Community-based Water Monitoring promotes a sense of stewardship and provides the community with the opportunity to become actively involved in the health of their local watershed.

A guide to completing the NJ DEP Tier 3.1 Biological Monitoring Assessment

Visit us on the web for more info @
https://www.state.nj.us/dep/wms/bears/comm_water_monitoring.htm
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1.0 Introduction

The NJDEP and other stakeholders across New Jersey have been utilizing the help of AmeriCorps Watershed Ambassadors and community water monitoring groups to collect valuable data on surface water quality and watershed health for over 20 years. "Community water monitoring" is defined by the Department as the collection of scientific water quality data by concerned people working in partnership with professional scientists and government decision-makers. This valuable data helps determine the ecological condition of local waterbodies as well as identify the causes and sources of water quality impairment. Community water monitoring includes both "citizen science" and "volunteer monitoring" activities. Anyone can participate in community water monitoring - all you need is an interest in your watershed and some training. Community water monitoring is of vital importance to the continuation of monitoring efforts throughout the state.

Both NJDEP's AmeriCorps Watershed Ambassador Program and Community Water Monitoring Program are coordinated within the Division of Water Monitoring & Standards' Bureau of Environmental Assessment, Restoration and Standards. Through a grant from NJDEP, the Watershed Watch Network acts as an umbrella and provides resources and training for the community-based water monitoring programs in New Jersey.

Monitoring for the presence of benthic macroinvertebrates can tell us a lot about the health of a stream because each organism varies in its ability to tolerate pollution. Refer to Appendix A for an introduction to macroinvertebrates. Appendix B provides a handy ID reference, or "cheat sheet," although supplemental identification keys and references should be used to ensure accurate identification. A handy glossary of terms is found in Appendix L. Macroinvertebrate index scoring sheets are provided in Appendix C and D as a reference, although spreadsheets are used to calculate the indices automatically to avoid human error in these calculations.

Before going in the field to perform biological and habitat assessments, read this entire document, as well as the Biological and Habitat Assessment Quality Assurance Project Plan (QAPP) and ask Program Staff if you need any clarification. When completing a biological assessment, a habitat assessment must also be completed. However, a habitat assessment may be done without a biological when the stream conditions are non-wadable or if the biological data is not needed.

The Site Reconnaissance Data Sheets provided in Appendix K may be used to help determine appropriate sites to assess.

Data intended for different purposes has different training and quality assurance requirements, which are outlined in the Data Quality Tiers in Appendix E, and detailed in the project’s Quality Assurance Project Plan (QAPP). Data collected without an approved QAPP are for educational purposes only. In order for your data to be used for other purposes (such as the Integrated Report), you must pass the field audits and macroinvertebrate identification test described in the QAPP and summarized in Appendix F and I.
2.0 Before Heading into the Field

2.1 Safety & Reminders

NJDEP is not liable for any event that occurs during monitoring.

1. Determine if it’s the right time of year for monitoring especially if you plan to enter the stream
   - Best times are spring, summer and fall
   - Worst times are drought, extreme summer days and during flooding
   - For safety reasons we do not recommend sampling during cold winter months

2. Safety considerations: Safety First!
   - Thunderstorms: Check weather forecasts before and during sampling and postpone sampling if necessary.
   - High flow or turbid water conditions: Postpone sampling if water is unsafe due to high flow or turbidity. A “non-wadable” assessment (see Section 2.3) may be done, but in most cases a return visit is required to complete the full biological and habitat assessment.
   - Slip/fall hazards: On land and in streams, be aware of branches, logs, rocks, and slippery surfaces. Wearing waders provides traction and a barrier from potential contaminants, poison ivy and other hazards.
   - Insects: Reduce potential exposure to insect borne diseases by using insect repellent and by checking for ticks and removing them promptly.
   - Sun protection: Avoid overexposure to UV light by using sunscreen and protective clothing, such as a hat and long sleeves.
   - Visibility: Reflective “safety” vests should be worn when working on bridges or near traffic.
   - Cold weather: Biological assessments should not be done when (Air °F) + (Water °F) is less than 100°F.
   - Hot weather: Take necessary breaks and stay hydrated.

3. Confirm the time and location with your sampling partner Always monitor with another person!

4. Perform any equipment maintenance and calibration, as detailed in the QAPP and summarized as follows:
   - Thermometers are calibrated annually by program staff and must be within 0.5°C.
   - Inspect all equipment and repair or replace the damaged equipment. Any small rips or tears in the nets must be mended.
   - All equipment must be cleaned and decontaminated after each use (see Section 9.2).

5. If the site or parking is on private property, obtain property owner permission. Do not trespass.

6. Check to make sure you have all of your equipment before heading into the field.
2.2 Suggested Equipment List

- Data Sheets
- GPS/Smartphone
- Clip Board and Pen/Pencil
- Measuring Tape
- Meter Stick
- Floatable Rubber Ducky
- D-Frame Net
- Sieve bucket
- Bug Identification Tools
  - Bug ID Card, Magnifying Glass
- Collection/Sorting Equipment
  - Bucket, spoons, small containers, ice cube trays
- Proper Attire
  - Waders, boots, long sleeves, high visibility safety vest
- Water Bottle
- Sunscreen, Bug Repellent
- Whistle
- First aid kit

2.3 Wadable versus Non-wadable

Before going into the field, take note of any recent heavy rain events (such as checking the nearest weather site on the NJ State Climatologist website at https://www.njweather.org/data/daily) and stream flow levels (such as the National Weather Service at http://water.weather.gov). Even if there is no stream flow gage on your stream, viewing the flow at nearby streams can give you a general idea of increasing or high flows.

A WADABLE stream is one that you can safely enter and stand. The water level should be no more than thigh high.

A NON-WADABLE stream is a stream in which the current in moving too fast or the depth of the stream is unsafe for you to walk in. You can assess the stream from a bridge, road crossing or streambank.

In high-flow or icy conditions, or if the stream is just not accessible, you can perform a NON-WADABLE assessment. This means that you will estimate the width of the stream and you will not take velocity, depth, or water temperature measurement.

