Musconetcong Watershed Association

River Watcher

Water Quality Monitoring Program

Methods MANUAL

Including Guidelines for Monitoring Dam Removals

Updated March 2012

MUSCONETCONG
WATERSHED
ASSOCIATION

Contents

WELCOME TO THE RIVER WATCHER PROGRAM!

Intro

The MWA River Watcher program measures temperature, dissolved oxygen, acidity (pH), and nitrate levels downstream of Lake Hopatcong, in Stephen State Park, in Point Mountain Preserve, off of Mt. Joy Road in Finesville, and other sites where more data on water quality is needed to answer questions MWA or the community have. River Watchers also assess each site for biological richness using the presence of benthic macroinvertebrates as indicator species. Because sections of rivers have characteristics that influence the habitat of these biological organisms, the River Watcher program also measures various physical parameters of the stream, such as width, depth and flow to characterize each site, as well as performing a visual habitat assessment.

MWA uses the River Watcher data to

- Insure that water quality in the Musconetcong River remains suitable for recreational uses such as fishing and swimming
- Advocate for the river when proposed projects threaten the health of the Musconetcong River and its tributaries
- Observe how stream restoration projects such as dam removals, stream bank stabilization, and riparian restoration improve the river habitat
- Track how preservation of land, improved development controls, and pollution prevention programs all help keep the river ecosystem healthy

Surface Water Standards

It is very important to protect existing water quality in New Jersey. NJDEP is empowered, through the Federal Clean Water Act and New Jersey's statutory authority through the Water Pollution Control Act and the Water Quality Planning Act, to protect "surface water"-meaning rivers, streams, lakes, estuaries and coastal waters. The Department does this by setting policies that prevent degradation of those water bodies. These policies are called the Surface Water Quality Standards (SWQS). These Standards require that the designated use of a stream be maintained—and if a stream is found to be impaired, restoration must take place.

Not all water bodies have the same level of protection. There are three levels—waters of Outstanding National Resource, Category 1 waters, and Category 2 waters (all water bodies that are not in the other two categories). Fresh waters may also be classified as Non-Trout (NT), Trout Maintenance (TM), and Trout Production (TP).

Various parts of the Musconetcong River are classified in various ways. From the Lake Hopatcong outfall to and including Saxton Lake, excepting certain tributaries and Lake Musconetcong, the Muskie is classified as FW2-TM. Lake Musconetcong is classified as FW2-NT. From Saxton Falls down to the Delaware River, the Musconetcong River is classified as FW2-TM(C1). The tributaries of much of the Musconetcong are classified as FW2-TP(C1). You can learn more about stream classifications from the NJDEP Monitoring and Standards Website.

Why are these classifications important to the River Watcher program? Each classification has a level of protection that helps the maintain the river's designated use. In the case of the Musconetcong River, that means the water quality should stay within the acceptable limits necessary for it to remain suitable for fishing and swimming. For River Watchers, that means that if a dissolved oxygen reading is below 5.0mg/ml, a pH lower than 6.5 or higher than 8.5, a nitrate reading above a 2, and a temperature above 23C, the water quality at the site may be impaired or there may be a serious problem upstream which requires further investigation.

Report Unusual Results

When you get a result at your monitoring station that seems unusual, and particularly if it is outside of the above values limits, you should call the River Watcher Coordinator immediately. It is very important for MWA to document these instances, and communicate them to the NJDEP and other organizations that work to protect the river.

Emergencies and Suspicious Activity

If you see any ongoing activity that you think may threaten the river, call the River Watcher Coordinator or the MWA office, or call the NJDEP Environmental Hotline at 1-877-927-6337 or 1-877-WARNDEP if it is an emergency. Documenting the problem with photos, data, and an exact location is recommended.

Safety Considerations

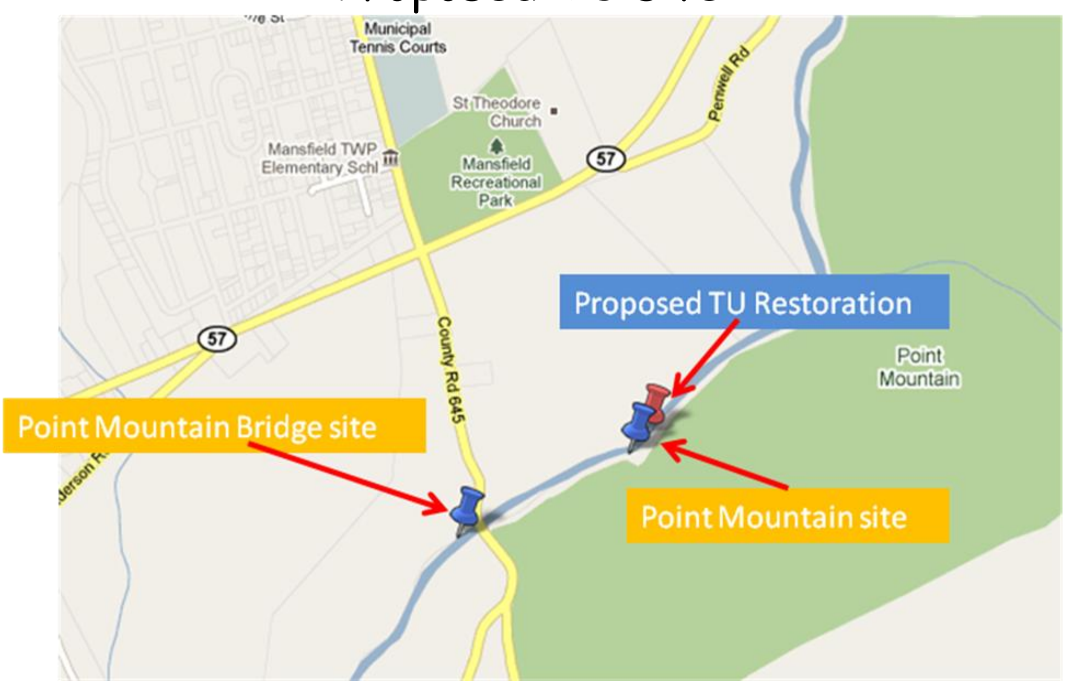
Working in and around a river is safe as long as you observe some basic precautions.

1. **Do not monitor alone**. The river bed can be quite slippery; if you fall in the river you can severely injury yourself or drown. If you come to a monitoring session and your team is not there within one half hour of the scheduled monitoring, assume that the monitoring session has been delayed or postponed. If you must go to your site without a partner, make sure you let the River Watcher Coordinator know when you are going; carry a cell phone on you at all times.
2. **Wear appropriate clothing**. River temperatures can be near freezing during the winter, and are commonly below 60F in the spring and fall. High waterproof boots may be sufficient protection at some sites at certain times of the year, but waders are recommended for volunteers spending significant amounts of time in the water. It is also advisable for monitors to wear clothing that dries quickly as it is common to get very wet during monitoring; non-cotton clothing is best. Some monitors bring extra clothing in case of a dunking; bringing dry socks and footgear is always recommended.
3. <u>Never</u> **monitor if it is thundering or lightning** in the vicinity of your site.
4. **Do not eat or drink anything during the monitoring session**. While your tests may indicate excellent water quality, there may be harmful bacteria in the river. Wash your hands or clean them with an alcohol-based cleaner before you eat a meal.
5. **Do not monitor a location where the water is above your knees, unless you are wearing a Personal Floatation Device (PFD)**. It is much easier to fall in deeper water and sustain a severe injury. Wearing a PFD at sites that are close to dams and dam outfalls is advisable if you are monitoring.

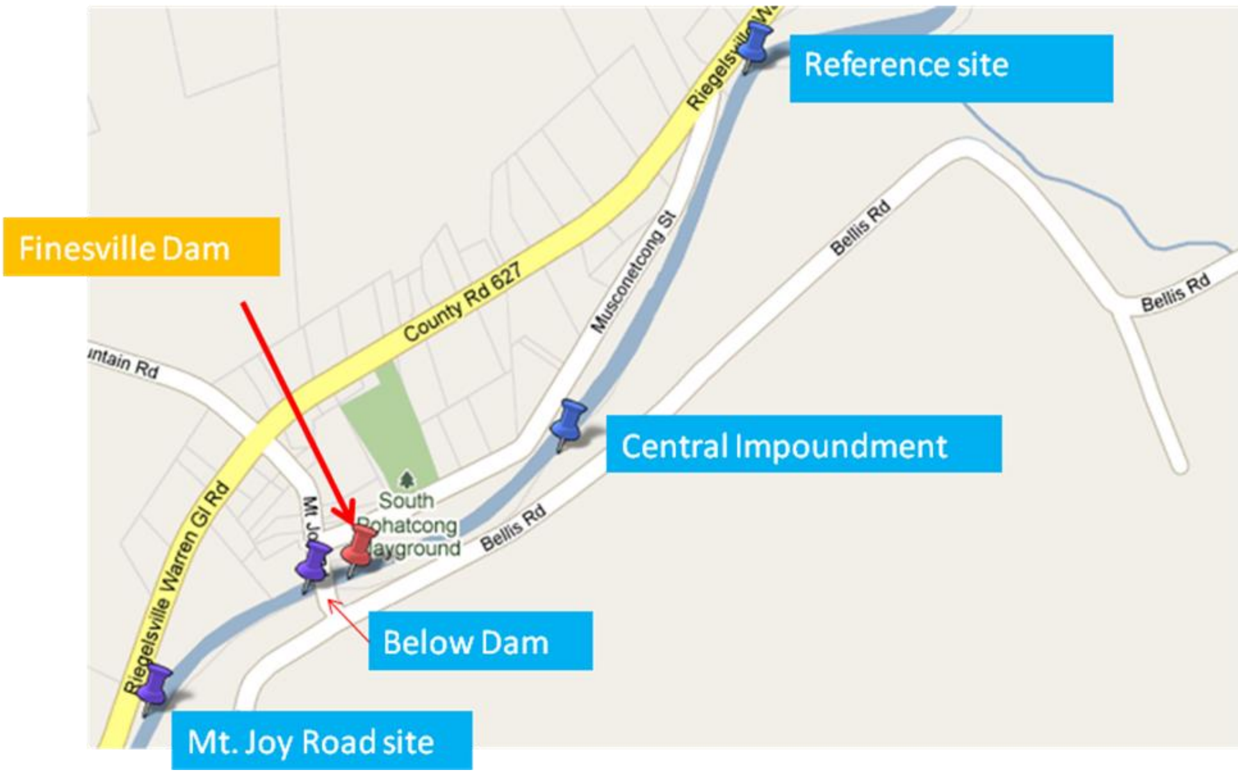
6. **If you are monitoring by boat**, all volunteers and staff monitoring those sites MUST wear a PFD at all times.
7. **Take extra precautions in the winter time**. Rocks that are easy to walk on in warm weather may be ice covered in the winter.
8. **A walking stick is recommended when wading across a river** to take measurements or photographs.
9. **If you feel that conditions at the site are hazardous—do not monitor.** We can always go back another day to monitor. Your safety is more important to us than a data point.

MWA River Watcher Sites (Upper Musconetcong River) with project sites

MWA River Watcher Sites (Point Mountain) with Proposed TU site



MWA River Watcher site (Lower Musconetcong) with Dam Removal Project sites



CHEMICAL TEST RATIONALE

The Basics About Dissolved Oxygen

Almost all plants and animals, whether they live on land or in water, require oxygen for their survival. In water, oxygen is present in a dissolved form and is measured in milligrams (mg), per liter (l) of water. Milligrams per liter (mg/l) is also sometimes expressed as parts per million (ppm). Dissolved oxygen (DO) can also be measured as percent saturation, which takes into account temperature. Saturation is the maximum level of DO that would be present in the water at a specific temperature, in the absence of other influences.

