DAVIDSON COUNTY
CITIZENS FOR IMPROVING
STREAM HEALTH

DC FISH

Water Quality Monitoring Handbook

PIEDMONT TRIAD
REGIONAL COUNCIL

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STREAMWATCH

Each StreamWatch group is unique. The following four steps identify the basic elements of a StreamWatch group. Please review these steps and determine which components best fit the needs of your group.

CREATE A PLAN

A. Identify your watershed and stream using area maps.
B. Determine how often and what parameters you want to survey.

CONDUCT THE RIVER STUDY

A. Visual Survey: Evaluate your sampling site and collect stream bank, water, and land use data.
B. Macroinvertebrate Survey: Collect a sample of benthic macroinvertebrates. Calculate the Pollution Tolerance Index from the quantity and variety of benthic macroinvertebrates collected for each site.
C. Chemical Survey: Collect chemical data including the eight water quality tests at each sample site: Fecal coliform bacteria, Dissolved Oxygen, Biochemical Oxygen Demand (BOD), Nitrate, pH, Phosphate, Temperature, and Turbidity.

SUBMIT THE DATA

A. Mail the data sheets to PTRC. Make sure to note any irregularities and issues encountered during sampling in the comments section of the data sheet.

TAKE ACTION

A. Implement actions in your personal life that will improve the water quality of your local stream.
B. Report any pollution issues to the appropriate authorities (contacts at the end of this handbook.

SAFETY

One of the most critical considerations for a volunteer monitoring program is the safety of its volunteers. All volunteers should review these safety procedures and should carry with them a set of safety instructions and an emergency phone number. Safety precautions can never be overemphasized. The following are some basic common sense safety rules.

BEFORE YOU START

Always monitor with at least one partner. Teams of three or four people are best.

Always let someone else know where you are, when you intend to return, and what to do if you don't come back at the appointed time.

Develop a safety plan. Locate the nearest medical center and write down directions on how to get between the center and your site(s) so that you can direct emergency personnel.

Have each member of the Stream Watch group complete a medical form that includes emergency contacts, insurance information, and pertinent health information such as allergies, diabetes, epilepsy, etc.

Have a first aid kit handy.

Know any important medical conditions of team members (e.g., heart conditions or allergic reactions to bee stings). It is best if at least one team member has first aid/CPR training. Listen to weather reports. Never go stream walking if severe weather is predicted or if a storm occurs while at the site. Never wade in swift, rising or high water. Do not monitor if the stream is at flood stage.

If you drive, park in a safe location. Be sure your car doesn't pose a hazard to other drivers and that you don't block traffic. Put your wallet and keys in a safe place, such as a watertight bag you keep in a pouch strapped to your waist. Without proper precautions, wallet and keys might end up downstream. Never cross private property without the permission of the landowner. Better yet, use public access points such as bridge or road crossings or public parks.

Confirm that you are at the proper site location by checking maps, site descriptions, or directions.

SAFETY AT THE STREAM SITE

- Do not monitor a stream if the stream is posted as unsafe for body contact. If the water appears to be severely polluted, contact your program coordinator.
- Do not walk on unstable stream banks. Disturbing these banks can accelerate erosion and might prove dangerous if a bank collapses. Disturb streamside vegetation as little as possible.
- Be very careful when walking in the stream itself. Rocky bottom streams can be very slippery and can contain deep pools; muddy-bottom streams might also prove treacherous.
- Do not attempt to cross streams that are swift and above the knee in depth.

APPROPRIATE EQUIPMENT

Listed below is some optional equipment appropriate for any volunteer field activity.

- Boots or waders;
- Life jackets if you are sampling by boat;
- Walking stick of known length for balance, probing, and measuring;
- Bright-colored snag- and thorn- resistant clothes; long sleeves and pants are best;
- Rubber gloves to guard against contamination and skin irritation;
- Insect repellent/sunscreen;
- Small first aid kit, flashlight, and extra batteries;
- Whistle to summon help in emergencies;
- Refreshments and drinking water;
- Clipboard, preferably with plastic cover;
- Several pencils;
- Tape measure;

- Thermometer
- Field data sheet;
- Information sheet with safety instructions, site location information, and numbers to call in emergencies; and
- Camera and film, to document particular or beautiful conditions.

FIRST AID KIT: SUGGESTED ITEMS

The minimum first aid kit should contain the following items:

- Telephone numbers of emergency personnel;
- Several band-aids for minor cuts;
- Antibacterial or alcohol wipes and first aid cream or ointment;
- Several gauze pads 3 or 4 inches square for deep wounds with excessive bleeding. A 2-inch roll of gauze bandage for large cuts. A triangular bandage for large wounds;
- Tweezers for removing splinters;
- A first aid manual which outlines diagnosis and treatment procedures;
- A large compress bandage to hold dressings in place;
- A 3-inch wide elastic bandage for sprains and applying pressure to bleeding wounds;
- If a participant is sensitive to bee stings, include their doctor prescribed antihistamine or epi-pen;
- Be sure you have emergency telephone numbers and medical information with you at the field site for everyone participating in field work (including the leader) in case there is an emergency.

**If at any time you feel uncomfortable about the condition of the stream or your surroundings, stop and leave the site at once. Your safety is more important than the data!*

WATERSHEDS

BASIC CONCEPTS

A **watershed** is the area of land from which runoff (from rain, snow, and springs) drains to a stream, river, lake, or other body of water (Fig. 2.1). Its boundaries can be identified by locating the highest points of lands around the waterbody. Just as arteries connect the parts of a body to one another, the majority of the rivers and streams thread together to carry water from Davidson County's hills and valleys downhill to High Rock Lake. Understanding where your study streams falls in this network is an important part of improving water quality in the County.

You're sitting in a watershed now. Watersheds come in all shapes and sizes. A watershed can be as small as your backyard or large enough to cross international boundaries. This is because several smaller watersheds exist within the watershed of a larger river basin. North Carolina is divided into 17 river basins. Davidson County is in the Yadkin River Basin. From its headwaters near Blowing Rock, the Yadkin River travels 433 miles, eventually changing its name to the Pee Dee before ending its journey in South Carolina's Winyah Bay.

The watershed of the Yadkin River is about 7,221 square miles and contains thousands of smaller watersheds, each defined by a tributary stream that eventually flows into the river or reservoir. High Rock Lake is the first and largest of seven reservoirs along the Yadkin River.