3.0 Overview of Filling out your Monitoring Packet

Each time you go out into the field to begin a biological assessment, make sure to have 5 pages, as illustrated below, including the 3 page Habitat and Macroinvertebrate Data Sheet – Low Gradient or High Gradient version, the Macroinvertebrate Tally Sheet and the Pipe & Drainage Ditch Inventory Sheet. You can do a habitat assessment without doing a biological assessment, but if you are doing a
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Biological assessment, you must also complete a habitat assessment. Copies of blank data sheets are provided in Appendix O.

**Fill out all sections while you are in the field.**

**Write the site ID and date in the space provided on each sheet in case the data sheets get separated.**

**Table 1. Data Sheet Overview**

<table>
<thead>
<tr>
<th>Thumbnail Image</th>
<th>Description of Data Sheet</th>
</tr>
</thead>
</table>
| ![Page 1: Site Information](image1.png) | **Page 1: Site Information**  
The first page is used to record site information, recent and current weather, and a wide range of stream characteristics. This section should be completed after the entire stream-reach has been walked. To properly identify the exact coordinates of each site, we recommend using a smartphone GPS app. |
| ![Page 2: Land Use and Site Sketch](image2.png) | **Page 2: Land Use and Site Sketch**  
The *Land Use* page is meant to provide general information about the surrounding watershed. Make sure to consider any land use within view of your monitoring location that may influence stream habitat. Brief comments and observations may be written in the comments section.  
The first two pages are the same for low or high gradient streams. |
| ![Page 3: Scored Habitat Assessment](image3.png) | **Page 3: Scored Habitat Assessment** (left)  
The third page is the EPA Rapid Bioassessment Habitat Assessment, and is different for low and high gradient streams. This page scores parameters individually from 1 to 10 or 1 to 20 according to the Condition Category descriptions, for the most part, using data recorded on pages 1 and 2. After completing this section, determine the total score and identify a habitat rating of optimal, suboptimal, marginal, or poor. |
| ![Macroinvertebrate Tally Sheet](image4.png) | **Macroinvertebrate Tally Sheet**  
This page is designed to obtain specific biological data regarding the health of your stream. This section is to be completed stream side once you have collected your sample. After performing your biological assessment, record the number of macroinvertebrates onto the tally sheet. Write the site ID and date in the space provided in case the data sheets get separated. |
| ![The Pipe & Drainage Ditch Inventory Sheet](image5.png) | **The Pipe & Drainage Ditch Inventory Sheet**  
The *Pipe & Drainage Ditch Inventory* can be used if a drainage ditch or pipe is encountered while conducting an assessment. The data collected helps determine point and non-point sources of pollution that may be entering the stream. Each pipe should be geospatially located for potential follow-up at that location and identified on site sketch. |
Note: There are two versions of the 3-page data sheets that may be used, HIGH GRADIENT or LOW GRADIENT, depending on which is appropriate for your site. The Macroinvertebrate Tally Sheet and Pipe & Drainage Ditch Sheet are the same statewide.

4.0 Habitat and Macroinvertebrate Data Sheets

4.1 Date, Time and Investigators (Survey Team)

Activity Time & Date: Record the date and time when the assessment was performed.

Investigators (Survey Team): Record the names of the people involved in the assessment, using first initial and full last name. Remember, never conduct an assessment alone!

4.2 Watershed Management Area & County

WMA: This refers to one of the 20 Watershed Management Areas identified by the Department. See the map at left. This information can also be obtained from NJ GeoWeb.

County: The name of the county you are doing the assessment in.

4.3 Site Name and Site ID

Site Name: Use the site names and ID’s provided by the Program Manager. The name selected should be descriptive and include the local name for the water body. For example, if you are going to a site on the Passaic River, your site name might be “Passaic River at intersection of Rt. 3 and Board St.”

Site ID: Site IDs should be consistent for a location for all monitoring activities within a monitoring organization. Site ID’s are case sensitive.

Latitude/Longitude: Take a GPS point at the starting point of your assessment. Confirm that you are at the correct coordinates, and record in comments (page 2) if there is any discrepancy that isn’t due to GPS accuracy. Some programs may require the Latitude and Longitude to be recorded on the data
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sheet. You can also check accuracy of GPS points by identifying the latitude and longitude on a USGS
topographic map, NJ GeoWeb, ArcGIS or Google maps.

4.4 Reach Length

**Estimate of Segment Length**: Estimate the length of the reach (aim for 100 meters or 328 feet).

4.5 Current Weather, Days Since Last Rain, & Temperature

**Current Weather**
Check the one that best describes the weather conditions on the day of the assessment as Clear, Partly Cloudy, Overcast, Light Rain/Showers (no runoff), Steady to Heavy Rain (there is runoff), Snow, Heavy Snow Melt.

**Days Since Last Rain**
Weather can affect assessment interpretation, so it is important to record recent rainfall or drought conditions. Record the number of days since the last rainfall in the space provided. You can also check the volunteer weather monitoring site at http://www.cocorahs.org/ or visit the National Weather Service at http://water.weather.gov.

**Current Temperature**
Enter the air and water temperature in °C. If you need to convert Fahrenheit to Celsius use the Converter at https://www.wpc.ncep.noaa.gov/html/tempconversion.shtml

4.6 Transect Measurements (Width, Depth & Velocity)

![Figure 2. Data Sheets - Section 2 of Page 1](image)

Make sure to record the units you are using. Meter is the unit of choice for the data management system.

Using your flags, mark off a **3.048 m** or 10 foot section of stream that is representative of your stream reach. You should consider the average width of your stream by walking the whole 100 m stretch first, then select an area that is accessible and representative of the stretch. Within this section, you will be measuring width, depth and calculating velocity.
Stream Width
Measure the stream width using your surveyor’s tape measure. Simply have one partner stay at the water’s edge and the other partner walk directly across to the other water’s edge and record the measurement. Take 1 measurement within the 3 m (or 10 foot) section and record the measurement on the data sheet. Measure width from water’s edge to water’s edge (wetted width).

Stream Depth
Take 5 depth measurements along the width transect. Calculate the average of the measurements and record it on your data sheet.

Stream Velocity
With a stopwatch, measure the time it takes your rubber duck to float the 3 m or 10 foot section. Repeat 5 times using the same floating tool, in the same section and record each time on your data sheet. Then average the 5 times to determine the average time. Divide the distance (D) by the average time (T) to determine velocity (V = D/T). If your distance was 10 feet, convert to meters using the conversion factor of 0.3048 m/ft, as illustrated below:

- If using a 10 foot distance: (10 foot/T seconds) * 0.3048 meters/foot = Velocity m/s
- If using a 3 m distance: (3 m/T seconds) = Velocity m/s

Record this on your data sheet.

