of the water which can make finding and sorting macros difficult.

4. Carry the net to the shoreline.

5. One volunteer should hold the sampling bucket/pan, while a second volunteer empties the net's contents into the tray.

6. Using the squirt bottle filled with stream water, rinse the inside of the net into the bucket/pan to collect all the organisms.

7. Remove any clinging organisms and place them directly into the sampling bucket/pan.

8. Turn the net inside out and rinse it with stream water, letting the water run through the net into the sample bucket/pan to dislodge any aquatic macroinvertebrates that are still attached to the net. Remove any remaining macros using forceps and place them in the sample bucket/pan.

9. If using a smaller pan, dump the sample into the five-gallon bucket.

Sediments

Areas of mostly sand and / or mud can usually be found on the edges of the stream, where water flows more slowly.

1. A collector stands downstream of the sediment area with the dip net resting on the bottom. A collection assistant disturbs the sediment to a depth of about two inches as he or she approaches the net.

2. The collector sweeps the net upward to collect the organisms as the collection assistant approaches.

3. **Keeping the opening of the net at least an inch or two above the surface of the water, wash out the sediment from the net by gently moving the net back and forth in the water of the stream. THIS IS VERY IMPORTANT FOR KEEPING SEDIMENT OUT OF THE SAMPLE BUCKET**.

Note: If the net is relatively empty after sampling at the first station, steps 4 - 8 may be skipped and the net emptied (according to steps 4 - 8) only as necessary.

4. Carry the net to the shoreline.

5. One volunteer should hold the sampling bucket/pan, while a second volunteer empties the net's contents into the tray. TRY NOT TO ADD SEDIMENT TO COLLECTION BUCKET.

6. Using the squirt bottle filled with stream water, rinse the inside of the net into the bucket/pan to collect all the organisms.

7. Remove any clinging organisms and place them directly into the sampling bucket/pan.

8. Turn the net inside out and rinse it with stream water, letting the water run through th net into the sample bucket/pan to dislodge any aquatic macroinvertebrates that are still attached to the net. Remove any remaining macros using forceps and place them in the sample bucket/pan.

9. If using a smaller pan, dump the sample into the five-gallon bucket.

Rinse all nets, pans, WADERS and other equipment VERY well before leaving the site to avoid transporting animals or plants between monitoring locations (invasive species are often spread by not rinsing equipment, fishing gear, boats, etc.). Dispose of identified invasive species in the trash.

Things to keep in mind and some tips:

Before you go streamside….

What are your monitoring goals?

Survey students' interests…who wants a particular job?
Macro expert, Chemical test expert, Mathematician, Photographer, equipment inventory/collection

Students should know that they'll be graded on the completion of their monitoring forms. Do you want everyone to fill out a form or have teams? How will forms be gathered at the site?

Encourage cooperative learning. How can students ask each other for help?
Consider a "catch phrase" that everyone knows to ask for help
(e.g. "I need a team player", Stream Leader alert...help me out!)

Students must know who will be going in the water and when.

Safety

- Know that just ¼ inch of rain can cause rapid flows in the river.
- Always have a ratio of 1 adult for 4-6 students when in the river.
- Use Goggles & gloves for chemical testing
- Always provide a screw top container for used chemical solutions.

During Monitoring…
- Keep your hands away from eye and mouth areas
- Check if any students are allergic to insects
- Require full skin protection to prevent exposure to ticks/poison ivy.
- When wearing waders, shuffle feet…never take steps

What would happen if a student got into trouble in the water or splashed in the eyes with a chemical?

Have a safety plan…
Who will have a cell phone for an emergency?
Where will student emergency cards be kept?
Where will the first aid kit be kept?

Accidents often happen when students have nothing to do. What can students do when they've completed their work?

THE PHYSICAL SURVEY FORM

Prior to monitoring

1. Students/Teams complete the top portion of the form
2. Use CRWC watershed map to locate school & monitoring site
3. Observe weather (need to know amounts of precipitation)

Streamside Tasks

Task I (3.1 and 3.3)
1. Average Stream Width
Measure from the water's edge at random points
(careful with those measuring tapes, don't wind them too quickly)
2. Stream Flow: Aw (X) Ad (X) water V
Multiply average width by the average depth by water velocity

Task II
3. Surface Water Velocity (3.2)
(ask volunteers to set up markers before hand)
For markers ues PCV pipe or painted rebar
To measure velocity stand behind the "marker" so momentum is constant. Also beside the ball, not behind.
Whiffle balls work really well, as do oranges.

Task III (3.4 – 3.10)
4. Channelized – has the stream been straightened? Concrete present?
5. What does the soil feel like? Can you take a core sample?
6. Can you see the bottom? Describe odor using similes.
7. Be a detective! Accumulations of trash indicates how high the water level can rise during wet weather events.
8. Substrate composition determines benthic macroinvertebrates habitat.
9. Do silt and sand cover the gravel land cobble? If so, it's heavy siltation.
10. Embeddedness refers to the extent that gravel, cobble, or boulders are surrounded or covered by fine materials (silt & sand) and it relates to the area available for invertebrates to colonize.