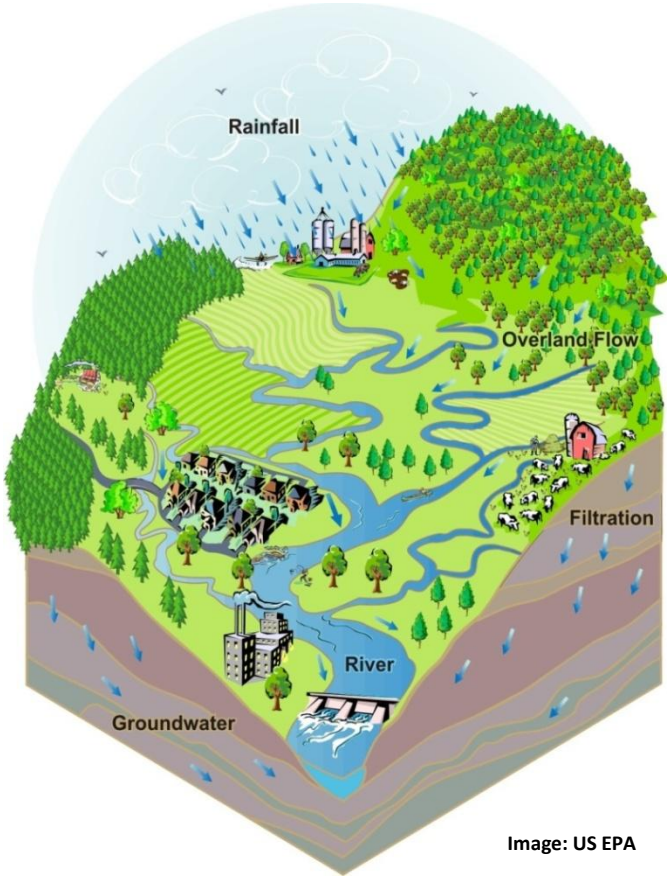

Image: US EPA

Figure 1: Watershed Image

The waters within a watershed are supposed to be suitable for aquatic life, wildlife, recreation and agriculture. Some watersheds are identified as "water supply watersheds," meaning users in that watershed must take special precautions to protect drinking water. Many of the streams in Davidson County and High Rock Lake are considered "impaired" for aquatic life by the North Carolina Division of Water Quality.

Preference is given to impaired streams in Davidson County. Other streams will also be considered for Stream Watch adoption. PTRC staff can assist in locating streams and access points.

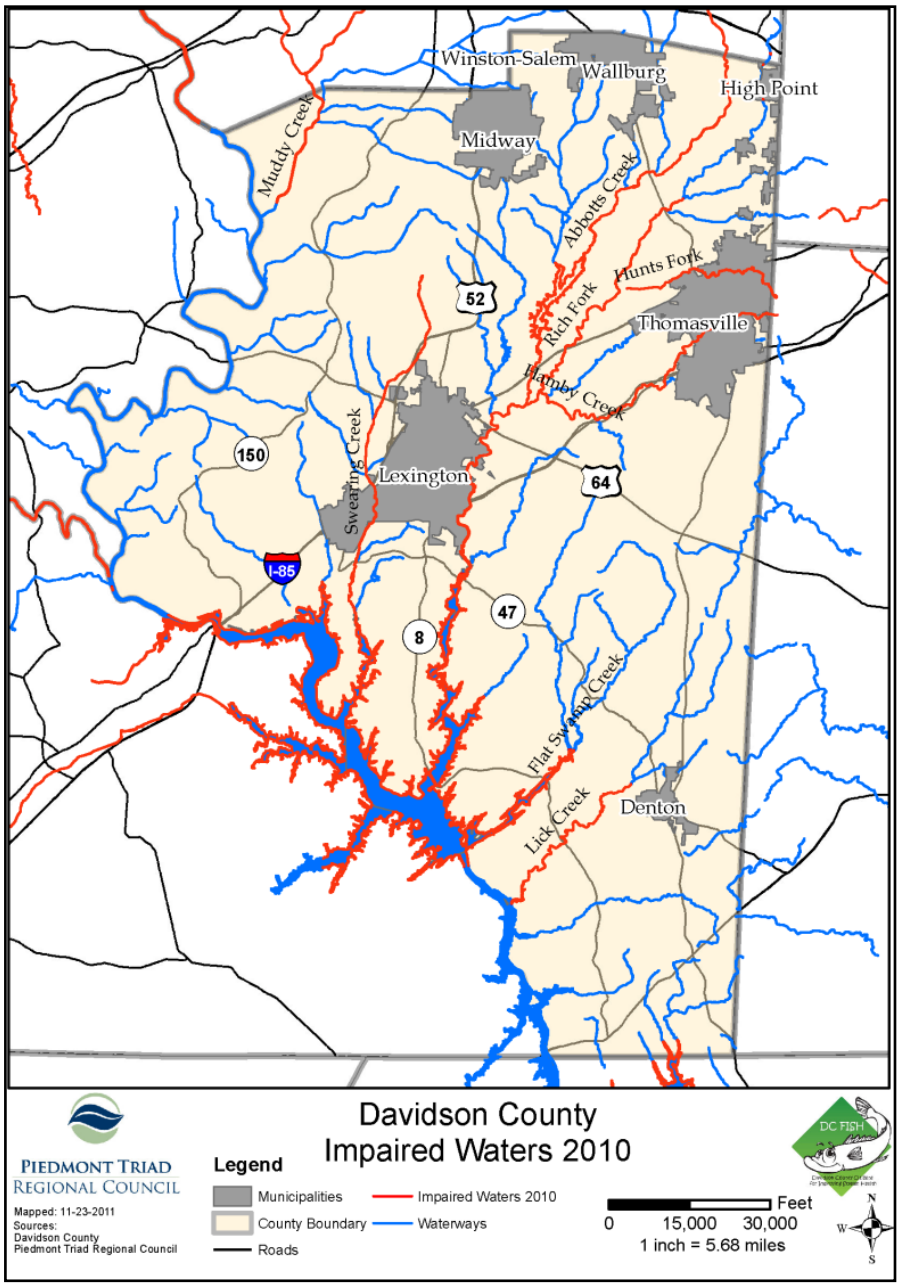

Figure 2: Davidson County Impaired Waters

VISUAL SURVEYS

One of the most rewarding and least expensive activities a volunteer water quality monitoring program can conduct is the visual stream survey. To do a visual survey, volunteers walk along the stream and drive through the watershed noting key features.