The amount of oxygen in water is dependent on the transfer of the gas from the atmosphere to surface waters. In addition, the mixing action of wind, waves, riffles, and other turbulence facilitates the air mixing with water. During the daylight hours, aquatic plants that may be present in the stream also add a substantial amount of oxygen to the stream via photosynthesis. At night, these same plants use up oxygen during their respiration cycle, dramatically decreasing DO resources. Since photosynthesis by floating and rooted aquatic plants depends on light, oxygen production occurs nearer the water surface. Because respiration in plants is highest just before dawn, there is a daily cycle of dissolved oxygen.

Temperature also influences the DO cycle. Warm water is not able to hold as much DO as colder water. For example, streams below a water discharge pipe, in an unshaded section of stream or in a dam impoundment can have higher temperatures and therefore, lower dissolved oxygen levels. Because the temperature of a stream varies daily, if you are analyzing dissolved oxygen in a sample of water and wish to factor out the effect of temperature, calculating the percent saturation can be used to eliminate variation due to temperature.

Increased organic pollution and nutrients (nitrogen and phosphorous) from fertilizers, manure piles, lawn waste dumped in or near streams, leaking septic systems and inadequate sewage treatment facilities also decrease

DO, by stimulating the growth of algae and aerobic bacteria. When the alga uses up the excess nutrients, it dies. The bacterial decay uses oxygen; this decay process robs the water column of DO. Increased sediment loads and stormwater runoff can also decrease dissolved oxygen. Dams may cause an oxygen deficit in the impoundment as water temperatures increase. When this water is released from the spillway, it may have less oxygen due to increased organic matter (in the form of plant and animal remains) that tends to accumulate in ponds below the surface. Below the spillway, DO levels may be extremely high due to increased turbulence.

Many organisms begin to experience stress as dissolved oxygen levels drop, much like you would feel walking on a mountaintop at 8,000 feet. At DO levels of 5.0 milligrams per liter (mg/l) in warm-water fisheries (or 6.0 mg/l in cold-water fisheries), this stress is large enough that scientists are able to see less diversity in the organisms that live in streams, as the old, young and weak individuals die off before reproducing. Some hardier species may be able to tolerate levels below 4.0 mg/l, but they do not thrive in large numbers; lethal levels for these hardier species are reached at 2.0 mg/l.

In summary, oxygen is affected naturally by temperature, flow, the presence of aquatic plants and bacteria, altitude, and dissolved or suspended solids. Human activities affecting DO include removal of riparian vegetation, urban development, organic and nutrient inputs, and dams. In general, oxygen supplies are lowest in the summer months, just before dawn, when waters are warmest, bacterial decomposition is at its highest, and photosynthesis is at its lowest.

The Basics About pH

pH is a measure of the acidity of a solution. The pH test measures the concentration of hydrogen ions (H^+) and is based on a scale of 0 to 14. A pH of 7.0 is neutral, while lower numbers indicate an acid nature (more H^+ ions), and higher numbers indicate basic (or alkaline) conditions. The pH scale is logarithmic which means that each incremental change is equal to a ten-fold increase or decrease in the acid or base. So a pH of 8 is 10 times less acidic than pH 7.

Each stream tends to have a narrow range of pH values with most levels falling between 6 and 9. Natural, unpolluted rain water can have a pH as acidic as 5.6. As rainwater falls through the atmosphere, it absorbs carbon dioxide, forming carbonic acid. Where soils are alkaline (basic), for example in limestone streams, pH levels may be greater than 7. Alkalinity often helps to buffer the stream, giving the stream an ability to maintain a constant pH even when large amounts of acid or base enter the stream. Aquatic plants, when present, also impact pH levels, causing pH to have a daily cycle. Photosynthesis causes increases in pH as plants remove carbon dioxide from the water during the day. Conversely, at night, pH decreases as plants give off carbon dioxide during respiration. As the pH changes, so do the chemical reactions in the water. For example, as pH increases, smaller amounts of ammonia are needed to reach a level that is toxic to fish. As pH decreases, the concentration of metals may increase because highly acidic water acts as a solvent, leaching metals from the sediments and substrate.

Freshwater aquatic organisms generally prefer a pH range of 6.5-8.0 and deviations from this can have serious effects on the health of a stream. A pH of 4.0 or below can destroy aquatic eggs and larvae, and frequently results in fish kills and/or mutations. Low pH leaches metals from soils and rocks, resulting in poisoning and deformities. While the effects of high pH levels (above 9.0) are not as well documented, it is likely that these also cause mutations in aquatic organisms. In areas where coal mining is present, mine drainage often has acidic pH levels as low as 4.0, making streams inhospitable to wildlife. Acid rain also decreases pH levels. Acid rain is formed when nitrogen oxides and sulfur dioxides are released from our cars and fossil fuel burning power plants.

The Basics about Nitrate

Nitrogen makes up about 80 percent of the air that we breathe and is an essential component of proteins. In aquatic systems, the inert gas Nitrogen is converted to useable forms by bacteria, which are then taken up by algae and other plants. Nitrogen occurs in natural waters in various forms including nitrate (NO_3), nitrite (NO_2), and ammonia (NH_3). Nitrate (or nitrate-nitrogen) is the most common form tested in water.

While nitrates are essential to plant growth, an overabundance can lead to eutrophication (increased plant growth), often blocking sunlight to the water column. When the algae uses up all nutrients and dies, the natural decay process robs dissolved oxygen from the stream, potentially causing fish kills and other impairments to aquatic life.

Nitrogen levels in streams are affected by ammonia in acid rain, freezing and thawing of soils, forest fires, and recycling by vegetation and retention by the soil's humus layer. High levels of nitrogen are generally the result of improperly treated sewage from treatment plants or leaky septic systems; runoff from over-fertilized agricultural fields, lawns, and golf courses; pet, livestock, and other animal waste; detergents; and industrial effluent. High levels of nitrates also impact human health. The national drinking water standard is 10 mg/l nitrate-nitrogen and drinking water should not exceed this level. In many cases, rural communities where farms are in operation, have levels of nitrate-nitrogen higher than this in their wells. These elevated levels can cause blue baby syndrome (methemoglobinemia), a disorder which is hazardous to young animals and infant humans. This blood disorder is caused when nitrate interacts with the hemoglobin in red blood cells. Unlike hemoglobin, the methemoglobin formed in this interaction cannot carry sufficient oxygen to the body's cells and tissues.

When nitrate levels are greater than 1.0 mg/l as nitrate-nitrogen (or 4.4 mg/l as nitrate), you can suspect degraded water quality and unnatural sources of nitrogen entering the system. From the biological perspective, no nitrate limit is established in the water quality standards however; in a general sense, less is better.

WHY STUDY BENTHIC MACROINVERTEBRATES?

Stream-bottom macroinvertebrates are an important part of the community of life found in and around a stream. Aquatic organisms that live in the bottom of streams, or benthic macroinvertebrates, are an essential link in the aquatic food chain and energy cycle. In most streams, the energy stored by plants is available to animal life either in the form of leaves that fall in the water or in the form of algae that grows on the stream bottom. The algae and leaves are eaten by benthic macroinvertebrates. The macroinvertebrates are an important source of energy for larger animals such as fish, which in turn, are a source of energy for birds, raccoons, water snakes, and even fishermen.

Benthic macroinvertebrates differ in their habitat requirements as well as their sensitivity to changes in water quality. Some macroinvertebrates cannot survive in warm or polluted water. Others can survive or even thrive in lower quality water because they are adapted to slower or warmer water conditions. In a healthy stream, the benthic community will include a variety of highly sensitive macroinvertebrates. In an unhealthy stream, there may be only a few types of tolerant macroinvertebrates present. As dams create poor habitat in streams, and influence water quality, it is expected that more sensitive organisms will migrate into the restored stream. The presence of more sensitive organisms after restoration can provide insight into the project's effectiveness.

Benthic macroinvertebrates provide information about the quality of a stream over long periods of time. It may be difficult to identify poor stream conditions that fluctuate with chemical water analysis, which can only provide information for the time of sampling. Even the presence of fish may not tell us about a water quality problem, because fish can move away to avoid poor water quality and return when conditions improve. However, most benthic macroinvertebrates do not move around the streambed far enough to avoid warm water, for example. Thus, a macroinvertebrate sample may provide information about impacts that are not present at the time of sample collection.

Benthic macroinvertebrates are relatively easy to collect. Useful stream-bottom macroinvertebrate data are easy to collect without expensive equipment. The data obtained by macroinvertebrate sampling can serve to indicate the need for additional data collection, possibly including water analysis and fish sampling.

The following is an excerpt from the Proposed Amendments to N.J.A.C. 7:9B-1.4 and 1.15 (Surface Water Quality Standards). The proposed amendments were prepared by the New Jersey Department Of Environmental Protection and released on May 21, 2007 regarding Benthic Macroinvertebrates:

"The biological health of New Jersey's wadeable streams can be assessed based upon the resident in-stream benthic macroinvertebrate community. Benthic macroinvertebrates are primarily benthic (bottom-dwelling) fauna easily viewed with the naked eye. These fauna are generally ubiquitous in freshwater and estuarine environments, and play an integral role in the aquatic food web. Insects (largely immature forms) are especially characteristic of freshwaters; other major groups include worms, mollusks (snails, clams) and crustaceans (scuds, shrimp, water fleas, etc.). Species comprising the in-stream community occupy various niches, based on functional adaptation or feeding mode (for example, predators, filter or detritus feeders, scavengers, etc.). Their presence and relative abundance is governed by environmental conditions (which may determine available food supply), and by pollution tolerance levels of the respective species. Benthic macroinvertebrate communities integrate the effects of short-term environmental variations and provide an ecological measure of fluctuating environmental conditions. Since benthic macroinvertebrates have limited migration patterns, or a sessile mode of life, they are particularly well-suited for assessing site-specific ecosystem health. Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects. Sampling is relatively easy, requires few people and inexpensive gear, and has minimal detrimental effect on the resident biota. This makes benthic macroinvertebrate assemblages good indicators of localized conditions. "

RIVER WATCHER HABITAT ASSESSMENT

Introduction

The purpose of setting up a volunteer monitoring program is to get more eyes out into the watershed to observe what is going on and collect data so we can have a strong base of information. Volunteer Monitoring promotes a strong sense of stewardship. It is also helpful to gather data on water bodies that are currently not assessed by the state, or on water bodies where more water quality information is needed by the MWA, or municipalities. Regardless of how the data is used, the methods used in collecting the data need to be consistent and well-structured so that the people using them can easily understand them and also compare the data from different sites.

The data packet sheets for this Habitat Assessment tool are based on the EPA Habitat Assessment protocol for High Gradient Streams (http://water.epa.gov/scitech/monitoring/rsl/bioassessment/ch05b.cfm and the method recommended for volunteer monitors at NJDEP (see website at www.state.nj.us/dep/wms/bwqsa/vm/). The protocol is tailored to New Jersey and has been adjusted to reflect the common conditions in the Musconetcong River and its tributaries.