4.7 Water Conditions: Flow, Odor, Turbidity, & Surface Coating

Stream Flow
Consider the whole 100 meter stretch to determine how the stream appears to be flowing.

Check the box by the option that best identifies the reach.
1. Slow means that when looking at the stream the water does not appear to be moving or is barely moving.
2. Moderate means that when looking at the stream, the water appears to be moving but the surface still appears flat.
3. Swift means that the water is moving fast and the surface of the water is not flat.
4. Combination means that the flow in the reach varies because the reach is made up of pools and riffles and/or constrictions that are causing small pooling of water.

Odor
The odor of the stream will be dependent upon many things such as the time of year. Check the box by the option that best describes the general water odor along the stream.

Turbidity
Turbidity is the measure of total suspended solids in the water causing a decrease in clarity. Keep in mind that the natural color of the stream will be dependent upon what region you are assessing. For example, tea colored water in the pinelands does not mean high turbidity. Check the box by the option that best describes the turbidity of your stretch of stream.

**Surface Coating**
Determine if there is a coating on the surface of the water. Check the box by the option that best describes the surface coating you see in your stretch of stream.

**Examples of Surface Coating**

- **Foam**: Foam can also be naturally occurring. One way to help determine if it is natural foam or petroleum-based foam (usually soap or detergent) is by looking closely at the bubbles within the foam. If the bubbles have a noticeable iridescent look to them, it is likely to be petroleum based.

- **Oil**: An oily sheen can be naturally occurring or petroleum-based. To determine the type of sheen, move the surface water around with a stick or throw a rock into it. If the oily coating is natural, it will break up and look like puzzle pieces and will not float back together. If the oily coating is petroleum-based, it will break up but then quickly move back together.

- **Pollen Coating**: A coating of pollen on the surface of the water.

**4.8 Vegetation, In-stream Structures, and Litter**

Aquatic vegetation is important for instream habitat. It provides food and habitat for aquatic life. However, excessive aquatic vegetation affects the health of a stream as plant respiration and decomposition uses dissolved oxygen in the water. If there are too many aquatic plants in the stream it may suffocate fish and other oxygen dependent organisms.
Figure 6. Aquatic Vegetation Types

Check the boxes next to all the predominant aquatic vegetation observed.
1. Rooted Submergent - vegetation is completely underwater
2. Rooted Emergent - vegetation is rooted in substrate and is partially exposed above the water surface
3. Rooted Floating - vegetation is rooted into the substrate and is floating on top of the water surface (an example is a lily pad)
4. Free Floating - vegetation is not rooted or attached to anything
5. None

Algae Growth
Estimate the percentage of the reach substrate covered with either or both filamentous algae and periphyton.

Algae Type
Algae can provide shelter and food resources for fish and macroinvertebrates; however, large populations of algae can limit the amount of oxygen available to organisms.

This refers to the predominant type of algae in the stream.

Filamentous refers to algae that are stringy or cotton like. Filamentous algae are single algae cells that form long visible chains, threads or filaments. These filaments intertwine forming a mat that resembles wet wool. Often filamentous algae floats to the surface forming large mats. This type of algae often appears bulky.

Periphyton is benthic (lives on the stream bottom) algae that grow attached to surfaces such as rocks or larger plants. Periphyton are primary producers and sensitive indicators of environmental change in water bodies.

Woody Debris
Woody debris includes logs, sticks, and branches and other wood that falls into the stream. Attached woody debris can create in-stream habitat for invertebrates and fish. Streams get a lot of their nutrients from woody debris. However, too much woody debris can negatively impact a stream by slowing down stream flow, by causing a barrier to fish movement or by nutrient overloading. Check the box by the option that best describes what was observed.
If the debris are free floating, it may have recently floated down stream and is not a useable habitat. However, if the debris is established and attached it will provide habitat for invertebrates and fish.

**Tree Canopy Cover**

Stand in the middle of the stream or at the stream’s edge and look straight up toward the sky looking over the center of the stream. In the fall or winter try to visualize how the leaves will look in the summer on the tall overhanging treetops. See Figure 7 for an illustration of percent cover. Some people may find it more useful to look at the reflection of the tree canopy on the stream. Use your best judgment in picking the option that best represents the estimated percentage of stream canopy coverage.

**Visual Estimates of Percentage Cover**

Use these reference figures to help estimate the percentage of canopy cover and the percentage of low vegetation cover. We suggest you laminate this copy so it will last longer in the field.

![Figure 7. Percentage Cover (Source: http://static.birds.cornell.edu/bfl/percentcover.pdf)](http://static.birds.cornell.edu/bfl/percentcover.pdf)

**In-Stream Structures**

Bridges, culverts, weirs, and dams are all examples of in-stream, man-made structures that will affect the stream’s health. Please mark the structures observed in the stream within the reach. Also identify any other structures observed outside of your stream reach in your site stretch.

**Litter Concentration**

Note whether or not you see litter throughout your stream reach. Large litter should be identified in the notes section of your report. Illegal Dumping should be reported using a new mobile application, which can be accessed on smart phones at [https://www.nj.gov/dep/stopdumping/index.htm](https://www.nj.gov/dep/stopdumping/index.htm)

The user reports the illegal dumping location, the size and type of the dump, as well as a picture of the debris. Once the site is reported, DEP investigators will...
work to find the responsible party. For additional instructions on how to use the mobile application, visit: www.nj.gov/dep/stopdumping/instructions.htm

4.9 In-stream Habitats, Substrate, and Method

The information in this section is used to identify macroinvertebrate habitats, so that macroinvertebrates can be collected in proportion to represented habitats in the stream reach.

Macroinvertebrate & Epifaunal Habitat Types
Check the boxes next to all the epifaunal habitat types present in your stream reach. When you are also collecting macroinvertebrates, this information is important for targeting your D-net collections in the best and all representative habitats in your stream reach. This information will also help when you assess question 1 on page 3 of the data sheet.

Benthic Substrate Characteristics
Estimate the percentage of each substrate type within your stream reach.