The visual survey requires little in the way of training or equipment. Visual surveys help in:

- Screening for pollution problems;
- Identifying potential sources of pollution;
- Identifying sites that may need monitoring;
- Interpreting biological and chemical information;
- Giving volunteers and local residents a sense of the value of the stream or watershed;
- Educating volunteers and the local community about potential pollution sources and the stressors affecting the stream and its watershed; and
- Providing a blueprint for possible community restoration efforts such as cleanups and tree plantings.

Draw or sketch maps and problem areas, or take pictures if that will help you remember what you are observing. Don't be afraid to take too many notes or draw too many pictures. You can always sort through them later

* To actually determine whether visible stressors are affecting the stream requires additional monitoring of chemical, physical, or biological conditions.

WATERSHED CHARACTERISTICS

The **floodplain** is the low area of land that surrounds a stream and holds the overflow of water during a flood.

The **riparian zone** is the area of natural vegetation extending outward from the edge of the stream bank. The riparian zone is a buffer to pollutants entering a stream from runoff, controls erosion, and provides stream habitat and nutrient input into the stream. A healthy stream system generally has a healthy riparian zone. Reductions and impairment of riparian zones occur when roads, parking lots, fields, lawns, and other artificially cultivated areas, bare soil, rocks, or buildings are near the stream bank.

The **stream bank** includes from the break in the normal slope of the surrounding land to the water line.

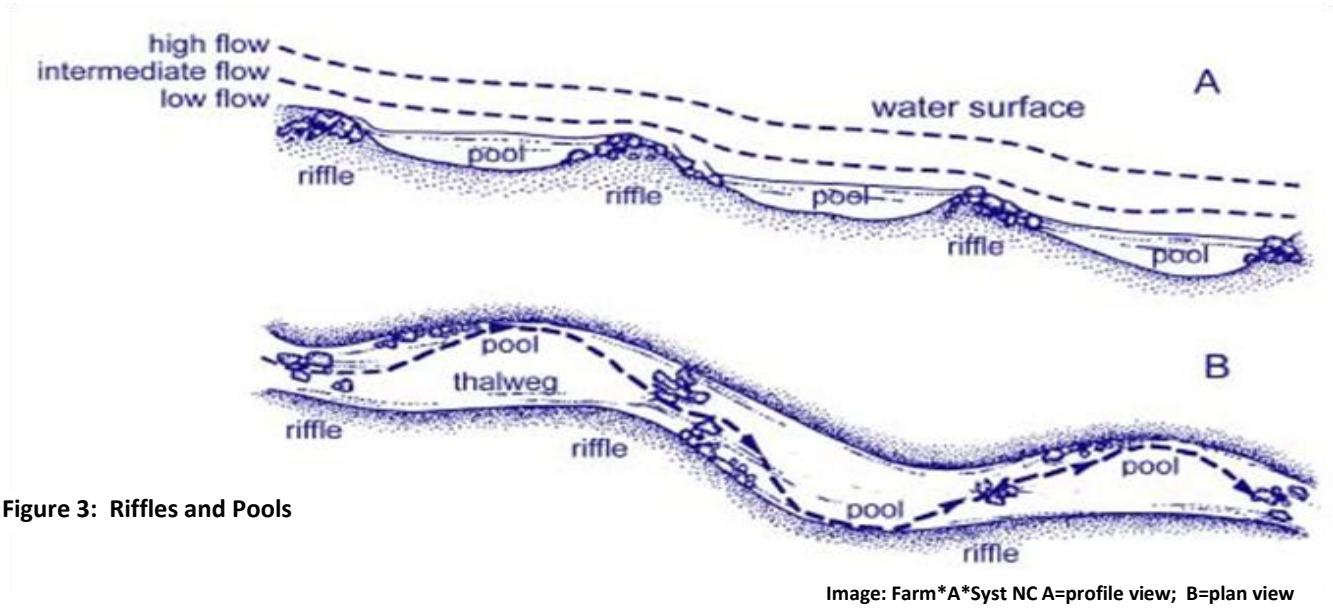

Figure 3: Riffles and Pools

Image: Farm*A*Syst NC A=profile view; B=plan view

IN-STREAM CHARACTERISTICS

The **streamside cover** includes any overhanging vegetation that offers protection and shading for the stream and its aquatic inhabitants.

Stream vegetation includes emergent, submergent, and floating plants.

Emergent plants include plants with true stems, roots, and leaves with most of their vegetative parts above the water.

Submergent plants also include some of the same types of plants, but they are completely immersed in water.

Floating plants (e.g., duckweed, algae mats) are detached from any substrate and are therefore drifting in the water.

Channels of the streambed is the zone of the stream cross section that is usually submerged and totally aquatic.

Pools are distinct habitats within the stream where the velocity of the water is reduced and the depth of the water is greater than that of most other stream areas. A pool usually and has soft bottom sediments.

Riffles are shallow, turbulent, swiftly flowing stretches of water that flow over partially or totally submerged rocks.

Runs or glides are sections of the stream with a relatively low velocity that flow gently and smoothly with little or no turbulence at the surface of the water.

The **substrate** is the material that makes up the streambed, such as clay, cobbles, or boulders.

Sand (up to 0.1 inch). A sandy bottom is made up of tiny, gritty particles of rock that are smaller than gravel but coarser than silt (gritty, up to ladybug size).

Gravel (0.1-2 inches). A gravel bottom is made up of stones ranging from tiny quarter-inch pebbles to rocks of about 2 inches (fine gravel - pea size to marble size;coarse gravel - marble to tennis ball size).

Cobbles (2-10 inches). Most rocks on this type of stream bottom are between 2 and 10 inches (between a tennis ball and a basketball).

Boulders (greater than 10 inches). Most of the rocks on the bottom are greater than 10 inches (between a basketball and a car in size).

Bedrock. This kind of stream bottom is solid rock (or rocks bigger than a car).