In the data packet contains the General Sheet, Monitoring Sheet, the Land Use Assessment Sheet and the Pipe/Drainage Ditch Inventory Sheet. In addition to these sheets, when a new site is being established or when features have changed, it is recommended that a hand drawn map (drawn from a bird's eye view) be used to mark the approximate locations of the reach and each notable features. You may use Google maps, NJGeoWeb or GIS tools to assist you. For the sites where dam removal or restoration monitoring takes place, site maps and land use assessments etc have been prepared by the MWA Water Quality Program Coordinator.

The order of the sheets is the same as the order as it appears in the NJDEP data management system for water quality data. *Please do not alter the sheets*—it will increase the time it takes for data input.

The General Sheet provides the monitor a way to describe the location of your assessment as well as the weather conditions during monitoring. Without this information, it is difficult for data users to determine where and when monitors have accessed their site, creating problems for a data user. To insure the quality of your data, fill out this sheet completely when you are still at your site.

The Land Use Assessment Sheet allows you to record general information about the entire stretch you are monitoring and the surrounding watershed. The Musconetcong Watershed Association's River Watcher program has provided you with the most recent assessment of land use within 50 feet of the bank. The Assessment Sheet will stay relatively the same between monitoring events at most sites. If you have changes to this information, please fill out an additional land use sheet while you are at your site. One example of a change may be the presence of waterfowl or pets. Beyond that, monitors should review the sheet once per year, during the mid-summer assessment and record the reviewers name and date. This data is extremely useful to water quality data users because it allows data users to assess how streamside land use may be affecting the river.

The Monitoring Sheet allows you to obtain specific information that will allow you to thoroughly investigate and describe the health of your stretch. Complete this sheet after you have walked the stretch, but while you are still present at your site.

The Pipe/Drainage Ditch Inventory Sheet should be completed for each pipe and drainage ditch you find along a NEW site, or if you note changes in the pipe/ditch conditions. The pipe/ditch should also be marked on your reference map. Data collected here is critical in determining point sources and nonpoint sources of pollution entering into the stream. There are many more pipes/ditches draining into our streams than are known by municipalities and state agencies; volunteer monitors are a critical resource in identifying these.

How to Fill Out Your Visual Assessment Sheet

The following is a line-by-line explanation of how to fill out your data sheets, the techniques and evaluations methods used to collect and record the data

General Sheet

Site Name
The site name should already be filled in by the River Watcher program staff. The site name allows the MWA and data users to identify what section of the Musconetcong River you are assessing.

Survey Team
Names of the people involved in the assessment.

Activity Time
Time of day when the assessment was performed.

Activity Date
Date on which the assessment was performed.

Weather Today
Fill in the appropriate number:

1. Clear, 2. Overcast 3. Light rain/Showers, 4. Steady Rain, 5. Heavy Rain 6. Snow 7. Heavy Snow Melt) that best describes the weather conditions on the day of the assessment

Days Since Last Rain
Record the number of days since the last rainfall prior to the day of the assessment.

Current Water Temperature
Enter the water temperature in C degrees at the time of the assessment.

Current Air Temperature
Enter the air temperature in C degrees at the time of the assessment.

Water Condition
This section allows you to evaluate basic water conditions without a test kit.

Odor

The odor of the stream is influenced by the time of year you are assessing; you may notice an anaerobic smell in the summer when the stream flow is slow and the temperature is warm. This may indicate the dissolved oxygen in the stream is low.

Fill in the number that best describes the general water odor along the reach of the stream.

1. Normal
2. Sewage
3. Petroleum
4. Chemical
5. Anaerobic
6. Other

Color

The local ecosystem's chemistry changes the natural color and clarity of the stream. **Fill in the number that best describes the general water color at your site:**

1. Clear
2. Tea
3. Milky
4. Muddy
5. Other

Surface Coating

Fill in the number that best describes the general surface coating along the reach of the stream at your site.

1. None
2. Oily –This may be natural or petroleum based. To tell the two types apart move the
surface water around with a stick or throw a rock into it. Natural oils will break up (like a puzzle) and stay part. Petroleum-based oils will break up, and then quickly move back together.
3. Foam—May also be naturally occurring. You can tell petroleum-based foam (from soap or detergent) by looking closely at the bubbles within the foam. If the bubbles have a noticeable iridescent shine to them, it is most likely not naturally occurring foam.
4. Scum

5. Other--please explain other

Site Sketch
This should be a hand drawn map of your stream segment. Mark features such as direction of water flow, pools, riffles, runs, road crossings, measurement locations, structures, outfalls, pipes, stream confluences, flocks of waterfowl, etc. Please be sure to include anything you may see along your stream walk. You can use a general template that you copy or scan and add to at subsequent assessments.

Monitoring Sheet

Consider whether you can safely enter and stand in the stream. The water level should not be higher than knee height and the velocity of the stream should be at a safe rate. If the current in moving too fast or the depth of the stream is unsafe for you to walk in, you should estimate the physical measurements. Please indicate on your monitoring sheet if you have provided an estimate. **Do not monitor the stream if there is lightening or thunder.** If your team is unable to monitor on the selected day due to bad weather conditions at the site, call the River Watcher. An alternate day for monitoring will be selected.

Stream Width
Walk the whole stretch of the stream first and select a width that represents a typical stretch and is accessible. Use your surveyor's tape measure to measure the width of the stream; fix the surveyor's tape to the stream bank for accurate measurements. Alternatively, one partner can stay at the water's edge and the other partner walk directly across and record the measurement. Make sure you record the units you are using—the measuring tapes are usually in 1/10 feet. When conducting your assessment, keep in mind that depth, width, velocity and flow are direct measurements and are collected in the same areas. For variable with stretches, record each width as **W1, W2**, etc, on your data sheet.

Stream Depth
Stream depth measurements are taken in the same area as stream width. Take three measurements in the main channel of the stream and record all

measurements on your data sheet. If creating a rating curve, a minimum of ten measurements should be taken and the surveyor's tape is in place, record the tape measurement where depth is measured. Deep holes should be noted separately.

Stream Velocity

Measure stream velocity by (1) marking off a 10 foot section of stream run, on a linear section of stream bank and with a stopwatch measure the time it takes a stick, orange, or any other biodegradable object to float the 10 feet section. Repeat 3 times using the same floating tool, in the same 10-foot section, and determine the average time after recording all float times on the worksheet. The velocity formula is V=D/T; divide 10 (the distance; D) by the average time (T) to determine velocity in feet per second (ft/sec). If the stream velocity is too high to get an accurate measure, measure off a 30 foot section and adjust the distance for the calculation.

***Stream Velocity Combinations**

Stream velocity and depth can greatly affect the aquatic life of a stream. The best available habitat includes all of the following combinations of velocity and depth combinations. **Record all available combinations on your data sheet.**

Slow (<1ft/sec), shallow (<1.5ft)
Slow, deep
Fast, deep
Fast, shallow
Slow, shallow
(EPA, Volunteer Stream Monitoring Manual. 1995)

***Channel Flow Status**

Channel Flow status is the degree to which the stream channel is filled with water. Flow status changes as the channel widens due to erosion, and decreases as a result of dams and other obstructions, diversion of flow, dry weather conditions or drought. When water does not cover much of the streambed, the amount of suitable substrate for aquatic organisms is limited.

4. **Base of both lower banks**

Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.

3. **Greater than 75%-**
Water fills >75% of the available channel; or <25% of channel substrate is exposed.
2. **25-75%**
Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.
1. **Very little water**
Very little water in channel and mostly present as standing pools, riffles and cobble substrate are exposed

***Channel Alteration**
Signs of channelization, or straightening, of the stream may include an unnaturally straight section of a stream, high banks, or lack of flow diversity (pools, riffles, and runs), uniform-sized stream substrate. Channelized streams segments may lack vegetation, shrubs, or be lacking diversity.
4. Stream with normal pattern
3. Some channelization present, usually in areas of bridges etc…
2. Channelization extensive, 40-80% of the streams reach
1. Over 80% of the stream channelized, gabion baskets and/or riprap, and/or concert present.

***Embeddedness**
Embeddedness is the extent to which rocks (gravel, cobbles, and boulders) are sunken into the silt, sand, or mud of a stream bottom. Observe the amount of fine particles overlying, in between, and surrounding the rocks; as rocks become more embedded, there is less rock surface or space between rocks is available as habitat for invertebrates and spawning fish.
To determine embeddedness, pick up a rock within the stream. As you look at the side of the rock you will be able to see a line or discoloration that shows where the rock was embedded where it was exposed. **Estimate the percentage that was embedded.**
4. 0-25% surrounded by sediment
3. 26-50% surrounded by sediment
2. 51-75% surrounded by sediment
1. 75% or greater surrounded by sediment

***Riffles or bend presence**

Riffles and bend presence refer to the mixture of flows and depths that create in-stream habitat for invertebrates and fish. Pools are created at bends and are deeper than the average stream depth with slower moving water than the average flow appearance. Riffles are shallower depth areas of the stream segment with faster, turbulent water running over gravel and/or rocks. This description will be dependent upon the stream gradient. Riffles and bends are typical of healthy high gradient streams.

Your choices are:

4. Frequent occurrence
3. Infrequent occurrence
2. Occasional occurrence
1. Flat water

***Available Stable Habitat and Cover for Aquatic Insects, etc.**

The abundance and variety of natural structures in the stream (cobbles, large rocks large rocks, fallen trees, log and branches, undercut banks) provides macroinvertebrates and fish shelter, as well as places to breed and feed. **Record the relative quantity and variety of natural structures to estimate habitat diversity.** Greater habitat diversity can support a greater diversity of organisms.

4. Greater than 70% (mix of snags, submerged logs, undercut banks, cobble or other stable habitat to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).
3. 40-70% mix of stable habitat (a mix of adequate habitat for maintenance of populations; may be newly fallen logs, etc. that are not yet prepared for colonization).
2. 20-40% mix of stable habitat; habitat availability less than desirable; stream bottom appears to be frequently disturbed or removed.
1. Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.

***How much of the Stream is affected by Sediment (Deposition)?**

4. **Less than 5%** --of bottom affected by sediment deposition (no new bars)
3. **5-30%** ---of the bottom affected, slight deposition in pools (Some new increase in bar formation, mostly from gravel, sand or fine sediment)

2. **30-50%** --of the bottom affected (sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. Moderate deposition of new gravel, sand or fine sediment on old or new bars)
1. **More than 50%** --of the bottom changing frequently (pools almost absent due to substantial sediment deposition. Heavy deposits of fine material, increased bar development)

***Bank Stability Left and Right Bank**

Bank Stability refers to the existence of or the potential for erosion of soils from the stream banks and its movement into the stream. Excessive bank erosion occurs when the watershed surrounding the stream has been altered. An example of this may be a newly constructed parking lot on the stream bank. Precipitation will hit the parking area and rush off site quickly and towards the stream, causing the stream flow to rapidly increase, causing the banks to erode. *Left and right bank* is determined by looking up stream. Signs of erosion may include exposed tree roots, undercut banks, banks with no vegetation, or evidence of vehicles, grazing areas, and walking paths.

Pick the number that best describes what you see.

4. Stable-Evidence of erosion or bank failure absent or minimal; <5% of bank affected.
3. Moderately Stable-Small areas of erosion mostly healed over; 5-30% of bank in reach has areas of erosion.
2. Moderately Unstable- 31-60% of bank in reach has areas of erosion, high erosion potential during flooding.
1. Unstable- Many eroded areas, "raw" areas frequent; obvious bank sloughing; 60% or > of bank erosion scars.