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Diameter &amp; Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt</td>
<td>0.00015 to 0.0025 inches (feels slippery)</td>
</tr>
<tr>
<td>Sand</td>
<td>0.0025 to 0.079 inches (feels gritty)</td>
</tr>
<tr>
<td>Gravel</td>
<td>0.1 to 2.5 inches</td>
</tr>
<tr>
<td>Cobble</td>
<td>2.5 to 10 inches (between a baseball and basketball size)</td>
</tr>
<tr>
<td>Boulder</td>
<td>Over 10 inches (about basketball size or larger)</td>
</tr>
<tr>
<td>Bedrock</td>
<td>Solid rock</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Macroinvertebrate Sorting Method
For this project, check the box by (A) Streamside field identification.

Form Attached
For this project, check the box by (A) Tier 3.1: Macroinvertebrate Tally Sheet if macroinvertebrates are evaluated.
5.0 Land Use & Site Sketch

5.1 Site ID and Date
Record Site ID and Date in case the data sheets get separated, and to avoid any mix-ups when scanning documents for digital storage.

5.2 Streamside Land Use
Land use data collected on this sheet is extremely useful to water quality data users within the NJDEP because it allows streamside land use to be assessed more frequently. Go through the list of streamside land uses provided and mark everything that is present within viewing distance of the stream reach you are surveying. If you notice anything unusual or important, make sure to add it to the comments box.

5.3 Observations

Comments/Observations (Habitat Assessment):  Comments/Observations (Biological Assessment):

| What do you believe to be the greatest potential threat to the stream both now and in the future? |

Comments/Observations
Fill in any other observations made about the reach related to the habitat or biological assessment. 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 site sketch map. Be concise.
If you suspect a Harmful Algal Bloom (HAB) in a lake or pond nearby, report it using the Report a HAB website [https://www.state.nj.us/dep/wms/bfbm/cyanohabreporting.html](https://www.state.nj.us/dep/wms/bfbm/cyanohabreporting.html) or anything you think needs urgent NJDEP attention using the [1-877-WARNDEP Hotline](tel:1-877-927-6337) or [app](#).

### 5.4 Site Sketch

This is a hand drawn map of your stream segment. Your map should include such note-worthy features as direction of flow, pools, riffles, runs, road crossings, transect locations, outfalls, ditches, stream confluences, flocks of waterfowl, etc. Please be sure to include anything you may see along your stream walk.

Each *Site Sketch* ensures that we understand physical characteristics of the stream and the land use surrounding the immediate monitoring location. While sketching the site, keep in mind the importance of adding reference points such as road names or GPS points to the map.

---

**Figure 11. Data Sheets - Section 3 of Page 2**

---

**Figure 12. Example of Site Sketch**
6.0 Scored Habitat Monitoring

6.1 Introduction

There are two predominant stream types, high gradient and low gradient. You can check GeoWeb under “Physiographic Provinces” to identify each region ie. Valley and Ridge, Highlands, Piedmont, and Coastal Plain.

**High gradient** indicates a steep slope and rapid flow of water with more ability to erode. High gradient streams are found in areas that have some elevation above sea level like the Valley and Ridge, Highlands or the Piedmont region.

**Low gradient** indicates a nearly level stream bed and sluggish moving water. Low gradient streams are found in low-lying areas like the Coastal Plains or the Pinelands.

Your monitoring sheet results will vary depending upon your stream gradient status. For example, pool and riffle variability may not be present if you are in a low gradient stream. However, in high gradient streams, pools and riffles may be easily assessable.

Score each parameter on a scale of 1-20 (or 1-10 for Left Bank and Right Bank options) and determine which range the parameter falls into such as optimal, suboptimal, marginal or poor.

After completing this entire section, add up all parameter scores to determine the health of the entire stream reach.

6.2 Epifaunal Substrate/Available Cover

* Description is different for high and low gradient regions.

Includes the relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refugia, feeding, or sites for spawning and nursery functions of aquatic macrofauna. A wide variety and/or abundance of submerged structures in the stream provides macroinvertebrates with a large number of niches, thus increasing habitat diversity. As variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases. Riffles and runs are critical for maintaining a variety and abundance of insects in most high-gradient streams. The extent and quality of the riffle is an important factor in the support of a healthy biological condition in high-gradient streams. Riffles and runs offer a diversity of habitat through variety of particle size, and, in many small high-gradient streams, will provide the most stable habitat. Snags and submerged logs are among the most productive habitat structure for macroinvertebrate colonization in low-gradient streams. However, "new fall" will not yet be suitable for colonization.
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**High Gradient Stream**

1. Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).
2. 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).
3. 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.
4. Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.

**Low Gradient Stream**

1. Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).
2. 30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).
3. 10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.
4. 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.

**6.3 Pool Substrate Characterization – Low Gradient ONLY**

Pool substrate characterization evaluates the types of substrates and the conditions of pools within a stream. Firmer sediment types (e.g., gravel, sand) and rooted aquatic plants support a wider variety of organisms than a pool substrate dominated by mud or bedrock and no plants. In addition, a stream that has a uniform substrate in it’s pools will support fewer types of organisms than a stream that has a variety of substrate types. Substrate characterization should be determined based on the range of substrates you find in each pool; hard-pan clay, bedrock, mud, silt, organic matter, etc.

**6.4 Embeddedness - High Gradient ONLY**

Refers to the extent to which rocks (gravel, cobble, and boulders) and snags are covered or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, the surface area available to macroinvertebrates is decreased. Embeddedness is a result of large-scale sediment movement and deposition, and is a parameter evaluated in the riffles and runs of high-gradient streams. The rating of this parameter may be variable depending on where the observations are taken. To estimate embeddedness, observe the amount of fine particles overlying, in between and surrounding the rocks in the bottom of the stream.

![Figure 13. Embeddedness](image-url)
**6.5 Pool Variability – Low Gradient ONLY**

The overall mixture of pool types found in streams, according to size and depth. The 4 types of pools are large-shallow, large-deep, small-shallow and small-deep. A stream with many pool types will support a wide variety of aquatic species. Rivers with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community. General guidelines are any pool dimension (i.e., length, width, oblique) greater than half the cross-section of the stream for separating large from small and 1 m depth separating shallow and deep.