Embeddedness is the extent to which rocks (gravel, cobbles, and boulders) are sunken into the silt, sand, or mud of the stream bottom. Generally, the more rocks are embedded, the less rock surface or space between rocks is available as habitat for aquatic macroinvertebrates and for fish spawning. To estimate embeddedness, observe the amount of silt or finer sediments overlying, in between, and surrounding the rocks.

Algae are simple plants that do not grow true roots, stems, or leaves and that mainly live in water, providing food for the food chain. Algae may grow on rocks, twigs, or other submerged materials, or float on the surface of the water. The algae naturally occurs in green and brown colors. Excessive algal growth may indicate excessive nutrients (organic matter or a pollutant such as fertilizer) in the stream.

Water Temperature can be particularly important for determining the suitability of the stream as aquatic habitat for some species of fish and macroinvetebrates that have distinct temperature requirements. Temperature also has a direct effect on the amount of dissolved oxygen available to the aquatic organisms.

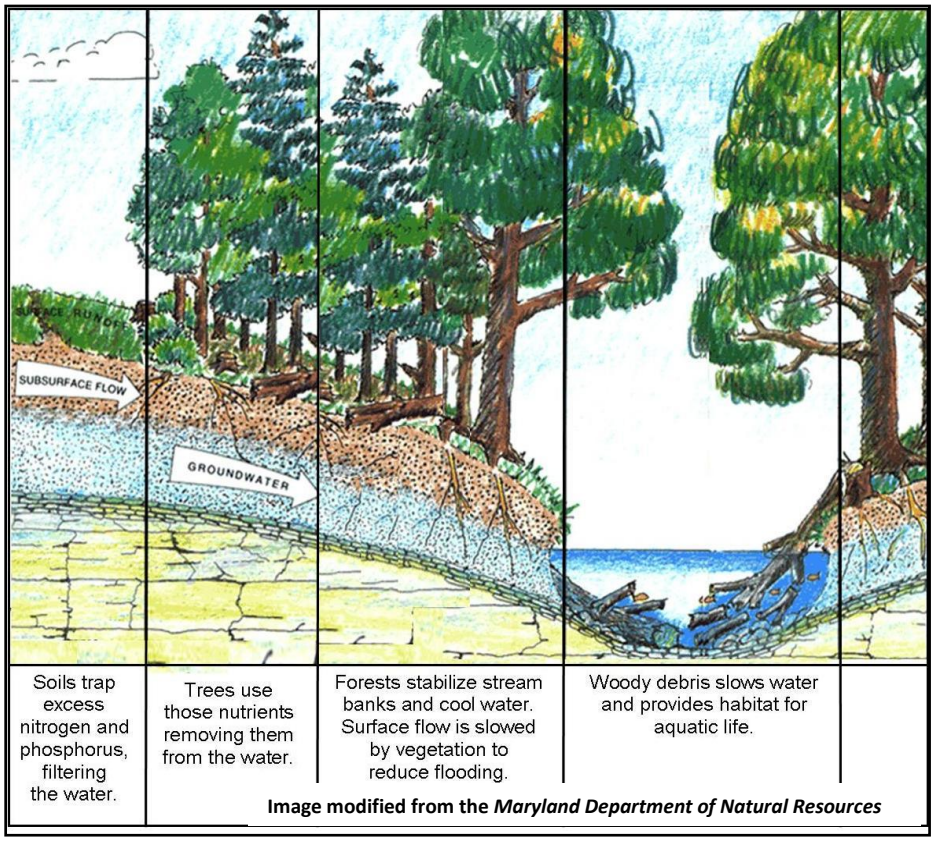

Figure 4: Stream Side Buffer Functions

STREAM BANK CHARACTERISTICS

Streamside cover information helps determine the quality and extent of the stream's riparian zone. This information is important on the stream bank and in the general vicinity.

- *Lawn* - cultivated and maintained short grass. Lawns indicate that the stream's riparian zone has been altered, that pesticides and grass clippings are a possible problem, and that little habitat and shading are available.
- *Bare Soil, Pavement, Structure* - any structures or paved areas, including paths, roads, bridges, houses, etc. Bare soil and pavement might indicate problems with erosion and runoff.
- *Evergreen trees (conifers)* - cone-bearing trees that do not lose their leaves in winter.
- *Hardwood trees (deciduous)* - in general, trees that shed their leaves at the end of the growing season.
- *Bushes, Shrubs* - conifers or deciduous bushes less than 15 feet high.

- *Tall grass, Ferns, etc.* - includes tall natural grasses, ferns, vines, and mosses.

Stream shading is a measurement of the extent to which the stream itself is overhung and shaded by the cover. This shade (or overhead canopy) provides several important functions in the stream habitat. It cools the water, offers habitat, protection, and refuge for aquatic organisms, and provides a direct source of beneficial organic matter and insects to the stream. General conditions of the stream bank and stream channel, and other conditions that might be affecting the stream are determined by standing at the downstream end of the 25-yard site and looking upstream. Don't forget to provide observations for the right and left banks of the stream.

Vegetative conditions can also affect water quality. When streamside vegetation is trampled or missing or has been replaced by landscaping, cultivation, or pavement, these conditions could lead to erosion. If stream banks or parts of banks have been washed away or worn down this could limit habitats in the area.

Stream Channelization describes any activity that moves, straightens, shortens, cuts off, diverts, or fills a stream channel, whether natural or previously altered. Such activities include the widening, narrowing, straightening, or lining of a stream channel that alters the amount and speed of the water flowing through the channel. Examples of channelization are: lining channels with concrete; pushing gravel from the stream bed and placing it along the banks; and placing streams in culverts. Straightening even small stretches of streams can cause adverse stream impacts.

Image: Farm*A*Syst NC

Figure 5: Healthy Riparian Habitat

Mud/silt/sand on bottom/entering stream. Excessive mud or silt can interfere with the ability of fish to sight potential prey. It can clog fish gills and smother fish eggs in spawning areas in the stream bottom. It can be an indication of poor construction practices, urban area runoff, silviculture (forestry-related activities), or agriculture in the watershed. It can also be a normal condition, especially in a slow-moving, muddy-bottom stream.

Garbage or junk in stream. Note the presence of litter, tires, appliances, car bodies, shopping carts, and garbage.

Yard waste (e.g., grass clippings) - is there evidence that grass clippings, cut branches, and other types of yard waste have been dumped into the stream?

Livestock in or with unrestricted access to stream - are livestock present, or is there an obvious path that livestock use to get to the water from adjacent fields? Is there streamside degradation caused by livestock?