***Left/Right Bank Vegetative Protection**

This refers to the vegetation protecting the stream's banks and the near-stream portion of the riparian zone. The root systems of plants growing on stream banks help hold the soil in place, thereby reducing the amount of erosion that is likely to occur.

Looking upstream evaluate how much of the stream bank is covered by vegetation.

4. Greater than 90%
3. 70-90%
2. 50-70&

1. Less than 50%

***Riparian Vegetation**

Riparian vegetation refers to the vegetation contiguous to the stream bank. It should consist of a good mix of types of vegetation: aquatic plants, sedges, rushes, grasses, flowering plants, shrubs, understory trees, and large trees. A healthy riparian zone is critical to a healthy stream. Again, left and right bank is determined by looking up stream. **Pick the number that best describes what is observed on both banks.**

4. >50 ft width
3. 35 - 50 ft width
2. 15 - 35 ft width
1. < 15 ft width

% Tree Canopy

Shading of a stream by trees is important for species that need cold water, like trout, because it keeps the temperature of the stream down. **To determine % of tree cover, or canopy, stand in the middle of the stream or at the stream's edge and look straight up toward the sky look over the center of the stream, or look at the reflection of the tree canopy on the stream.** Be aware that the time of year and time of day of your assessment can affect your estimation of the percent of tree cover, or canopy. Assessments made during mid-summer may be the most accurate. At other times of the year, try to visualize the tall, overhanging treetops as they will look when they have all of their leaves.

Tip: If trees do not overhang the bank at all, the tree canopy is 0%.

Stream Substrate Stability

It is important to determine if the bottom of the stream is established or if new material is entering into the stream. While you are standing in the stream kick your feet around:

1. If you kick up a plume of fine particles and can move around the rocks easily the bottom is **loose**.
2. If your action does not kick up a large plume and you can feel the rocks are anchored, the bottom is **stable**.

Woody Debris

Woody debris is the organic matter, provided by fallen trees or tree limbs that are in the stream. Woody debris creates in-stream habitat for invertebrates and fish. Too much woody debris can slowing down stream flow or causes a barrier to fish movement. **Pick the number that best describes what was observed**.

1. None
2. In spots
3. Heavy throughout reach

Woody Debris

This provides more detail about the woody debris. If the debris is free floating, it may have recently floated down stream and is not useable habitat. If the debris is established and attached it <u>will</u> provide habitat for invertebrates and fish.

1. Free floating
2. Attached

Predominant Aquatic Vegetation

Aquatic Vegetation is normal in streams. It provides food and habitat for aquatic life. If there are too many aquatic plants in the stream there may be a lack of dissolved oxygen--fish and other oxygen-dependent organisms will suffocate.

Pick the number that best describes the predominant aquatic vegetation observed.

1. Rooted Emergent means the vegetation is rooted in substrate and is partially exposed above the water surface (like cattails).
2. Rooted Submergent means the vegetation is completely underwater.
3. Rooted Floating means vegetation is rooted into the stream bottom and is floating on the water surface (like a lily pad).
4. Free Floating means vegetation is not rooted or attached to anything (like duck weed).

Algae Growth

Algae can provide shelter and food resources for fish and macroinvertebrates; too much can limit the amount of oxygen available to organisms as well. Record the presence or absence of algae growth and evaluate the density of the algae growth in the stream and on the stream bed.

If absent, record "absent"; if present, record whether the growth is very obviously "densely populated" or "sparse".

Algae Location

Pick the number that best describes where algae are located.

1. None
2. On streambed
3. On surface
4. Both

Algae Color

Pick the number that best describes the color of the predominate algae.

1. Light Green
2. Dark Green
3. Brown
4. Other (note other color)

Structures

Bridges, culverts, dams and other structures, such as weirs, are all examples of in-stream man-made structures that affect the stream's health. Record the structures observed in the stream within the reach. Identify any other structures that you observe above and below your stretch.

Other Observations

Fill in any other observations made about the reach. This can include wildlife observed, anything that appears out of the ordinary, or information obtained by talking with local residents concerning the history of land use in the area. Observation locations should be marked on the map of the area that you prepare.

Photo Reference #'s

Assign each photo taken a number, and mark the location and direction of the photo on the site sketch.

Pipe & Drainage Ditch Inventory Sheet

Outfall Pipe Reference #

Assign a reference number for each outfall that is observed and record it on the working map.

Pipe Diameter

Enter the estimated or measure the diameter of the pipe.

Type

Pick the number that best describes the type of discharge from the pipe.

Storm drain is a discharge is from storm sewers from an adjacent development or highway/road system.

Residential discharge is a pipe from a nearby home discharging water from a sump, drain or washer.

Industrial Discharge (NJPDES#) means a permitted industrial discharge. These discharges will be clearly marked in the field and should be identified prior to going out. The NJPDES permit number should be recorded here.

Combined Sewer Overflow is a sewer system that carries both sewage and stormwater runoff. Normally, its entire flow goes to a waste water treatment plant, but during a heavy storm, the volume of water may be so great as to cause overflows of untreated mixtures of stormwater and sewage into receiving waters.

Other is any other discharge that you observe whether or not you can identify the specific type.

Pipe Material

Pick the number that best describes the pipe material.

Pipe Location

Pick the number that best describes the location of the pipe in relation to the stream bank.

In Stream-the end of the discharge pipe is located at the bottom of the stream bank or in the channel.

In Stream Bank-the discharge pipe is coming out of the stream bank

Near Stream-discharge pipe is located at or slightly behind the top of bank and discharges down the bank.

Pipe Flow/Appearance

Pick the number that best describes the flow coming out of the pipe.

1. None

2. Trickle
3. Intermittent
4. Steady
5. Heavy

Is the stream bank at the outfall eroded?
1. Yes
2. No

Stream Channel Downstream
1. Stable
2. Eroded

Is the Stream bank at the outfall eroded? Enter yes or no.

Drainage Ditch

Drainage Ditch #: Assign a reference number for any drainage ditch found and record it on the working map.

Location

Mark on the map the point where the ditch enters the stream.

Ditch Lining

Pick the number that best defines the lining of the ditch.

Ditch Flow Pick the number that best describes the flow in the ditch.

Flow Appearance:

Pick the number that best describes the appearance of the flow in the ditch.
1. Clear
2. Turbid
3. Oily
4. Foamy
5. Colored

Stream Channel Downstream
1. Stable
2. Eroded

Other Observations

Enter any other observations that are made to further explain the information that was entered on this sheet or were not listed on this sheet.

Photo Reference #'s

Assign each photo taken a number and mark the location and direction of the photo on the working map.

TESTING PROCEDURES

How to Take a Macroinvertebrate Sample

Cobble, snags or other woody debris, submerged vegetated banks, submerged plant stems, and sand or sediment generally supports the diversity of the macroinvertebrates in stream ecosystems. It is important to sample the approximate percentage of the combination of these habitats that are found in the stream sampling location. The goal of the total sampling is to collect a minimum of 100 organisms—fewer than 100 organisms in the sample will make analysis less accurate.

For dam removal and restoration monitoring, it can be useful to do stream side id and analysis, even if a lab analysis is done subsequently. Dam removals can have moving timelines due to permit approvals, as well as public approval processes that can accompany funding requirements. This can result in frequently adjusted monitoring schedules which can disrupt the original study design and plan, adding the need for more sample collection to track the restoration properly—this can add high lab costs if lab analysis is necessary. Streamside id and analysis, while it produces lower quality data, can help fill in data gaps to answer questions in a cost effective way.

Macroinvertebrate Multi-habitat Method

1. **To select a site, find a riffle that is typical of the stream reach**. A reach means the 300 foot section that is the study area. A good riffle for sampling will have cobble-sized stones, fast-moving water, and a depth of 3 to 12 inches. If no riffle in the reach is available, pick an area that seems typical for the reach. For dam impoundments, that might mean taking samples from the submerged bank.
NOTE: If the site will be used for long-term monitoring it will be easier to identify if there are nearby landmarks that can be used to identify the site. Sites that are in dam impoundments where a dam removal is scheduled to take place are particularly tricky as the site may undergo dramatic changes when the pond is de-watered. Take special precautions to note permanent landmarks such as structures and identify the site with a GPS unit. These notes should accompany any data and site report.

2. Collect one riffle-habitat benthic macroinvertebrate sample at each sampling site utilizing <u>the traveling kick net method</u>. At the top of the riffle or selected area, facing downstream, place kick net on the stream bottom perpendicular to the current and kick the stream bottom in front of the net vigorously. Continue this procedure while moving slowly forward, making sure that the net makes contact with the stream bottom. Move diagonally across the riffle area as you slowly travel downstream.

2. Duration is the critical factor in standardizing sampling efforts at each site. All sites should be sampled for a minimum of 10 minutes, except for small tributaries that are considered headwater streams with drainages of less than 5 square miles. Tributaries sites should be sampled for 2 minutes. **If you sample and do not collect 100 bugs, keep sampling. Do not sample for more than 30 minutes. If 100 bugs are not collected, and the 30 minute maximum has been attained, note this on the data sheet.**

3. **The sample should be sorted and counted as soon as possible**. If it is not possible to sort at the site, carefully put the sample in a bucket with a top and return to the River Resource Center immediately. Place the collected sample into a white sorting tray and carefully remove as much large extraneous debris as possible. Be sure to remove all attached macroinvertebrates prior to discarding debris (rinse thoroughly in collecting tray and check with field magnifying glass). Smaller debris, such as leaves, twigs, sand, and gravel may be left with the sample.

4. Using the ice cube trays, sort the organisms by type using the **Stream Insects & Crustacean** ID sheet. Using the Volunteer **Macroinvertebrate Sample Count sheet**, tally the number of organisms in each organism type. Record the total number of organisms in the provided space on the **Macroinvertebrate Sample Count sheet**. This number should not be less than 100 unless the maximum sampling time of 30 minutes has been achieved with few organisms. Determine the **Volunteer Biological Assessment Score** on the **Stream Rating Sheet** and transfer that number to the **Data Summary Sheet**. If no lab analysis is taking place, return the organisms to the stream.

5. **If the sample is to be sent to the lab for analysis, place the entire collected sample in a jar with as little water as possible and add 95% ethanol until the jar is almost completely filled and covers the sample**. If the sample is too large, place them in two or more sample jars. Complete **two** labels containing site information, date, and time **in pencil;** place one label inside the jar and attach one label to the outside of the jar.

6. At the designated monitoring site, monitors should always complete the Visual/ Habitat Assessment Sheet. Any deviations from procedure should be clearly stated on the visual site survey data sheet.

7. Return any collected sample, and field assessment forms to the MWA office as soon as possible. MWA will send the samples to the laboratory where they will be analyzed. The Monitoring Coordinator will oversee collection of field sampling data in order to ensure the sampling protocol is performed correctly, and all of the field sheets are complete.

CHEMICAL TESTING PROCEDURES

Dissolved Oxygen (Lamotte 5860)

This test (LaMotte 5860) uses the azide modification of the Winkler titration method to determine dissolved oxygen. Results are recorded as **mg O_2/L or ppm O_2** and the values should fall between 0.0-15.0. To ensure accuracy, the Water Sampling Bottle (0688-DO) should be filled directly from the body of water being sampled. There may however be times when you do not have direct access to a site. In this case it is permissible to use a clean sample container to retrieve sample water. The DO procedure up to and including Step 6 should be followed immediately in order to obtain accurate results.

Step 1. To avoid contamination, thoroughly rinse the Water Sample Bottle (0688-DO) 3 times with the water to be sampled.