Clinton River Stream Leaders
GREEN Data Sheet

School: ______________________________ Teacher(s): ______________________

Date: ________________ Time: ________________

Test location: ____

River Branch: ____________________ Tributary: ____________________________

Weather conditions: ___________ Air temp: ________°C Water temp: _______°C

Rainfall in the last 5 days? Y N If yes, approximately how much? __________________

	4 **Excellent**	3 **Good**	2 **Fair**	1 **Poor**
Dissolved Oxygen (% saturation)	☐ 110 - 91	☐ 90 - 71	☐ 70 - 51	☐ <50
BOD (ppm = mg/L) DO original sample ___________ DO incubated sample __________	☐ 0	☐ 4	☐ 8	☐ >8
Nitrate (ppm) **(note that values are estimated)**	☐ 0	☐ 1 - 4	☐ 5	☐ 20, 40 ppm
pH	☐ 7	☐ 6, 8	☐ 5, 9	☐ 4, 10, 11
Phosphate (ppm)	☐ 1	☐ 2	☐ 4	☐ >4
Temperature change (°C) downstream T ___________ upstream T ____________ difference _____________	☐ 0 - 2	☐ 3 - 5	☐ 6 - 10	☐ >10
Turbidity (JTU)	☐ 0	☐ >0 - 40	☐ >40 - 100	☐ >100
Fecal Coliform Bacteria (colonies/100mL)	☐ 0	☐ Negative 1 - 300	☐ 301 - 500	☐ Positive >500

Overall water quality:

Excellent ______ # Good ______ # Fair ______ # Poor ______

x 4 x 3 x 2 x 1

☐ **+** ☐ **+** ☐ **+** ☐ **=** ☐ **÷ n =** ☐

n = number of tests performed

CLINTON RIVER WATERSHED COUNCIL

Section 1: General Information

School: ______________________________ Teacher(s): ______________________

Date: ______ Time: ______ Township / City: _______________ County: _____

Test location: ____

River Branch: _______________ Tributary: _____________________________

If the access point to this site is a road crossing, does a road ditch discharge directly into the stream at the crossing?

yes no

Section 2: Weather Conditions

sunny partly cloudy cloudy rain

Any precipitation in the last 5 days? yes no If yes, approximate amount: _______

Air temperature: ______°C Water temperature: ______°C

Section 3: Stream Habitat

3.1) Average stream width (**0.1ft**): ______ 1. ____ + 2. ____ + 3. ____ = ______ ÷ 3

Average stream depth (**0.1ft**): ______ 1. ____ + 2. ____ + 3. ____ = ______ ÷ 3

3.2) Surface water velocity (**0.1 ft / sec**): ________

distance (**0.1 ft**): _____	distance (**0.1 ft**): _____	distance (**0.1 ft**): _____
time (sec): _____	time (sec): _____	time (sec): _____
Test 1 velocity: _____ +	Test 2 velocity: _____ +	Test 3 velocity: _____ = ______ ÷ 3

3.3) Estimated flow (width x depth x velocity): ________

3.4) Has the stream been channelized? yes no

3.5) Dominant watershed soil type: clay loam / sand organic

3.6) Water color Water Color Clear [ ] Gray [ ] Brown [ ] Black [ ] Green [ ]
Water odor (describe): _______________

3.7) Trash in stream along banks? yes no

Trash / debris in trees (or shrubs) above stream? yes no

3.8) Substrate (**Rank** relative abundance;
1 = most common, 2 = next most
abundant, etc. Leave blank if absent)

______ Clay

______ Silt

______ Sand

______ Gravel (0.25” - 2”)

______ Cobble (2” - 10”)

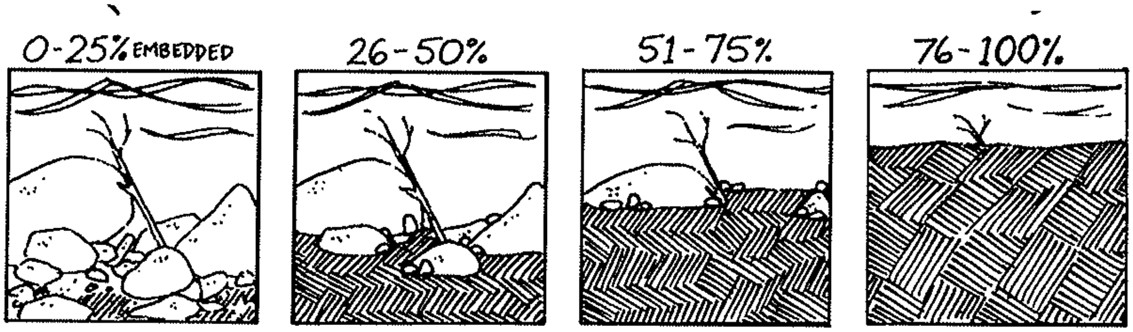
______ Boulder (>10”)