VISUAL CHARACTERISTICS

Clear - colorless, transparent

Milky - cloudy-white or grey, not transparent; might be natural or due to pollution

Foamy - May be natural or due to pollution. When white and greater than 3 inches high, generally caused by detergents or nutrients

Turbid - cloudy brown due to suspended silt or organic material

Yellow-Brown to Dark Brown - May indicate that acids are being released into the stream due to decaying plants. Also common in streams draining a marsh or swampland

Oily Sheen - multicolored reflection might indicate oil floating in the stream, although some sheens are natural

Orange to Red Deposits - May indicate acid drainage

Green - May indicate excess nutrients being released into the stream

Light Brown (muddy or cloudy) – may be sedimentation deposition caused by erosion

Yellow Coating on Stream Bed - Indication of sulfur entering the stream

White, Cottony Masses on Stream Bed – Possible "sewage fungus" masses on stream bed

ODOR CHARACTERISTICS

Figure 6: Stream Bottom

No smell or a natural odor – indicate healthy conditions

Sewage - May indicate the release of human waste material

Chlorine - May indicate over-chlorinated sewage treatment/ water treatment plant or swimming pool discharges

Fishy - May indicate excessive algal growth or dead fish

Rotten Eggs - May indicate sewage pollution (the presence of methane from anaerobic conditions). Odor may also be present in marsh or swampy land.

Musky Odor - May indicate presence of untreated sewage, livestock waste, algae or other conditions.

Chemical - May indicate the presence of an industrial plant or the spraying on nearby agricultural land.

BIOLOGICAL INDICATORS OF WATER QUALITY

Wildlife in the stream area indicates it is of sufficient quality to provide food, water, and habitat for animals. Look for signs of frogs, turtles, snakes, ducks, deer, beaver, etc.

Are fish present in the stream? Fish indicate the stream is of sufficient quality for other organisms.

- Visible Barriers – Any obstruction that might keep fish from moving freely upstream or downstream.
- Odd Behavior - Jumping out or non-responsive action of fish may indicate toxic substance in the stream.
- Absence of Fish- This is a good indication of a badly stressed stream. The cause could be urban run-off, sewage seepage or toxics entering the stream.

Macroinvertebrates are organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate). They inhabit all types of running waters, from fast flowing mountain streams to slow moving muddy rivers. Examples of aquatic macroinvertebrates include insects in their larval or nymph form, crayfish, clams, snails, and worms. Most live part or the majority of their life cycle attached to submerged rocks, logs, and vegetation.

Many types of macroinvertebrates can be found in a stream. Some macroinvetebrates are tolerant to pollution and will be able to live in fairly polluted waters. Others are sensitive to pollution and will either die or move away when waters are polluted. By measuring the abundance and diversity of macroinveterbrates, we can get a fairly accurate indication of water health.

Aquatic macroinvertebrates are good indicators of stream quality because:

- They are affected by the physical, chemical, and biological conditions of the stream.
- They can't escape pollution and show the effects of short- and long term pollution events.
- They may show the cumulative impacts of pollution.
- They may show the impacts from habitat loss not detected by traditional water quality assessments.
- They are a critical part of the stream's food web.
- They are relatively easy to sample and identify

After collecting macroinvertebrates, examine the types of organisms by morphological features (e.g., snails or worm-like). Use a magnifying glass to observe the organisms in water so you can clearly see the legs, gills, and tails. Note the relative abundance of each type on the field data sheet. When finished, return all the organisms to the stream. If no macroinvertebrates are found in the initial sample move to a new location and note the difficulty on the data sheet.

Macroinvertebrate Sampling Methods.

Rock-Rubbing Method

Use this method in streams with riffle areas and rocky bottoms.

Remove several rocks from within a riffle area of your stream site (e.g., randomly pick 1 rock from each side of the stream, 1 rock from the middle, and 1 rock from in between). Try to choose rocks that are submerged during normal flow conditions. Each rock should be about 4-6 inches in diameter and should be easily moved (not embedded). Either inspect the rock's surface for any living organisms or place the rock in a light-colored bucket or shallow pan, add some stream water, and brush the rock with a soft brush or your hands. Try to dislodge the foreign particles from the rock's surface. Also look for clumps of gravel or leaves stuck to the rock. These clumps may be caddisfly houses and should be dislodged as well.

Stick-Picking Method

Use this method in streams without riffles or without a rock bottom.

Collect several sticks (approximately 1 inch in diameter and relatively short) from inside the stream site, and place in a bucket filled with stream water. Select partially decomposed objects that have soft, pulpy wood and a lot of crevices and are found in the flowing water, not buried in the bottom. Pick the loose bark from the sticks to find organisms.

- Fill the shallow pan with water from the stream and remove one of the sticks from the bucket.
- Examine the stick making sure you hold it over the pan so no organisms are lost. Remember that the organisms will have sought shelter, and they could be hiding in loose bark or crevices.
- After examining the sticks, it might be helpful to break up the woody material. Examine each stick carefully.
- Using tweezers or a soft brush, carefully remove anything that resembles a living organism and place it in the pan. Also examine the bucket contents for anything that has fallen off the sticks

Leaf Pack-Sorting Method

This method can be used in streams with or without a rock bottom.

If no natural leaf packs are present, leaf packs can be made by filling a mesh bag with leaves and placing it in the stream for 3-4 weeks.

Figure 7: Leaf Pack

- Remove several handfuls of submerged leaves from the stream and place them into a bucket.
- Remove the leaves one at a time and look closely for the presence of insects.
- Using tweezers or soft brush, carefully remove anything that resembles a living organism and place it in a pan containing stream water.
- Also examine the bucket contents to see if anything has fallen off the leaves.

Kick-Seine (Kick Net) Method

This method can be used in streams with or without a rock bottom.

The equipment required includes a kick-seine (a fine mesh net with a supporting pole on each side) or an old window screen with no holes, forceps, a clear plastic container, several jars for collecting, and a microscope or magnifying glass.