Step 2. With the sample bottle pointed downstream, slowly tilt it while submerging it slightly, and allow the water to fill the bottle. It is important to avoid bubbling as the water enters, since this can artificially increase your readings. Once the bottle has filled, keep it submerged and return it to a vertical position. Gently tap the side to remove any stray air bubbles and then cap the bottle while it is still under water.

Step 3. Lift the bottle out of the water, turn it upside down and look carefully to make sure that no air bubbles are trapped inside. Once a satisfactory sample has been collected, proceed immediately with Steps 4 through 6. Note: Be careful not to introduce air into the sample while adding the reagents in Steps 4 to 6.

Step 4. Add 8 drops of Manganese Sulfate Solution (4167) followed by 8 drops of Alkaline Potassium Iodide (7166) to the sample. Be sure to hold the dropper-bottles of indicator solution vertically (not tilted) and at eye-level to dispense uniformly-sized drops. **Note** – chemicals will drop to the bottom and displace water from the sample bottle. This helps keep oxygen out of the sample.

Step 5. Carefully cap the bottle and mix by inverting 30 times. (Putting on the cap will also displace water, preventing oxygen from entering the sample.) A precipitate (floc) will form. Allow the precipitate to settle below the shoulders of the bottle.

Step 6. Add 8 drops of Sulfuric Acid (6141) to the sampling bottle. Cap the bottle and gently mix until both the reagent and the precipitate have dissolved (some suspended material may remain).

NOTE Step 6 "fixes" the water sample and takes about 5 minutes. The solution will be clear yellow to orange if the sample contains dissolved oxygen. **Note**: After performing this step, exposure of the sample to the atmosphere will no longer affect the test results. It is not necessary to perform the rest of the procedure (the actual test) immediately. Samples fixed in the field can be carried back to a testing station, laboratory or other sheltered area for testing. Titration (Step 9) should be completed no longer than 8 hours after fixing and the sample should be refrigerated until testing. If sample is kept in the refrigerator, allow it to come to room temperature before proceeding with titration.

Step 7. Rinse the Titration Tube (0299) with distilled water, then pour the fixed DO sample into the tube filling it so that the bottom of the meniscus is level with the white (20ml) line.

Step 8. Fill the syringe-like Titrator (0377) to the "0" mark with Sodium Thiosulfate Solution (4169) making sure no air bubbles are in the Titrator. The next step is called titration.

Step 9. Titrate the sample using the following guidelines: Insert the Titrator into the hole in the cap of the Titrator Tube. Add 2 drops of Sodium Thiosulfate Solution to the Titration Tube and gently swirl to mix. Keep adding Sodium Thiosulfate Solution 2 drops at a time and swirling until the yellow-brown color of the solution begins to fade (iodine reduction is occurring). Stop when the solution is a pale yellow (straw-colored). Remove the Titrator and store in its protective sleeve in DO kit (do not remove the remaining Sodium Thiosulfate Solution!).

Step 10. Add 8 drops of Starch Solution (4170) to the Titration Tube. Swirl the tube to mix. The solution should turn from light yellow to dark blue (this indicates that the iodine has been neutralized).

Step 11. Continue the titration. Remove the Titrator from the kit, insert into the Titrator Tube (with the scale facing you) and inject 1 drop of Sodium Thiosulfate Solution and swirl vigorously. Continue this process until the solution turns from blue to clear.

Step 12. Using the scale on the side of the Titrator, record the total number of units of Sodium Thiosulfate used in titration (this amount equals the mg O_2/L or ppm O_2 in the water). Note both the whole and 0.2 unit graduations on side of the Titrator. Read results from the widest part of the titrator tip (see specific titrator directions published by Lamotte and note whether a plastic or glass titrator is in your kit – plastic titrators are used in the newer kits).

Step 13. Empty the Titration Tube and rinse it with distilled water. **Return to Step 7 and perform a second titration with the existing fixed sample.**

Step 14. Record the two acceptable readings on the data sheet, then record the average of those tests. This is your DO reading for the period.

Note: At least two titrations are required for accurate DO measurements. If the amount of DO in the second titration varies from the DO from the first titration by greater than 0.6 mg/L, you must do a third and fourth titration (full duplicate). Record the average of the two closest results on the Chemical Monitoring Data Sheet.

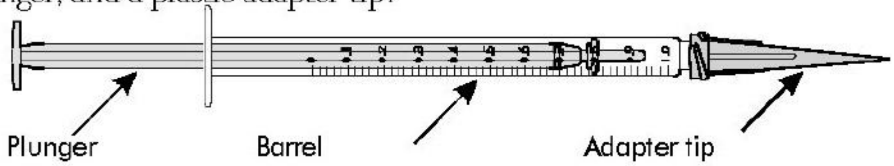
Step 15. Discard waste reagents by diluting and dumping 50 yards from the stream in a vegetated area. Rinse equipment with distilled water and replace in the kit. A visual set of General instructions has been below provided for your convenience.

LaMotte

Product Upgrade Notice

Direct Reading Titrator
General Instructions **Code 1649**

The new Direct Reading Titrator consists of a plastic barrel, a plastic plunger, and a plastic adapter tip.



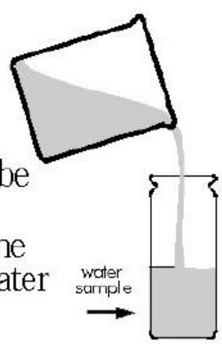
The adapter tip reducesthe size of the drops that are dispensed and increases the precision of the test results. DO NOT REMOVE THE ADAPTER TIP.

Instructions

These are general instructions for the use ofthe Direct Reading Titrator. The titrator in the illustrations is an example. Refer to individual test kit instructions for test procedures and the actual range and increment values.

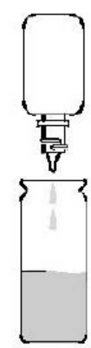
1.

Fill the titration tube to the specified line with the water sample.



2.

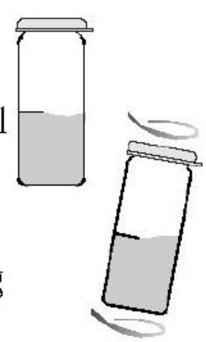
Add the reagentsas specifiedinthe instruction for the individual test method.



3.

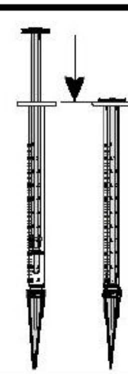
Cap the tube with the special titrationtube cap.

Mix by swirling gently.



4.

Depress the plunger of the Titrator.

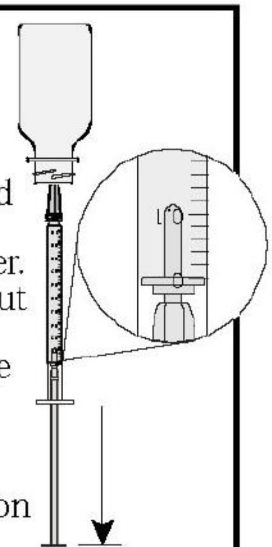


5.

Insert the adapter tip into the special plastic plug in the titrating solution bottle.

6.

Invert the bottle. Hold the bottleand the Titrator firmly together. Slowly pull out the plunger until the large ring onthe plunger is opposite the zero (0) line on the scale.

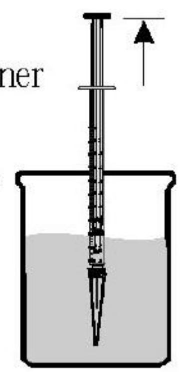


7.

If an air bubble appears in the Titrator barrel or theadapter tip, partially fill the barrel and pump the titration solution back into the inverted reagent bottle to expel the bubble.

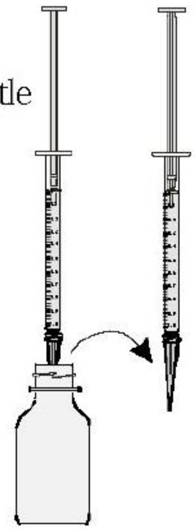
NOTE:

When filling the Titrator from a container without a special plug, submerge the adapter tip below the surface of the solution and pull out the plunger.



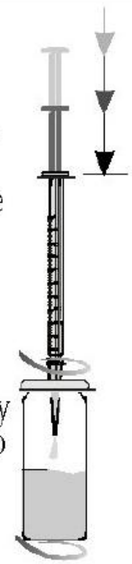
8.

Turn the bottle right side up and remove the Titrator.



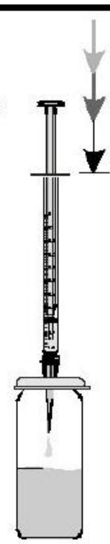
9.

Insert the adapter tip into the opening in the titrator tube cap. Slowly depress the plunger to dispense the titrating solution. Gently swirl the tube to mix the solution.



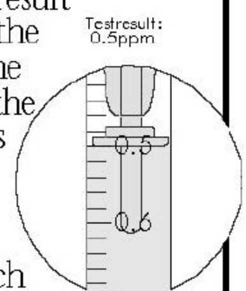
10.

Continue adding the titrating solution until the specified color change occurs. If the color change does not occur when the large ring on the plunger reaches the bottom of the scale, refill the Titrator to the zero line. Continue the titration until the color change occurs.



11.

Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. If the Titrator was refilled to reach the final color change, add the total amounts of titrant used to determine the final test result.



12.

If no additional tests are to be made, discard the remaining titrating solution in the Titrator. Do not return the titrating solution to the reagent bottle. Thoroughly rinse the titration tube and the Titrator. Do not remove the plunger or the adapter tip from the Titrator.

pH Testing (Lamotte Kit 2117)

This test is performed using a wide-range (3.0-10.0) pH field test kit which utilizes an Octet Comparator, much like those used for swimming pools or aquariums. The comparator contains eight permanent color standards, ranging from 3.0-10.0 pH units. A test sample is inserted into one of the openings in the top of the comparator and then compared to four color standards at once. If the test sample color matches one of the standard colors, the value of the standard is read directly on the face of the comparator. For optimum color comparison, the comparator should be positioned between the operator and a light source, so that light enters through the special light-diffusing screen in the back of the comparator. Avoid irregular or colored light sources.

pH usually varies between

WIDE RANGE TEST

Step 1. Rinse the small test tube (0230) with sample water, then refill the tube to the 5ml line with sample.

Step 2. Add ten (10) drops of wide-range indicator solution (2218) to the sample in the tube. Be sure to hold the dropper-bottle of indicator solution vertically (not tilted) and at eye-level to dispense uniformly-sized drops.

Step 3. Cap the tube and invert 10 times to mix the contents.

Step 4. Remove cap and insert tube into comparator (2192). To obtain the pH, match the color of the test sample against the color standards and record the result on your datasheet.

Step 5. After discarding the test sample, rinse the test tube with distilled water and replace all materials in the test kit.

Notes: pH readings can only be read in whole and half (0.5) units. Thus, pH readings of 6.0 or 5.5 would be acceptable, while a reading of 7.25 would not.

Nitrate-Nitrogen Test

(Lamotte Kit 3354 Zinc Reduction)

The Lamotte Kit 3354 is not as precise as the cadmium reduction method (Lamotte 3119) but this test does not use the heavy metal (cadmium). This test also allows for higher nitrogen measurements to be obtained without having to perform a dilution. The Lamotte 3354 Kit has varying degrees of error depending on the measurement. The higher the reading, the greater degree of error. Generally, the error can be as great as halfway between each color standard. For example, a reading of 2 has an accepted error of -.5/+1, a reading of 4 has an accepted error of +/-1, and a reading of 10 has an accepted error of +2.5/-1. You can estimate values between color standards if the sample does not match a color standard exactly.
Be sure to run blank using distilled water first. This is part of the internal QA/QC for this test. Record your blank value on the datasheet. The value should be 0.