1. Even mix of large-shallow, large-deep, small-shallow, small-deep pools present
2. Majority of pools large-deep; very few shallow
3. Shallow pools much more prevalent than deep pools
4. Majority of pools small-shallow or pools absent

**6.6 Velocity/Depth Combinations – High Gradient ONLY**

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. The occurrence of these 4 patterns relates to the stream's ability to provide and maintain a stable aquatic environment. Record all available combinations for both wadable and non-wadable streams.

**6.7 Sediment Deposition**

* Description may be different depending on if you are located within a high gradient or low gradient region.

Measures the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition. Deposition occurs from large-scale movement of sediment. Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of a meander that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling of runs and pools. Usually deposition is evident in areas that are obstructed by natural or manmade debris and areas where the stream flow decreases, such as bends. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms.

**High Gradient Streams**

1. Little or no enlargement of islands or point bars and less than 5% of bottom affected by sediment deposition.
2. Some new increase in bar formation, mostly from gravel, sand or fine sediment: 5-30% of the bottom affected, slight deposition in pools.
3. Moderate deposition of new gravel, sand or fine sediment on old or new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.
4. Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition

**Low Gradient Streams**

1. Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.
2. Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.
3. Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.
4. Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition

**6.8 Channel Flow Status**

The channel flow status is the amount of water in the channel. The flow status will change as the channel enlarges (e.g., widening caused by erosion) or as flow decreases as a result of dams and other obstructions, diversion of flow, dry weather conditions or drought.

1. Base of both lower banks
   - Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.
2. Greater than 75%
   - Water fills >75% of the available channel; or <25% of channel substrate is exposed.
3. 25-75%
   - Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.
4. Very little water
   - Very little water in channel and mostly present as standing pools.

In high-gradient streams, riffle areas and cobble substrate can be exposed; in low-gradient streams, the decrease in water level exposes logs and snags and reduces the areas of good habitat for aquatic organisms. Channel flow is especially useful for interpreting biological condition under abnormal or lowered flow conditions.

![Figure 5. Channel Flow Status](image)
6.9 Channel Alteration

Channel alteration is any changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened, or diverted into concrete channels, often for flood control or irrigation purposes. Such streams have fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Signs of channelization, or straightening of the stream, may include an unnaturally straight section of a stream, high banks, lack of flow diversity (pools, riffles, runs), uniform-sized stream substrate, lack of vegetation diversity, and absence of vegetation.

1. Stream with normal pattern
2. Some channelization present, usually in areas of bridges etc.
3. Channelization extensive, 40-80% of the streams reach
4. Over 80% of the stream channelized, gabion baskets and/or riprap, and/or concrete present

6.10 Channel Sinuosity – Low Gradient ONLY

Sinuosity refers to the natural tendency for a stream to meander. A high degree of sinuosity provides for diverse habitat and fauna, and can better handle increased flow when the stream level fluctuates as a result of storms. Meandering allows for the absorption of the energy of moving water and protects the stream from excessive erosion and flooding and provides refuge for benthic invertebrates and fish during storm events. For purposes of measuring sinuosity, volunteers may want to consider a longer segment or reach when evaluating this parameter.

1. Sharp bends (oxbows): The bends increase the stream length by 3-4 times compared to if it was in a straight line.
2. Moderate bends: The bends in the stream increase the stream length by 2-3 times compared to if it was in a straight line.
3. Slight bends: The bends in the stream increase the stream length by 1-2 times compared to if it was in a straight line.
4. Straight-channelized: the channel is straight and has obviously been channelized with an artificial lining or bank stabilization.

6.11 Frequency of Riffles - High Gradient ONLY

Riffles are shallower depth areas of the stream segment with faster, turbulent water running over gravel and/or rocks. The frequency of riffles refers to the heterogeneity occurring in a stream. Riffles are a source of high-quality habitat and diverse fauna, therefore, an increased frequency of occurrence enhances the diversity of the stream community. In headwaters, riffles are usually continuous and the presence of cascades or boulders provides a form of sinuosity and enhances the structure of the stream.

1. Occurrence of riffles relatively frequent; distance between riffles is 5-7 times stream width. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.
2. Occurrence of riffles infrequent; distance between riffles is 7 to 15 times stream width.
3. Occasional riffle or bend; bottom contours provide some habitat; distance between riffles is 15 to 25 times stream width.
4. Generally all flat water or shallow riffles; poor habitat; distance between riffles is >25 times stream width

### 6.12 Bank Stability

*Note: Be sure to score both Left and Right Banks - left and right bank are determined by looking upstream.*

Bank Stability refers to the existence of or the potential for detachment of soil from the stream banks and its movement into a stream. Excessive bank erosion occurs when the watershed surrounding the stream has been altered. Signs of erosion may include exposed tree roots, undercut banks, unvegetated banks and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams.

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

### 6.13 Bank Vegetative Protection

* Note: Be sure to score both Left and Right Banks- left and right bank are determined by looking upstream.

Bank Vegetative Protection is 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. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection.

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

1. Greater than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.
2. 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.
3. 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.
4. Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.

### 6.14 Riparian Vegetation

This quantifies the width of the riparian zone. It is the measure of natural vegetation from the edge of the stream bank out through the riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and nutrient input into the stream. A relatively undisturbed riparian zone supports in stream habitat; narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Natural vegetation should consist of a good mix of plants including grasses, forbs, shrubs, understory trees and large trees. Again, left and right bank is determined by looking up stream.

1. Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.
2. Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.
3. Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.
4. Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.

### 6.15 Habitat Score

In order to fully understand the health of the stream reach add up all of the scores of each habitat parameter. After totaling you will receive one of the following scores.

- Optimal: 160-200
- Sub-Optimal: 110-159
- Marginal: 60-109
- Poor: <60

### 7.0 Pipe & Drainage Ditch Inventory

After returning to the office after completing this data sheet, compare to the NJPDES Surface Water Discharge Points using NJ-GeoWeb. Anything new or that you believe requires urgent NJDEP attention should be reported using the 1-877-WARNDEP Hotline (1-877-927-6337) or app.

**Pipe Information**

- Latitude and Longitude
- Take a GPS point where the pipe discharges into the stream

**NJPDES # - if applicable**

If the pipe has a permit number posted on it or near it, record that number in the space provided.

**Pipe Diameter**

Enter the estimated diameter or measure the diameter of the pipe.
Type
Circle the best description for the type of discharge from the pipe.