- Select a riffle typical if the stream, that is, a shallow, fast-moving area with a depth of 3 – 12 inches and stones which are cobble-sized (2 – 10 inches) or larger.
- Place the kick-seine or screen at the downstream edge of the riffle. Be sure that the bottom of the seine or screen fits tightly against the stream bed.
- Disturb the streambed upstream of the kick-seine. Stir up the bed with hands and feet until the area (3 foot square maximum) has been disturbed (Remember to be careful of your hands. Watch for objects that might cut). All detached insects will be carried into the net. For 60 seconds, and no longer, kick the streambed with a sideways motion of the net. This may bring up a few ground dwellers.
- When step 3 is completed, remove the net with a forward scooping motion. The idea is to remove the net or screen without allowing any of the critters to be washed from its surface.
- Using forceps, pick all of the creatures from the net and place them in a pan, or just wash the creatures into a light-colored bucket where they may be easily seen. Any

creatures moving, even if it looks like a worm, is part of the sample. (Do not miss snails and clams.) Look closely since most of these organisms are only a fraction of an inch long.

- Once all animals have been removed from the net (excluding any fish or other vertebrates – throw these back quickly so they might survive the stress of being out of their habitat), count the total number. Then separate them into look-alike groups. Use body shape and number of legs and tails primarily since the same family can vary some in size and color.
- If the stream seems to have a problem, for example, no bugs are found, take a quick second sample from another spot, preferably a riffle. If your results are similar, you might want to check another spot upstream. When you find a place where the variety of benthic creatures is greater and the numbers are more balanced, then you know the problem occurs between that spot and where you last tested downstream.

It can be difficult to locate a riffle. Remember that a riffle is an area of turbulence. It may be composed of rocks, logs, or even an old car! Look for large stationary objects or things which have "weathered" in the stream a while. (The critters need time to make these objects home.) Kick around as you would other rocks and debris. I f the substrate is covered with sand or composed entirely of bedrock and a "kickable" riffle does not exist, you can use the bank habitats. Place your net downstream of a submerged tree or grass roots and kick in and around them. Make sure it is an area where water is flowing or there is current.

Sweep Net Survey Method

- Most people are familiar with the dip nets used for fishing. A sweep net is similar in construction, but the mesh of the net is smaller. In fact, the net mesh found on a sweep net is smaller than the mesh net used on most kick-nets.
- You can order sweep nets from scientific supply companies or simply and inexpensively construct a sweep net using a pool net and a long dowel. **Small aquarium dip nets can also be used for sampling an area many times in a short period (i.e. student sampling over several periods during a week).**

- To perform a sweep net survey sweep around the banks of your stream. Sweep in and around tree roots and vegetation. Stir the sediment near the stream bank with your foot and use the sweep net to scoop up the creatures jarred loose. Dragonflies, damselflies, mayflies, and snails will often be found in a sweep net sample.

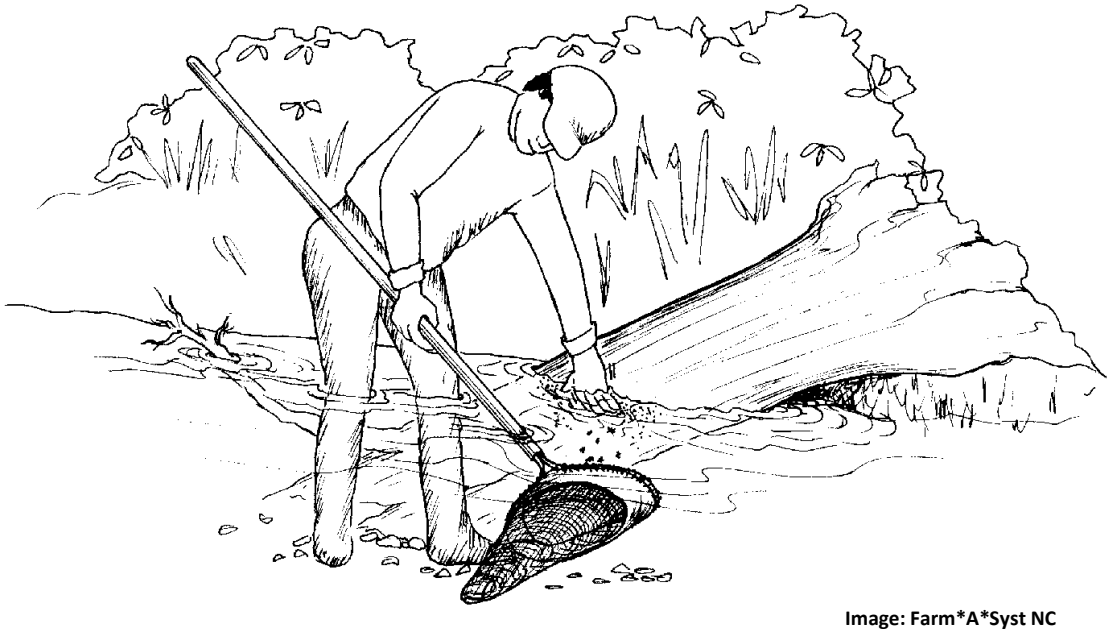

Image: Farm*A*Syst NC

Figure 8: Kick/Sweep Net Method of Macroinvertebrate Sampling

CHEMICAL SURVEY

Water chemistry plays an important role in the health, abundance and diversity of the aquatic life that can live in a stream. Test for dissolved oxygen, nutrients, pH, bacteria and other parameters using an approved water quality testing kit. If measurement values seem erroneous, reassess the data and note the difficulty on the data sheet. Please contact PTRC to assist with obtaining these materials.

DISSOLVED OXYGEN AND BIOCHEMICAL OXYGEN DEMAND

Like us, fish, macroinvertebrates, bacteria and plants all require oxygen to survive. Oxygen dissolves easily into the water from the atmosphere until the water is saturated. Lots of factors affect how much DO is in the water. These include temperature, the amount and speed of flowing water, the number of plants and algae, and pollution. The composition of the stream bottom can also affect the level of DO. Gravelly or rocky bottoms stir up more water than muddy ones do and create bubbles, putting more oxygen in the water. A high level of dissolved oxygen in the water is an indicator of a healthy stream although some areas, like swamps, have naturally low levels of DO.

Aquatic organisms require different amounts of dissolved oxygen. Dissolved Oxygen levels of 6 to 6 ppm support the growth and activity of aquatic organisms. Dissolved Oxygen levels below 3 ppm are stressful to most aquatic organisms and levels below 2 or 1 ppm will not support fish.