Step 1. Fill one of the test tubes (0124 or 0106) to the 5 mL line (middle line) with sample water.

Step 2. Add to the sample one **Nitrate #1** tablet (Item #2799).

Step 3. Cap the test tube with a small cap (provided) and mix vigorously until the tablet dissolves in the sample. (Tiny particles of the tablet may remain suspended in the sample and will not affect the accuracy of the test.)

Step 4. Uncap the test tube and add one **Nitrate #2** CTA tablet (item #NN-3703) to the sample.

Step 5. Recap the test tube and mix vigorously until the tablet is fully dissolved. (Tiny particles of the tablet may remain suspended in the sample and will not affect the accuracy of the test.) Once the tablet is dissolved, let the sample stand for five minutes. **Do not wait longer than 5 minutes to read the sample.

Step 6. While waiting 5 minutes for the sample to react, insert the Octa-Slide Bar (3494) into the Octa-Slide Viewer (1100).

Step 7. At the five-minute mark, insert the test tube into the opening in the top of the viewer (1100). Match the sample color with the color on the slide bar (nitrate standard). If outside when reading the result, be sure to read the value with your back to the sun or in indirect light. If inside, read result near a window. Record the value as ppm Nitrate Nitrogen.

Step 8. Rinse all test tubes with distilled water and keep the kit dry and clean and at room temperature for storage.

Temperature Measurement

Each River Watcher Monitoring kit is equipped with an armored alcohol-filled thermometer factory calibrated against thermometer standards traceable to N.I.S.T. (The National Institute of Standards and Technology); Model 545; range -5.0°C to +45.0°C in 0.5°C increments -- LaMotte Chemical Products; Cat. No. 1066. Each thermometer is identified with a unique number.

Temperature Measurement Method:

NOTE: Volunteers must sample away from the stream bank in the main current. The outside curve of the stream is often a good place to sample since the main current tends to hug this bank. In shallow stretches, wade into the center current carefully to measure temperature.

Step 1: Record the air temperature before you take the stream temperature. Air Temperature should be taken by hanging the thermometer from a tree branch out of direct sunlight if possible. The thermometer should be left in place for about two minutes. Record the temperature in degrees C on the field summary sheet in the appropriate location.

Step 2: River Watcher volunteers must measure temperature in a location in the middle of the stream where the water is moving, not in pools or backwater areas.

Step 3: Lower the thermometer about four inches below the surface, as close as possible to the middle of the stream.

Step 4: Leave the thermometer immersed until the reading has stabilized. This usually takes about two minutes. Try to take the reading with the base of the thermometer still immersed. If it is not possible, quickly remove the thermometer and read the temperature immediately.

Step 5: Record your measurement in degrees C on the field data sheet.

Continuous Metering

In order to answer questions about parameters that have diurnal cycles, it may be necessary to monitor using monitoring devices specifically designed to collect data over many days. It is important to remember to keep in mind that any electronic equipment can drift and be inaccurate; it is best to have a secondary method of checking the accuracy and precision of meters and sondes.

In addition, it is important to insure that if multiple sondes or sensors are in place, they begin data collection at the same time—this will insure that simultaneous data is available.

When deploying any equipment that must remain in place for multiple days, the monitor must keep in mind that the equipment must be in a secure location, so a waterproof lock and cable is included with the device. Attach sondes to trees, bridges or other devices that cannot be moved easily. Occasionally equipment will be pulled out of the water or removed entirely from a site by the curious person who happens to come upon it; in other cases flooding from storms can overcome any method of anchoring sondes or probes. It is advisable to identify the equipment with a waterproof label in case it is pulled from the water or is located downstream of the site after it comes free of its anchor.

IMPORTANT: To prevent loss or breakage, devices should be removed from sites prior to severe weather events such as hurricanes.

YSI 650 MDS meter, YSI 600 sonde SOP

1. **Remove the sonde from the storage case in preparation for deployment or calibration**

a. The sonde is stored with the cap on the terminal end that will connect to the meter, and the probe end is stored in a plastic storage cup. Unscrew the top of the storage cup and remove the red O ring inside the cap carefully from the probe before removing the cap; avoid allowing the O ring to slide into the threads on the sonde as it can be difficult to remove once it is seated in the threads. Take the probe out of the storage cup, and take the black cap off the end of the probe. Make sure the sponges that keep the probe moist during storage stay with the cup and cap in the storage bag. Follow instructions to connect the meter to the sonde.

2. Connect the Meter to the Sonde

a. Use the cable to connect the meter to the sonde. Spin the end of the cable (male)around the terminal on the end of the sonde (female)until it sets in.
b. Then screw the end of the cable onto the sonde until there are only two threads left visible on the sonde. If it meets unusual resistance, unscrew the cable and remove any dirt or grit that may be in the threads with a clean, dry Kim Wipe. The connection is not water proof until only two threads are visible.
c. Connect the "quick connect"—a C shaped connector that becomes an O when closed-- to the wire hanger on the sonde to keep the weight of the sonde off the cable terminals.
d. Spin the other end of the cable around on the terminal on the meter until it sets, and then twist the cable into the locked position. It should click when it is seated correctly.
e. Follow instructions to **calibrate** or **set up the meter for deployment**.

3. Calibrate the Meter

The meter must be calibrated once a month during operation. It is a good idea to replace the batteries when you calibrate before deployment.

a. To calibrate conductivity you must first remove the D.O. probe. Insert the short end of the key (found in the box in the meter case) into the key hole just above the probe and unscrew the probe from the sonde. Hand tighten the gray cap into the end of the sonde where the probe was located. Once the cap is hand tight use the longer end of the key to tighten the cap ¼ turn. Rinse out the probe storage cup and fill it half way with 10,000 µS/cm conductivity standard. Insert the sonde into the storage cup making sure the two holes that go through the sonde towards the bottom are submerged.

b. Turn the meter on by pushing the green power button. Scroll down to "Sonde Menu" and press the enter key. Scroll down to "Calibrate" and press the enter key. Make sure that "Conductivity" is highlighted and press the enter key. Scroll to "Cond" and press the enter key. Enter the value of the conductivity standard you are using and press the enter key. Make sure that "Calibrate" is highlighted and press the enter key. The meter will go through the calibration process and let you know if the meter passed or failed. Press "Esc" to get back to the calibration screen.

c. **To calibrate D.O. you will have to reinstall the probe**. Again, use the long end of the key to loosen the cap from the end of the sonde. Place a small drop of Krytox lubricant on your finger tip and run it around the o-ring on the end of the D.O. probe. Line up the terminals in the probe with the terminals in the sonde. Screw the probe back into the sonde by hand. Once hand tightened, use the short end of the key to tighten the probe another ¼ turn.

d. Fill a bucket at least twelve inches deep with room temperature water. Run an aquarium air stone in the bucket for an hour. Screw the probe protector onto the end of the sonde and then place the probe in the bucket, making sure the conductivity sensor is submerged. From the calibration screen highlight "Optic-T Dissolved Oxy" and press the enter key. Make sure that "ODOsat %" is highlighted and press the enter key. Make sure that "1 point" is highlighted and press the enter key. Enter the barometric pressure in mm/Hg and press the enter key. Make sure "Calibrate" is highlighted and press the enter key. The meter will go through the calibration process and let you know if the meter passed or failed. Press "Esc" to get back to the main menu.

4. Set up the Meter for Deployment

a. If the sonde is not connected to the meter, go to part 2 for instructions on how to connect. Make sure the meter is on—if not press the green "on" button; the meter should display that it is connecting and display the main menu.
b. From the main menu, scroll down to "Sonde Menu" and press the enter key. Make sure that "Run" is highlighted and press the enter key. Choose either "Discrete sample" (to run the meter while you remain on site) or "Unattended sample" (to deploy the meter for an extended period of time).
c. Enter the amount of time you want between each reading in the "Interval" line, and enter the date and time that you would like the

sonde to start recording data. Enter the number of days you would like the meter to collect data for. Enter a file name and a site name.

d. Check that the battery life is long enough to last through the time you intend to leave the meter in the field, and that it has enough memory to hold the data. If not, change the interval to a longer one, or replace the batteries (see how to replace batteries).
e. Highlight "View params to log" and press the enter key to make sure that all the parameters you are looking for will be recorded. Scroll to "Start logging" and press the enter key. When it asks if you are sure, select "Yes" and press the enter key. This last step is often overlooked, remember, the meter will not start logging until you tell it to.
f. Turn off the meter and unscrew the cable from the sonde. Twist the cap on the end of the sonde until it sets into place, then screw the cap on until only two threads are left visible on the sonde.

5. Deploy the Sonde

a. Unscrew the top from the storage cup and remove the O ring inside the cap carefully from the probe before removing the cap. Take the probe out of the storage cup, and take the black cap off the end of the probe. Screw the probe protective sheath onto the end of the sonde. Thread the cable through the wire hanger on the probe and then thread one end of the cable through the loop in the other end of the cable. Pull the remainder of the cable through the loop so that there is a tight loop around the hanger. Place the sonde inside the PVC pipe and run the bolt through the metal hanger on the sonde. Tighten two nuts onto the bolt so that they back up against each other and the sonde is held securely in the pipe. Place the meter in the stream and lock the other end of the cable to a tree or other secure place with a weather proof lock. If you have trouble turning the key in the lock, put some graphite on the key and work it into the lock. Do your best to hide the remainder of the cable and the sonde from eye-sight.

6. To retrieve the sonde and stop collecting data

a. Pull the sonde out of the water and dry the top end off. Holding the sonde horizontally unscrew the cap from the top of the sonde. Use a Kim-wipe to dry any water in the terminal area and connect the cable to the sonde and the meter.

b. Turn the meter on. From the main menu, scroll down to "Sonde Menu" and press the enter key. Make sure that "Run" is highlighted and press the enter key. Choose "Unattended Sample" and press the enter key. Scroll to "Stop logging" and press the enter key. When it asks if you are sure, select "Yes" and press the enter key. Turn the meter off.

7. Meter Storage

The meter, cable, and sonde should be stored in the soft YSI case. The cap should be screwed onto the end of the sonde to protect the terminals and the end of the D.O. probe should be covered with the black cap with a damp sponge in it. The D.O. probe also has to be stored in the larger white storage cup. Slide the cap onto the end of the sonde, and then slide the red o-ring up past the threads above the D.O. probe, taking care to avoid allowing the o-ring to slide totally into the threads. Make sure the sponge in the bottom of the cup is damp and screw the cup onto the cap.

8. Changing the Batteries (AA)

The batteries should be changed in the lab or vehicle while the sonde is warm as it is difficult to open the battery compartment when the sonde is cold or has been in the water. Unscrew the top half of the sonde to reveal the battery case. Replace all four batteries and re-screw the two sonde sections back together until it is tight.