1. Storm Drain Discharge is from storm sewers in adjacent developments or highway/road systems.

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

3. 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.

4. Combined Sewer Overflows are sewer systems that carries both sewage and stormwater runoff during rain events. 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.

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

Pipe Material
In most cases you will find a pipe made from one of the following materials

Pipe Location
Circle the option that best describes the location of the pipe in relation to the stream bank.

1. In Water-the end of the discharge pipe is located at the bottom of the stream bank or in the channel.
2. In Bank-the discharge pipe is coming out of the stream bank
3. Near Water -discharge pipe is located at or slightly behind the top bank and discharges down the bank.

Pipe Flow/Appearance
Circle the option that best describes the flow coming out of the pipe.

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

Is stream bed eroded downstream?
1. Yes  2. No
8.0 Biological Assessment Information

8.1 Overview
The primary goal in benthic macroinvertebrate sampling is to collect a representative sample in that reach, using a consistent level of effort. There are two predominant stream types, rocky bottom (high gradient) and muddy bottom (low gradient) (see map at right). Rocky bottom streams are found in areas that are high above sea level like the Highlands or the Piedmont region. Muddy bottom streams are found in low-lying areas like the Coastal Plains or the Pinelands. Whether a site is considered rocky or muddy bottom, a multi-habitat sampling approach is used, focused on the most productive habitat types present. This includes:

- Riffle/run
- Submerged vegetated banks/root mats, including undercut banks
- Woody debris/snags
- Submerged aquatic vegetation (macrophytes)

8.2 Habitat and River Bottom Composition
On the Habitat and Macroinvertebrate Data Sheets you will record information about the habitat types present in the “Macroinvertebrate & Epifaunal Habitat Types” section. Refer to the Habitat Assessment Field Manual for instructions. Use this to plan where to target your macroinvertebrate sampling effort.

Sampling effort is allocated proportionate to the habitat types present. For example, if riffle/run is the dominant productive habitat type present, sampling is concentrated in this habitat type. If a habitat type is present in less than 5% of the sampling reach, it is not targeted. Freshly fallen woody debris, freshly fallen leaves (leaf packs) and silt/sand are not very productive and are not targeted unless the more productive habitats are not present.

8.3 Rocky Bottom
Stand in a riffle area with a D-Frame net facing upstream. Vigorously shuffle your feet and rub rocks with your hands in a one foot square area upstream of your net, letting the flow carry the debris into the net. When you feel that the upstream area has been thoroughly disturbed, pick up the net in a scooping motion so contents aren’t lost and rinse it off into a bucket, making sure to check the net for any remaining clinging organisms. Take several samples from the different depths, velocities and habitats present in your stream reach to make up your one overall sample.
2021-2022
All material from the net is deposited into the sieve bucket. During sampling, material collected in
the dip net may need to be emptied into sieve bucket more frequently if the net is clogging or
becomes filled with debris. After the contents of the net are dumped into the sieve bucket, the net is
carefully examined for adhering organisms. If observed, they are removed with tweezers, spoon or
fingers and placed into the sieve bucket.

8.4 Muddy Bottom
To collect your sample, you will be collecting a series of scoops. Break your scoops down into the
following categories: woody debris, leaf packs, vegetated/undercut bank margins, submerged logs,
cobble, coarse gravel, and other. If you are sampling undercut/vegetated banks, repeatedly jab your
D-frame net vigorously into the sampling habitat. If you are sampling woody debris/submerged logs,
you will vigorously scrape the wood with your net. If you have leaf packs in your stream reach, you
will rub them upstream of your net to dislodge any macroinvertebrates. To sample the substrate,
whether coarse gravel or fine sediment, you will disturb a one foot square area upstream of your net,
taking care not to collect too much sediment/debris.

When you believe the area has been disturbed thoroughly when targeting any of these habitats,
swing your net back and forth several times to collect any organisms that may be suspended in the
water column. That is considered one scoop. A good starting point is to take a total of 20 scoops.
Make sure scoops are taken from each of the represented habitat types with the most scoops being
taken from the habitat type most common/most productive in the sampling area. If your stream
bottom is muddy or silt, you will not find a large diversity of macroinvertebrates in that area, so
focus your scoops on more productive habitat types.

All material from the net is deposited into the sieve bucket. Periodically empty your net into a bucket
so that macroinvertebrates captured from previous scoops do not get out and more frequently if the
net is clogging or becomes filled with debris. After the contents of the net are dumped into the sieve
bucket, the net is carefully examined for adhering organisms. If observed, they are removed with
tweezers, spoon or fingers and placed into the sieve bucket.

Summary: You may need to take samples up and down your 100 meter stream reach. Find the
best habitat areas to sample within each stream reach and always face upstream to avoid losing
any macroinvertebrates.

Rocky Bottom
Take about 10-20 kicks, mostly within riffle areas, but also sample submerged vegetated banks,
undercut banks, woody debris and submerged aquatic vegetation, if present.

Muddy Bottom
Take about 20 scoops in the best muddy bottom habitats present, as follows:
• Submerged vegetated banks/root mats, including undercut banks
• Woody debris/snags
• Submerged aquatic vegetation (macrophytes)
• Leaf packs and silt/sand when better habitats are lacking
8.5 Macroinvertebrate Sorting, Identification & Tallying

Dump all of your macroinvertebrates from your net into a bucket of water. Pick your net clean of any remaining macroinvertebrates and place them in the bucket. Use your small sorting container to swirl the water and the macroinvertebrates in the bucket. Once everything is stirred up well, take a scoop (sub-sample) from the bucket with your sorting container. Sort all of the macroinvertebrates in your sorting container (ice cube trays can help you to stay organized; each compartment can be a different group of organisms). Use identification references to identify the 22 target organisms. Record the number and each type of macroinvertebrate you have sorted on the Macroinvertebrate Tally Sheet (provided in Appendix O). If you have 100 or more macroinvertebrates recorded in your table you can stop, if you have less than 100 macroinvertebrates re-stir the bucket and take another sub-sample to sort in your sorting container and continue this process until you have recorded 100 or more macroinvertebrates.