Biochemical Oxygen Demand is the measure of the amount of dissolved oxygen used by bacteria as they break down organic wastes. In slow moving and polluted waters, much of the dissolved oxygen is consumed by bacteria limiting the amount available for other aquatic organisms.

BACTERIA:

Scientists sample for certain types of bacteria including Fecal coliform bacteria that are naturally found in the stomachs and intestines humans but are absent in unpolluted waters. Although this type of bacteria is not necessarily harmful, it can indicate the presence of pathogenic (disease-causing) bacteria, viruses, and protozoans. Wastewater treatment plants, on-site septic systems, domestic and wild animal manure, and stormwater runoff are all potential sources of fecal bacteria.

Figure 9: Data Sheet Example

TEMPERATURE:

Scientists use temperature to determine what kind of animals can survive. If the temperature gets too hot or cold for some organisms, they die. Temperature also affects the chemical makeup of the water. For example, warm water contains less oxygen than cold water. A healthy stream bank full of trees and vegetation can help keep stream temperatures cool for trout and other fish. Thermal pollution, the discharge of heated water from industrial operations, for example, can cause temperature changes that threaten the balance of aquatic systems.

NUTRIENTS:

Everyone needs nutrients to survive. However, sometimes you can have too much of a good thing. The main nutrients scientists are concerned with are phosphorous and nitrogen. Nitrogen and Phosphorus are nutrients that act as fertilizers for aquatic plants and algae. Too many nutrients can hurt aquatic organisms by causing algae blooms, or fast growing algae that absorbs needed oxygen from the water. Nutrients are found in residential and agriculture fertilizers, pet waste, waste-water treatment plants, sewage plants, and other sources. Over half of the phosphates in lakes, streams and rivers come from detergents.

PH:

The p stands for "potential of" and the H is hydrogen. pH levels range from very acidic (0) to very basic (14). A range from 6.5 to 8.2 is considered optimal for most aquatic organisms. High levels of pH can be deadly to fish and other aquatic organisms. Rapidly growing algae removes carbon dioxide from the water during photosynthesis. This can result in a significant increase in pH.

TURBIDITY

Turbidity is the measurement of the relative clarity of water. Turbid water is caused by suspended matter such as clay, silt, organic and inorganic mater. Turbidity should not be confused with color, since darkly colored water can still be clear and not turbid. Turbid water may be the result of soil erosion, urban run-off, algal blooms and bottom sediment disturbances caused by boat traffic and abundant bottom feeders.

STREAM CLEANUPS

A stream cleanup is an organized effort to remove trash from a stream or river, or the land area or storm drains that flow to a local stream or waterbody. The accumulation of trash in a stream is not just an eyesore. Construction debris, junked cars, discarded appliances and litter can release pollutants into a stream. Large objects can block the flow of water, increasing flooding and bank erosion and preventing fish and other organisms from traveling up and downstream.

A trash cleanup is the first step towards creating cleaner aquatic environment. They also serve as valuable learning experiences and establish a connection between citizens and the stream that runs through their community. Citizens see first-hand, the impacts of their cleanup efforts and its effect on the quality of the stream. Ultimately, such cleanups encourage and empower citizens to participate in other projects to improve water quality.

If your stream is in need of a cleanup, DC FISH can provide additional volunteers and materials. Please contact us for more information.

STREAM SURVEY DATA SHEET

Date: _____ Site Location: _____

Start Time: _____ End Time_____

Weather Conditions/Recent Rain Events: _____Rainfall in inches:_____

Names of Volunteers: _____

_____

Type of Monitoring:

- ☐ visual monitoring
- ☐ macroinvertebrate count
- ☐ chemical parameters
- ☐ Litter Cleanup
- ☐ other

Comments and Observations:

VISUAL MONITORING DATA SHEET

Water appearance:	Odor:	Stream bed coating:	Stream Bed composition:
☐ scum	☐ rotten egg	☐ orange to red	____ % silt (mud)
☐ foam	☐ musky	☐ yellowish	____ % sand (1/16" – 1/4")
☐ muddy	☐ petroleum	☐ black	____ % gravel (1/4" – 2")
☐ clear	☐ Sewage	☐ brown	____ % cobbles (2" – 10")
☐ Tea-colored	☐ Fishy	☐ other	____ % boulders (> 10" stones)
☐ milky	☐ Chlorine	☐ none	____ % dead leaves
☐ color sheen (oily)	☐ Chemical		
☐ brownish	☐ other		
☐ other	☐ none		

What Kind of Algae:	Algae color :	Algae location :	Stream Bed Sinks :
☐ Phytoplankton type algae Water colored?	☐ Green,	☐ everywhere	☐ no spots
☐ Filamentous type algae "Hairlike" mat on rocks?	☐ Black,	☐ in spots	☐ a few spots
☐ Periphyton type algae Beardlike growth on rocks?	☐ Blue-green,	__ % bed cover	☐ many spots
☐ Diatomaceous type algae Brown slimy algae on rocks?	☐ Brown,	☐ unusual amount of algae	☐ no spots
☐ other	☐ Yellowish,	☐ everywhere	☐ a few spots
	☐ Bright blue,	☐ in spots	☐ many spots
	☐ Red,		

Stream Sides	Stream Shade	Stream Side Cover Composition (=100%):
Eroding? ☐Yes ☐No % bare soil on stream banks (not covered by plants, rocks and logs) Is stream getting cut deeper? ☐Yes ☐No Is stream widening? ☐Yes ☐No	☐ Best (25 - 90% shade--sun-dappled stream) ☐ Good (>90% shade -- almost totally shaded) ☐ Poor (<25 shade - almost no shade)	___ % Trees ___ % Shrubs ___ % grass ___ % bare soil ___ % rocks ___ % other _____

Wildlife

Mussel shells seen? ____Yes ____No
Fish seen? ____Yes ____No
Signs of beaver? ____Yes ____No
If Yes, describe:_____
Signs of other wildlife observed:
_____
_____
_____

Land use in watershed:

_____ homes _____ stores _____ factories _____ farming
_____ woods _____ fields _____ construction _____ mining

Illicit Discharge: Visible discharging pipes? _____ yes _____ no

If so, how many discharging pipes are there? _____

Did you test above the discharge and below the discharge to determine any changes in water quality and were changes notices? _____

Barrier to fish movements or Structure causing a water level difference of one foot or more:

_____ waterfalls _____ dams ___ beaver dams ____ none _____other

MACROINVERTEBRATE COUNT DATA SHEET

Use letter codes (A=1 – 9, B=10 – 99, C= 100 or more) to record the numbers of organisms found in a 3 foot by 3 foot area. Then add up the number of letter in each column and multiply by the indicated index value.