References

Stream Barrier Removal Monitoring Guide. Gulf of Maine Council on the Marine Environment. Published December 2007.
http://www.gulfofmaine.org/streambarrierremoval/

Volunteer Stream Monitoring: A Methods Manual. U.S, Environmental Protection Agency. Update November 2006.
http://www.epa.gov/owow/monitoring/volunteer/stream/

Delaware Riverkeeper Network Water Testing Protocols. Updated 2003 by Faith Zerbe, DRN Monitoring Coordinator

Save Our Streams Program of the Izaak Walton League of America.
http://www.iwla.org/index.php?id=19

From the Watershed Watch Network, NJDEP Volunteer Water Quality Monfitoring Program, the following documents are used in part or in their entirety. All documents can be found at http://www.state.nj.us/dep/wms/bwqsa/vm/visual.html
Visual Assessment Protocol.
Instructions for Completing Visual Assessment Data Sheets
A list of Parameters accepted by E2
Visual Monitoring Field Guide

University of Rhode Island Watershed Watch Manual
http://www.uri.edu/ce/wq/ww/Publications/StreamSpecific.pdf

SAMPLE FIELD SHEETS

Musconetcong River Watcher Data Summary Sheet

Test Site:_________ Date__________ Time___________

Volunteer(s) ____

Physical Test Results

Air Temperature________ ◦C Thermometer#______

Wate Temperature ________ ◦C

Width____________ft Average Depth______ ft

Average Float Time_________sec

Average Velocity (in 10foot stretch)___________ft/sec

Flow________ft^3/sec

Chemical Test Results

Dissolved Oxygen Sample #1________ ppm Kit #__________
Sample #2 ________ ppm

Nitrate ________ ppm Kit #_________________

pH __________pH units Kit #_________________

Biological Results (spring and summer only)

E2 Submission Information
Saved report ID______________
Submission ID______________
Resubmission History_________
____

SOS score:____________ # organis

Visual Assessment
Musconetcong Watershed Association
River Watcher Monitoring Program 2010-2011

General Sheet

Site Name ________________________________

Survey Team Names:

____

Time: _________________ **Date:** ____________________

Today's Weather: ☐Clear ☐Partly Cloudy ☐Overcast ☐Light Rain
(check all that apply) ☐Steady Rain ☐Heavy Rain ☐Snow ☐Heavy Snow Melt

Rainfall: Answer or check one:
Days since last rain: __________
☐ More than one week since last rain
☐ More than one month since last rain

Air Temperature: ____________________ ° C

Water Temperature:__________________ ° C

Water Conditions

Odor:		1. Normal 2. Sewage 3. Petroleum 4. Chemical 5. Anaerobic 6. Other
Color:		1. Clear or without color 2. Tea--colored 3. Milky 4. Muddy 5. Other
Surface Coating		1. None 2. Oily 3. Foam 4. Scum 5. Other

Water Condition comments (Are there any other water conditions that may influence monitoring accuracy?:

___

RiverWatcher Site Sketch:

Please include stream flow, roads, sampling locations, riffles, pools, runs, ditches, riprap, outfalls, and photo reference #s

Date: **Illustrator:**
Site:

River Watcher Visual/Habitat Monitoring Sheet

Right and left stream bank are determined facing upstream
Fields marked with ♦ are required for Visual Assessment scoring

♦ Stream width:___________ft ♦ Stream Depth 1)________2)_______3)_____ft Average Depth_____ft

♦ Float speed time in 10 foot section:1)______2)________3)_______sec Average Float

Average Stream velocity_________________ft/sec
(Calculate velocity by dividing distance float traveled by the float time)

Average Flow_________________________ft^3/sec
(Flow= Width x Depth x Average Stream Velocity

Circle the selection that best describes your monitoring site
If the score box already contains the score circle corrections only

Parameter	Score	Score Description
♦ Stream Depth / Velocity Combinations		Possible Stream Depth/Velocity Combinations: Slow, deep Fast, deep Fast, shallow Slow, shallow For scoring 1.Only one present 2 .two combinations present 3. three combinations present 4. All types present
♦ Channel Flow Status		4. Stream is filled to the base of both lower banks 3. Water fills greater than 75% 2. Water fills 25-75% 1. Very little water
♦ Channel Alteration		4. Stream shows normal pattern 3. Some channelization present, usually in areas of bridges, etc… 2. Channelization extensive, 40 – 80% of the stream reach 1. Over 80% of the stream channelized, gabion baskets and/or riprap, and/or Concrete present
♦ Embeddedness of Cobble, Bedrock or Gravel		4. 0 – 25% surrounded by fine sediment 3. 26 – 50% surrounded by fine sediment 2. 51 – 75% surrounded by fine sediment 1. Greater than 75% surrounded by fine sediment
♦ Riffles or bends presence		4. Frequent occurrence 3. Infrequent occurrence 2. Occasional occurrence 1. Flat water
♦ Available Stable Habitat and Cover for Aquatic Insects, etc.		4. Greater than 70% 3. 40-70% 2. 20-40% 1. Less than 20%
♦ How much of Stream Bottom is Effected By Sediment”		How much of the stream bottom that is affected by sediment? 4. Less than 5% 3. 5 – 30% 2. 31 -50% 1. Greater than 50%

♦ Bank Stability	Right Bank Left Bank	4. Stable, evidence of erosion or bank failure absent or minimal; <5% of bank affected 3. Moderately Stable, small areas of erosion, mostly healed over; <5 – 30% of bank in reach has areas of erosion 2. Moderately Unstable; 31 – 60% of bank in reach has areas of erosion, high erosion potential during flooding 1. Unstable, many eroded areas, "raw" areas frequent; 60% or > of bank erosional scars			
♦ Riparian Vegetation Zone Width	Right Bank Left Bank	4.. > 18 meters OR > 60 feet width 3. 12 – 18 m OR 40 – 60 ft width 2. 6 – 12 m OR 20 – 40 ft width 1. < 6 m OR > 20 ft width			
♦ Bank Vegetative Protection	Right Bank Left Bank	4. Greater than 90% 3. 70 – 90% 2. 50 -70% 1. Less than 50%			
% of Tree Canopy Above Stream		Estimate percentage OR record score 1. 0-25% 2. 26%-50% 3 .51%-75 4. 76%-100%			
Stream Substrate Stability		1. Loose 2. Stable			
Woody Debris		1. None 2. In spots 3. Heavy throughout reach			
Woody Debris		1. Free floating 2. Attached 3. Both			
Predominant Aquatic Vegetation present		1. Rooted emergents 2. Rooted submergents 3. Rooted floating 4. Free floating			
Algae Growth		1. Absent 2. Sparsely Populated 3. Densely Populated			
Algae Location		1. None 2. On streambed 3. On surface 4. Both			
Algae Color		1. Light green 2. Dark green 3. Brown 4. Other			
Litter Concentration		1. Flood Plain Accumulation 2. Water Borne 3. From Land Use			
Structures present in reach	Bridges	Culverts	Dams	Other	

Comment/Observations

____

____

____

Streamside Land Use Assessment

Land Use	Within 50 ft. of top of bank		Comments
	Left Bank	Right Bank	
Residential single-family housing			
Residential multifamily housing			
Residential Lawns			
Residential Pets			
Commercial / Institutional			
Commercial / Institutional Lawns			
Roads Paved			
Roads Unpaved			
Construction Underway For:			
Housing Development			
Commercial			
Road / Bridge Construction Repair			
Agricultural Grazing Land			
Agricultural Cropland			
Inactive Agricultural Land / Fields			
Recreational Power Boating			

Recreational Golfing			
Recreational Camping			
Recreational Swimming / Fishing / Canoeing			
Recreational Hiking / Paths			
Recreational Horse Trails			
Recreational Athletic Fields			
Recreational Other			
Waterfowl (with approximate #)			
Pet Waste			
Preserved Open Space			
Woodland			
Wetlands			
Cemetery			
Recycling/Waste Facility			
Industrial			
Other			

Observations: (indicate new land use on site sketch)

____

____

____

____

____

Biological Assessment
Musconetcong Watershed Association
River Watcher Monitoring Program 2010-2011

Site Name__________________________ Date__________________________

Bioassessment Team____

Macroinvertebrate Sample Count Sheet

Organism	Tally	Count	Organism	Tally	Count
Alderfly			Lunged Snail		
Beetle larva			Mayfly		
Blackfly			Midgefly		
Caddisfly			Mussel		
Clams			Netspinner Caddisfly		
Cranefly			Riffle Beetle		
Crayfish			Scuds		
Damselfly			Sowbugs		
Dobson/fishfly			Stonefly		
Dragonfly			Waterpenny		
Gilled Snail			Watersnipe fly		
Leeches			Worms		

Total number of organisms____________________

Stream Rating Sheet

Site Name______________________ Date:_________________________

Intolerant	**Sensitive**	**Tolerant**
☐ **Mayfly**	☐ **Netspinning Caddisfly**	☐ **Black Fly**
☐ **Stonefly**	☐ **Alderfly**	☐ **Midge Fly**
☐ **Caddisfly**	☐ **Damselfly**	☐ **Lunged Snail**
☐ **Dobsonfly/fishfly**	☐ **Dragonfly**	☐ **Aquatic Worm**
☐ **Watersnipe Fly**	☐ **Cranefly**	☐ **Leeches**
☐ **Riffle Beetle**	☐ **Sowbugs**	
☐ **Waterpenny**	☐ **Scuds**	
☐ **Gilled Snail**	☐ **Crayfish**	
	☐ **Clam**	
	☐ **Mussel**	
__#checks x3=_________	**___#checks x 2 =______**	**___#checks x 1=_____**

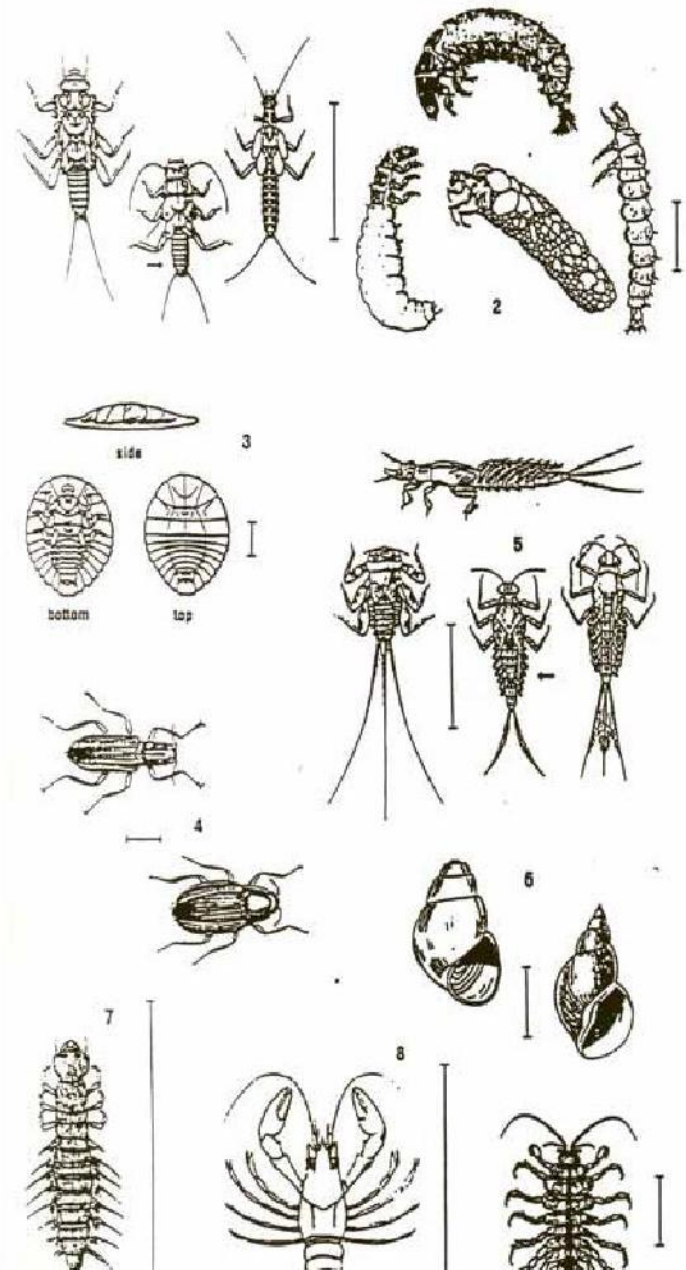
Add the three calculated numbers together to find the **Volunteer Biological Assessment score** ___________________

Rate your stream reach using the values below

Water Quality Rating (circle)

Excellent (>22) Good (17-21) Poor (< 11)

Observations____



Bar lines indicate relative size

Stream Insects & Crustaceans

GROUP ONE TAXA

Pollution sensitive organisms found in good quality water.