3.9) Obvious Siltation?

yes

no

3.10) Substrate Embeddedness (Circle One)



3.11) Riparian Vegetation (**Rank** relative abundance; 1 = most abundant, 2 = next most abundant, etc. Leave blank if absent)

_______ Trees

_______ Shrubs

_______ Herbaceous plants

_______ Grass

_______ Bare

3.12) Stream Shading

100 - 76%

75 - 51%

50 - 26%

25 - 0%

3.13) Bank Erosion

extensive

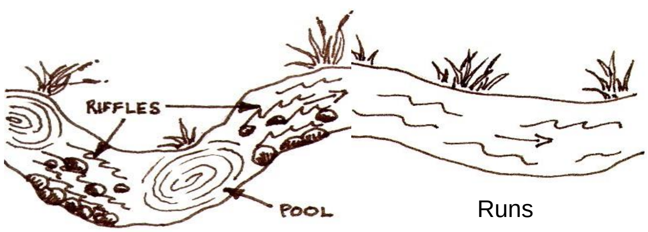
moderate

little / none

Other (please describe): ____

3.14) Estimated width of riparian vegetation corridor (ft): _______

3.15) Stream Habitat (circle if present)



3.16) Woody Debris

abundant

common

rare

none

3.17) Dams present: yes no If yes: man-made beaver / log jam

3.18) Aquatic plants: algae filamentous algae vascular plants

Are any of these plants very abundant? yes no Which one(s)? algae
filamentous algae
vascular plants

3.19) Surrounding Land Use: (Rank relative abundance; 1 = most abundant, 2 = next most abundant, etc. Leave blank if absent)

_______ Woodland _______ Wetland _______ Open field

_______ Farmland _______ Residential _______ Commercial

Other (please describe): ____

3.20) Any obvious pollution sources? yes no

If yes, please describe:

3.21) During the sampling and evaluation, did you observe any fish or wildlife? yes no

If yes, please describe (if possible):

3.22) Other observations:

3.23) Attach any photos to survey form (downstream, upstream, and others of interest).

3.23) Attach any photos to survey form (downstream, upstream, and others of interest).

CLINTON RIVER WATERSHED COUNCIL

STREAM LEADERS MACROINVERTEBRATE IDENTIFICATION

School: ______________________ Teacher(s): ______________________

Date: __________ Time: __________ Township / City: ______________ County: __________

Test location: ____

River Branch: ______________________ Tributary: ______________________

Benthos Identifier(s): ____

Use letter codes (Rare = 1-10, Common = 11+) to record the approximate numbers of organisms in each group found in the stream reach.

Group 1 Sensitive	Group 2 Somewhat-sensitive	Group 3 Tolerant
_______ Beetle adults (*Coleoptera*)	_______ Alderfly larvae (*Megaloptera*)	_______ Aquatic worms (*Oligochaeta*)
_______ Blackfly larvae (*Diptera*)	_______ Beetle larvae (*Coleoptera*)	_______ Leech (*Hirudina*)
_______ Caddisfly larvae (*Trichoptera*)	_______ Clam (*Pelecypoda*)	_______ Midge larvae (*Diptera*)
_______ Gilled Snail (*Gastropoda*)	_______ Cranefly larvae (*Diptera*)	_______ Other *Diptera* (Watersnipe, Horsefly)
_______ Hellgrammites (*Megaloptera*)	_______ Crayfish (*Decapoda*)	_______ Pouch Snail, Orb Snail (*Gastropoda*)
_______ Mayfly nymph (*Ephemeroptera*)	_______ Damselfly nymph (*Odonata*)	_______ Sowbug (*Isopoda*)
_______ Stonefly nymph (*Plecoptera*)	_______ Dragonfly nymph (*Odonata*)	_______ True bugs (*Hemiptera)* (Backswimmer, Giant Water Bug, Waterboatman, Water strider)
_______ Water penny (*Coleoptera*)	_______ Scud (*Amphipoda*)	

Group 1	Group 2	Group 3
_______ # of Rs x 5.0 = _______	_______ # of Rs x 3.0 = _______	_______ # of Rs x 1.1 = _______
_______ # of Cs x 5.3 = _______	_______ # of Cs x 3.2 = _______	_______ # of Cs x 1.0 = _______
Group 1 total = _______	Group 2 total = _______	Group 3 total = _______

Total stream quality score (sum of totals for Groups 1 - 3) = ___________

☐ Excellent (49+) ☐ Good (48 - 34) ☐ Fair (33 - 19) ☐ Poor (18 - 0)