GOOD		FAIR		POOR	
☐	caddisfly larvae	☐	beetle larvae	☐	aquatic worms
☐	dobsonfly larvae	☐	clams	☐	blackfly larvae
☐	mayfly nymphs	☐	crane fly larvae	☐	leeches
☐	gilled snails	☐	crayfish	☐	midge larvae
☐	riffle beetle adult	☐	damselfly nymph	☐	pouch snails
☐	stonefly nymphs	☐	dragonfly nymphs		
☐	water penny larvae	☐	scuds		
		☐	sowbugs		
		☐	alderfly		
		☐	fishfly		
___	**# of letters**	___	**# of letters**	___	**# of letters**
___	Multiply by 3	___	Multiply by 2	___	Multiply by 1
___	**Index Value**	___	**Index Value**	___	**Index Value**

Now add together the three index values = total index value.

Compare this total index value to the following numbers to determine the water quality of your stream. Good water quality is indicated by a variety of different kinds of organisms, with no one kind making up the majority of the sample.

EXCELLENT (> 22) GOOD (17 – 22)

FAIR (11 – 16) POOR (< 11)

Note: You should test at least 3 different riffles to ensure that you have a truly representative sample which includes all key organisms. You may also want to sample some of the rocks in the slower-moving water, nearer the banks, because mayflies and stoneflies are sometimes found there instead.

Fish:	Crayfish:
scattered individuals_____	Scarce_____
scattered schools_____	Abundant_____

CHEMICAL PARAMETERS DATA SHEET

Test Factor	Result
Biological Oxygen Demand (BOD)	_____
Dissolved Oxygen	_____
Nitrate-Nitrogen	_____
pH	_____
Phosphate	_____
Temperature	_____
Turbidity	_____

Comments and Observations: _____

LITTER CLEANUP DATA SHEET

Length of stream cleaned: _____

Number of participants: _____

Describe % and type of litter in and around the stream: _____

_____

_____

_____

Average number of small and large items collected:

paper, small trash		can and bottles		tires, carts, etc.	
_____	0 – 5	_____	0 – 5	_____	0 – 5
_____	5 – 10	_____	5 – 10	_____	5 – 10
_____	10 – 50	_____	10 – 50	_____	10 – 50
_____	more than 50	_____	more than 50	_____	more than 50

Total number of trash bags: _____

Unusual items found/Comments and Observations: _____

REFERENCES AND FURTHER READING

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USEPA. 1996. *The Volunteer Monitor's Guide To Quality Assurance Project Plans*.

USEPA. 1997. *Volunteer Stream Monitoring: A Methods Manual.* USEPA 841-B-96-003. November. Office of Wetlands, Oceans, and Watersheds, 4503F, Washington, DC 20460.

RESOURCES FOR WATER QUALITY QUESTIONS AND CONCERNS

Piedmont Triad Regional Council 336-294-4950, www.ptrc.org, email: stormwatersmart@ptrc.org

State Governmental Information Resources

- **Department of Environment and Natural Resources (DENR),** http://portal.ncdenr.org/web/guest
  For Environmnetal Assistance: 1-877-623-6748
  To Report an Environmental Emergency: 1-800-858-0368

Water Quality Questions and Concerns

- **DENR Division of Water Quality (DWQ),** http://portal.ncdenr.org/web/wq/
  Mailing Address: 1617 Mail Service Center, Raleigh, NC 27699-1617
  Raleigh Central office: (919) 807-6300,
- **DWQ Winston-Salem Regional Office**, 336-771-5000
  Serves the following counties: Alamance, Alleghany, Ashe, Caswell, Davidson, Davie, Forsyth, Guilford, Randolph, Rockingham, Stokes, Surry, Watauga, Wilkes, Yadkin
  Aquifer Protection Supervisor: Sherri Knight
  Surface Water Protection Supervisor: Corey Basinger

- **DENR Emergency Spill Response**
- Monday-Friday 8 AM-5 PM to the appropriate Regional Office found above, or call (919)807-6308
  To report spills after hours or on weekends in North Carolina, call 800-858-0368.
  To report spills to the National Response Center, call 800-424-8802 (24 hours.)

Sediment Runoff/Erosion Concerns

- **DENR Land Quality Section** http://portal.ncdenr.org/web/lr/land-quality
  Sediment Emergencies 1-866-Stopmud (1-866-786-7683)
  Winston-Salem Regional Office**,** 336.771.5000
  Regional Engineer: Matthew Gantt, PE

- **NC Division of Soil and Water Conservation (SWCD)** http://portal.ncdenr.org/web/swc/
  Davidson County SWCD Tel: 336-242-2075 • Fax: 336-242-2982
  http://www.enr.state.nc.us/dswc/pages/staff.html

- **NC Farm Service Agency County Offices**
  DAVIDSON COUNTY FARM SERVICE AGENCY (336) 248-2687
  Lanny Collett, County Executive Director (336) 248-2687 ext 2
  Lanny.Collett@nc.usda.gov

Forest Management Questions

- **NC Forest Service:** http://ncforestservice.gov/water_quality/water_quality.htm
  District Ten serves the following counties: Davidson, Randolph, Surry, Davie, Rockingham, Yadkin, Forsyth, Rowan, Guilford, Stokes
  District Forester Kevin Harvell, 336-956-2111, kevin.harvell@ncagr.gov

On-Site Wastewater Issues

- **NC Division of Waste Management:** http://portal.ncdenr.org/web/wm/sw/septage

Resources for Land Conservation of Wetlands and Streams

- **Conservation Trust for NC**, http://www.ctnc.org 919-828-4199
- **Piedmont Land Conservancy** http://www.piedmontland.org/, 336-691-0044
- **The LandTrust for Central North Carolina**, http://landtrustcnc.org/, 704.647.0302
- **NC Extension Service :** Davidson County http://davidson.ces.ncsu.edu/ 336-242-2080

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Improving Stream Health
DC FISH
2216 W. Meadowview Road
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Phone: 336-294-4950
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