1 *Stonefly: Order Plecoptera.* 1/2" - 1 1/2", 6 legs with hooked tips, antennae, 2 hair-like tails. Smooth (no gills) on lower half of body. (See arrow.)

2 *Caddisfly: Order Trichoptera.* Up to 1", 6 hooked legs on upper third of body, 2 hooks at back end. May be in a stick, rock or leaf case with its head sticking out. May have fluffy gill tufts on lower half.

3 *Water Penny: Order Coleoptera.* 1/4", flat saucer-shaped body with a raised bump on one side and 6 tiny legs on the other side. Immature beetle.

4 *Riffle Beetle: Order Coleoptera.* 1/4", oval body covered with tiny hairs, 6 legs, antennae. Walks slowly underwater. Does not swim on surface.

5 *Mayfly: Order Ephemeroptera.* 1/4" - 1", brown, moving, plate-like or feathery gills on sides of lower body (see arrow), 6 large hooked legs, antennae, 2 or 3 long, hair-like tails. Tails may be webbed together.

6 *Gilled Snail: Class Gastropoda.* Shell opening covered by thin plate called operculum. Shell usually opens on right.

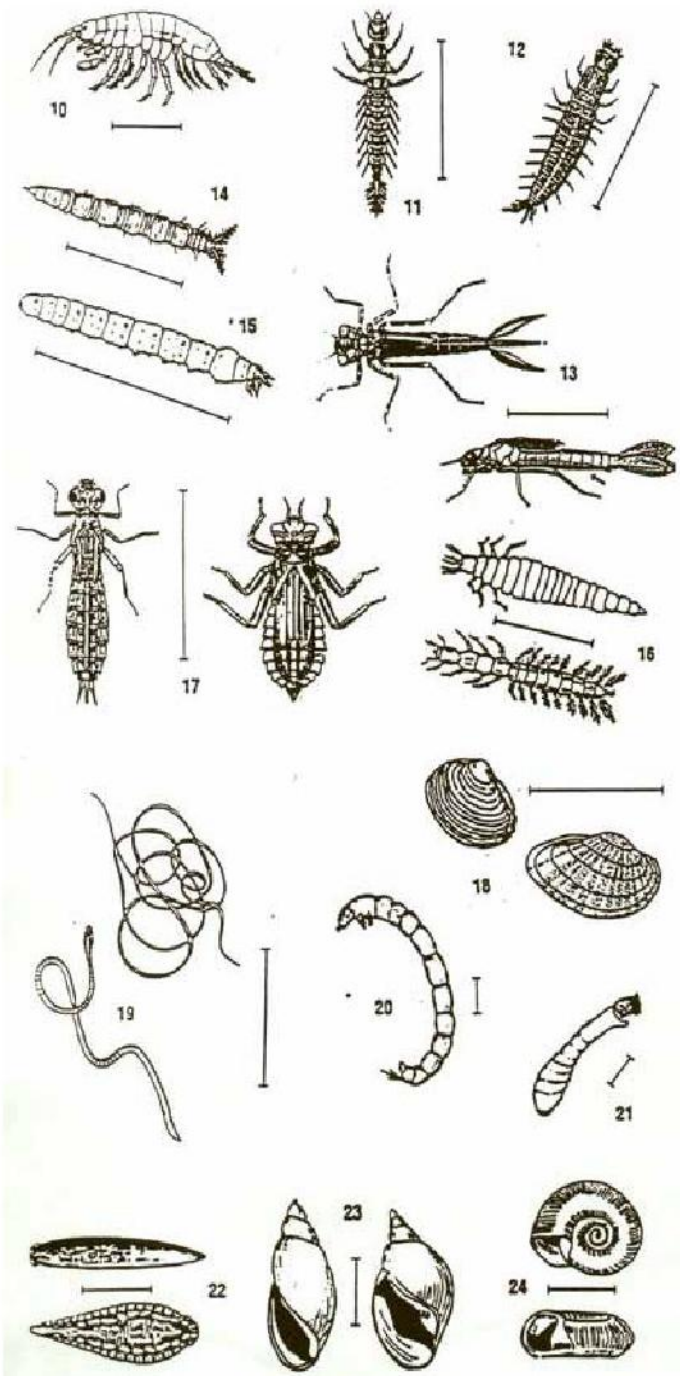
7 *Dobsonfly (Hellgrammite): Family Corydalidae.* 3/4" - 4", dark-colored, 6 legs, large pinching jaws, eight pairs feelers on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 tails and 2 pairs of hooks at back end.

GROUP TWO TAXA

Somewhat pollution tolerant organisms can be in good or fair quality water.

8 *Crayfish: Order Decapoda.* Up to 6", 2 large claws, 8 legs, resembles small lobster.

9 *Sowbug: Order Isopoda.* 1/4" - 3/4", gray oblong body wider than it is high, more than 6 legs, long antennae.



Bar lines indicate relative size

GROUP TWO TAXA continued

10 *Scud: Order Amphipoda.* 1/4", white to grey, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp.

11 *Alderfly larva: Family Sialidae.* 1" long. Looks like small hellgrammite but has 1 long, thin, branched tail at back end (no hooks). No gill tufts underneath.

12 *Fishfly larva: Family Corydalidae.* Up to 1 1/2" long. Looks like small hellgrammite but often a lighter reddish-tan color, or with yellowish streaks. No gill tufts underneath.

13 *Damselfly: Suborder Zygoptera.* 1/2" - 1", large eyes, 6 thin hooked legs, 3 broad oar-shaped tails, positioned like a tripod. Smooth (no gills) on sides of lower half of body. (See arrow.)

14 *Watersnipe Fly Larva: Family Athericidae (Atherix).* 1/4" - 1", pale to green, tapered body, many caterpillar-like legs, conical head, feathery "horns" at back end.

15 *Crane Fly: Suborder Nematocera.* 1/3" -2", milky, green, or light brown, plump caterpillar-like segmented body, 4 finger-like lobes at back end.

16 *Beetle Larva: Order Coleoptera.* 1/4" 1", light-colored, 6 legs on upper half of body, feelers, antennae.

17 *Dragon Fly: Suborder Anisoptera.* 1/2" - 2", large eyes, 6 hooked legs. Wide oval to round abdomen.

18 *Clam: Class Bivalvia.*

GROUP THREE TAXA

Pollution tolerant organisms can be in any quality of water.

19 *Aquatic Worm: Class Oligochaeta.* 1/4" - 2", can be very tiny; thin worm-like body.

20 *Midge Fly Larva: Suborder Nematocera.* Up to 1/4", dark head, worm-like segmented body, 2 tiny legs on each side.

21 *Blackfly Larva: Family Simulidae.* Up to 1/4", one end of body wider. Black head, suction pad on end.

22 *Leech: Order Hirudinea.* 1/4" - 2", brown, slimy body, ends with suction pads.

23 *Pouch Snail and Pond Snails: Class Gastropoda.* No operculum. Breathe air. Shell usually opens on left.

24 *Other snails: Class Gastropoda.* No operculum. Breathe air. Snail shell coils in one plane.

Musconetcong Watershed Association River Watcher Kit

Each River Watcher kit contains:

D-frame Wildco net
One yard stick/walking stick

One 24” x 15” Rubbermaid container that contains:

1 3 gallon bin
2 River Watcher Manual
3 1 LaMotte Dissolved Oxygen kit (5860)
4 1 LaMotte Wide pH kit (2117)
5 1 LaMotte Nitrate-Nitrogen kit (3354)
6 LaMotte thermometer, individually numbered and calibrated annually
7 1 Rubbermaid 1 pint container
8 2 1 liter Nalgene sample bottles
9 1 5X magnifier
10 1 pack of 12 pens
11 1 stop watch
12 1 pair of safety goggles
13 1 roll of paper towels
14 1 empty water bottle for velocity measurement
15 1 100’ fiberglass tape measure
16 6 large ziplock bags
17 2 fine tweezers
18 3 plastic spoons
19 empty shopping bags for removal of trash at test site
20 2 clip boards
21 1 Waterproof notebook
22 1 liter bottles filled with 95% ethanol for macro samples

The following items are in a waterproof plastic folder:

23 Visual Assessment report sheets
24 Chemical/Physical test report sheets
25 Macroinvertebrate report sheets

26 Chemical test kit lot number and expiration date information.

LaMotte Kit Content Descriptions

LaMotte Wide Range pH Kit
Code 2117 Model P-3100

Contents
LaMotte Octet Comparator (2192)
Wide Range Indicator WR Ind (2218-G)
2 sample test tubes
Test procedure

LaMotte Nitrate Nitrogen Kit
Code 3354

Contents
LaMotte Octa-slide (Code 1100)
Nitrate #1 Tablets (2799A)
Nitrate #2 Tablets CTA Tablets (NN-3703-A)
2 sample test tubes
Test procedure

LaMotte Dissolved Oxygen Kit
Code 5860

Manganous Sulfate Solution	4167-G
Alkaline Potassium Iodide Azide	7166-G
Sulfuric Acid 1:1	6141WT-G
Sodium Thiosulfate. 0.25N	4169-H
Starch Indicator Solution	4170-WT-G
Direct Reading Titrator	0377
Test tubes 25 mL	0608

2 Water Sampling Bottle, 60 mL, glass 0688-DO
Test procedure

Test Kit Lot Number And Expiration Date Information

LaMotte pH Kit_____Kit Number_______________

Wide Range Indicator WR Ind (2218-G)
Lot Number: ______________________
Expiration Date: ___________________ Note change:__________________________

LaMotte Nitrate Nitrogen Kit_____Kit Number_______________

Nitrate #1 Tablets (2799A)
Lot Number: ______________________
Expiration Date: ___________________ Note change:_________________

Nitrate #2 Tablets CTA Tablets (NN-3703-A)
Lot Number: ______________________
Expiration Date: ___________________ Note change:___________________

LaMotte Dissolved Oxygen Kit Kit Number_______________

Manganous Sulfate Solution 4167-G
Lot Number: ______________________
Expiration Date: ___________________ Note change:_______________________

Alkaline Potassium Iodide Azide 7166-G
Lot Number: ______________________
Expiration Date: ___________________ Note Change:_______________________

Sulfuric Acid 1:1 6141WT-G
Lot Number: ______________________
Expiration Date: ___________________ Note Change:_______________________

Sodium Thiosulfate 0.25N 4169-H
Lot Number: ______________________
Expiration Date: ___________________ Note Change:_______________________

Starch Indicator Solution 4170-WT-G
Lot Number: ______________________
Expiration Date: ___________________ Note Change:_______________________