If you have sorted your entire bucket and have not reached 100 macroinvertebrates you need to take another sample from the stream. If after 20 minutes you have not found 25 macroinvertebrates you are to return to the stream to collect more macroinvertebrates to add to the bucket. If after 40 minutes of sorting you have not found 50 macroinvertebrates you are to return to the stream again to collect a third round of samples to add to the bucket. If after an hour and a half and three separate attempts to collect macroinvertebrates to add to the sample bucket you are still unable to sort and identify 100 macroinvertebrates, you will stop sorting and check the box on the assessment form indicating you were unable to find 100 macroinvertebrates.

Summary: Take a sub-sample and sort all organisms in the sub-sample, including small organisms. Identify and record your tally on the data sheet. Take additional sub-samples until you reach 100 macroinvertebrates. Where macroinvertebrates are scarce, if you don’t find 100 organisms after 3 separate collection efforts and 1.5 hours of sorting, stop sorting and check the box on the tally form indicating you were unable to find 100 macroinvertebrates.

Note: For educational purposes, the indices can be calculated using the instructions in Appendices C & D. However, the calculations will be done for you when you enter your data into the GeoForm.

9.0 Before You Leave the Site

9.1 Checklist

1. Make sure you have filled out all data and tally sheet sections while you are in the field.
2. Always complete a habitat assessment with your biological assessment. See Habitat Assessment Field Manual for detailed instructions.
3. Decontaminate your equipment as described below.

9.2 Didymo (Rock Snot) Decontamination

Treat all streams like they have Didymo, not just ones that have been confirmed.

Didymo is not visible to the naked eye at first and by the time you see it, it is too late.
When collecting macroinvertebrates from the stream, return them back to the same stream and the same location. No mixing samples.

If you want to do more than one assessment in a day you should only work on one stream per day. Start upstream and work downstream when changing locations (following how the river flows), to avoid contaminating any upstream locations that have not been exposed to Didymo.

You should clean your equipment after each day in the same stream or in between sampling events on different streams.

You must decontaminate all small equipment (e.g., buckets, nets, water sampling equipment) AND Personal Protective Equipment (e.g., rain gear, gloves, boots, waders and PFDs)

1. Remove all organic material from gear
2. Fill bucket with Alconox and stream water and place all equipment in the tub.
3. Scrub small and personal protective equipment.
4. Rinse or let dry completely
Appendix A. Introduction to Benthic Macroinvertebrates

Benthic macroinvertebrates are animals that lack backbones and are visible to the unaided eye, meaning they do not require magnification to be seen. We call them benthic when they live on the streambed or attach themselves to aquatic plants or floating wood. Common benthic macroinvertebrates include the larval stages of many insects – such as dragonflies, mayflies, and black flies – as well as permanent stream dwellers like mussels, crayfish, and snails.

The presence of benthic macroinvertebrates can tell us a lot about the health of a stream because each organism varies in its ability to tolerate pollution. Mayfly larvae, for example, are very sensitive to pollution and can only survive in clean water. Rat-tailed maggots, on the other hand, are relatively unaffected by pollution and can tolerate highly degraded waterways.

Most of the benthic macroinvertebrates found in New Jersey fall under one of three categories. These categories include pollution intolerant, pollution sensitive, and pollution tolerant. Pollution intolerant organisms can only survive in streams that contain little to no pollution. Pollution sensitive organisms can tolerate some pollution, but cannot live in heavily degraded waterways. Pollution tolerant organisms can survive in very polluted water. The chart below lists common benthic macroinvertebrates found in New Jersey and shows which category they fall under.

<table>
<thead>
<tr>
<th>Pollution Intolerant</th>
<th>Pollution Sensitive</th>
<th>Pollution Tolerant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayfly Larva</td>
<td>Caddisfly Larva \textit{net spinning}</td>
<td>Black Fly Larva</td>
</tr>
<tr>
<td>Stonefly Larva</td>
<td>Alderfly Larva</td>
<td>Midge Fly Larva</td>
</tr>
<tr>
<td>Caddisfly Larva \textit{case making}</td>
<td>Damselfly Larva</td>
<td>Lunged Snail</td>
</tr>
<tr>
<td>Dobsonfly Larva/Hellgrammiate</td>
<td>Dragonfly Larva</td>
<td>Aquatic Worm</td>
</tr>
<tr>
<td>Watersnipe Fly Larva</td>
<td>Crane Fly Larva</td>
<td>Leech</td>
</tr>
<tr>
<td>Riffle Beetle</td>
<td>Sowbug</td>
<td></td>
</tr>
<tr>
<td>Water Penny</td>
<td>Scud</td>
<td></td>
</tr>
<tr>
<td>Gilled Snail</td>
<td>Crayfish</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clam/Mussel</td>
<td></td>
</tr>
</tbody>
</table>

\textbf{Remember:} A healthy stream will contain benthic macroinvertebrates from all three categories – it will not just include pollution intolerant organisms. Biological diversity is the key to a healthy stream!
Appendix B. Macroinvertebrate Cheat Sheet

Stream Insects and Crustaceans ID Card

Lines under picture indicate the relative size of organisms

Aquatic Worm:
Class Oligochaeta
1/2 - 2", can be very tiny; thin, wormlike body; tolerant of impairment

Flat Worm:
Family Planarieae
Up to 1", soft body, may have distinct head with eyespots, tolerant of impairment

Leech:
Order Hirudinea
1/2 - 2", segmented body, suction cups on both ends, tolerant of impairment

Crayfish: Order Decapoda
Up to 6", 2 large claws, 8 legs, resembles a small lobster, somewhat tolerant of impairment

Sowbug: Order Isopoda
1/4 - 1/2", gray oblong body wider than it is high, more than 6 legs, long antennae, somewhat tolerant of impairment

Scud: Order Amphipoda
1/4", white to gray, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp, somewhat tolerant of impairment

Stonefly: Order Plecoptera
1/4 - 1/2", 6 legs with hooked tips, antennae, 2 hair-like tails, no gills on abdomen, very intolerant of impairment

Mayfly: Order Ephemeroptera
1/4 - 1", plate-like or feathery gills on abdomen, 6 hooked legs, 2 or 3 long hair-like tails, tails may be webbed together, very intolerant of impairment

Dragonfly and Damselfly: Order Odonata
1/4 - 2", large eyes, 6 hooked legs, large protruding lower jaw, 3 broad ear-shaped tails OR wide oval to round abdomen, somewhat tolerant of impairment

Helconmite, Fishfly, and Alderfly:
Order Megaloptera
1/2 - 1", 6 legs, large pinching jaws, 8 pairs of feelers along abdomen, 2 hooks on tail end OR 1 single spiky tail, somewhat tolerant of impairment

Common Net spinners:
Family Hydropsychidae
Up to 1/4", 6 hooked legs on upper 1/3 of body, 2 hooks at back end, underside of abdomen with white tufts of gills, somewhat tolerant of impairment

Most Caddisfly:
Order Trichoptera
Up to 1", 6 hooked leg on upper 1/3 of body, may be in stick, rock or leaf case, no gill tufts on abdomen, intolerant of impairment

Stream Insects and Crustaceans ID Card

Lines under picture indicate the relative size of organisms

**Beetles: Order Coleoptera**
1/4” - 1”, disk-like oval body with 6 small legs and gill tufts on underside OR small black beetle crawling on streambed OR commensal-like brown “crunchy” body with 6 legs on upper 1/3 and possibly gill tuft on back end, OR (miscellaneous body form - rare), somewhat tolerant of impairment

**Midges: Family Chironomidae**
Up to 1/4”, distinct head, worm-like segmented body, 2 leg-like projections on each side, often whitish to clear, occasionally bright red, tolerant of impairment

**Black Fly: Family Simuliidae**
Up to 1/4”, end of body wider (like bowling pin), distinctive head, sucker on end, tolerant of impairment

**Most True Flies: Order Diptera**
1/4” - 2”, bodies plump and maggot-like, may have caterpillar like “legs” along body, may have lobes or conical tails on end, tolerant of impairment

**Gilled Snails: Class Gastropoda**
Up to 1/4”, shell opening covered by a thin plate called an operculum, with helix pointed up shell opens to the right, intolerant of impairment

**Lunged Snails: Class Gastropoda**
Up to 1/4”, no operculum, with helix pointed up shell opens to the left, tolerant of impairment

**Clams: Class Bivalvia**
Up to 1/4”, fleshy body enclosed between two clamped together shells (if clam is alive, shells cannot be pried apart without harming clam), somewhat tolerant of impairment

**Glossary:**
- **Abdomen**: Tails: There are many different kinds of macroinvertebrate tails. The thin thread-like tails found on stoneflies and mayflies are called cerci. The oar-shaped tails found on a damselfly are not really tails - they are actually gills called caudal lamellae.
- **Thorax**:
- **Head**

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These sheets are modified from the National Izaak Walton League of America SOS Program Stream Insects & Crustaceans ID Card.
http://www.iwla.org/SOS/index.html
### Volunteer Pinelands Macroinvertebrate Index

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Count</th>
<th>% Crustacea &amp; Mollusca Taxa</th>
<th># Insect Taxa</th>
<th># EPT / # Tolerant TAxa</th>
<th># Tolerant Taxa</th>
<th>% Worm, Leech, Lunged Snail</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollution Intolerant</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1 Mayfly</td>
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<tr>
<td>2 Stonefly</td>
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<tr>
<td>3 Caddisfly (case-building)</td>
<td></td>
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<tr>
<td>4 Hellgrammite/Dobsonfly</td>
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<tr>
<td>5 Watersnipe Fly*</td>
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<tr>
<td>6 Riffle Beetle</td>
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<tr>
<td>7 Water Penny*</td>
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<tr>
<td>8 Gilled Snail</td>
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<tr>
<td>9 Net-Spinning Caddisfly</td>
<td></td>
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</tr>
<tr>
<td><strong>Pollution Sensitive</strong></td>
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</tr>
<tr>
<td>10 Alderfly</td>
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<tr>
<td>11 Damselfly</td>
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<tr>
<td>12 Dragonfly</td>
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<td>13 Crane Fly</td>
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<tr>
<td>14 Sowbug</td>
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<tr>
<td>15 Scud</td>
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<td>16 Crayfish</td>
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<tr>
<td>17 Clams/Mussels</td>
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<tr>
<td>18 Black Fly</td>
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<tr>
<td>19 Midge Fly</td>
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<td>20 Lunged Snail</td>
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<tr>
<td>21 Aquatic Worm</td>
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<tr>
<td>22 Leech</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Total Individuals</strong></td>
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<td></td>
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</tr>
<tr>
<td><strong>Total Taxa</strong></td>
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</tr>
<tr>
<td><strong>Percent</strong></td>
<td></td>
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</tr>
</tbody>
</table>

* These macroinvertebrates are not found in the Pinelands
Check Box | Step | 
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Column B - Record the number of individual organisms present in each group (taxa) in your sample. Record total number of individuals in box B23. [Aim for approximately 100 macros – you must have 100 macros +/- 10% (90-110 macros) in order for the VPMI to work]</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Column B - Total the number of taxa which had individual organisms present and record in box B24.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Column C through H - Mark an X in each box where taxa for that category were present.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Column C through H, box 24. Add together the number of Xs for each column and record sum in boxes C24-H24 for each respective category.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Column I. Record the number of individual organisms in each taxa in this category in boxes I20-I22. Add totals in boxes I20-I22 and record in box I23.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Divide the Total Taxa from Column C (box C24) by the Total Taxa from Column B (box B24) and multiply by 100 (C24/B24 * 100). Record this number in the Percent box of Column C (box C25)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Divide the Total Individuals from Column I (box I23) by the Total Indivuals from Column B (box B23) and multiply by 100 (I23/B23 * 100). Record this number in the Percent box 25 of Column I</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Enter the numbers from the specified boxes into the formulas in the Metrics Table below and calculate the scores for each Metric</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Total the Score Column in the Metrics Table and record this number in the Total box of the Metrics Table. Divide this number by 5 to find the average Metrics Score.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Compare the Average Score to the chart below to find your final stream score</td>
<td></td>
</tr>
</tbody>
</table>

**Metrics Table** (The scoring scale is 0 – 100. Direction of metric change with increasing stress is shown with + or – signs)

<table>
<thead>
<tr>
<th>Metric #</th>
<th>Metric Name</th>
<th>Scoring Formula</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Percent Crustacea &amp; Mollusca Taxa (+)</td>
<td>100 * (47.2- C25) / (47.2-0)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Number of Insect Taxa (-)</td>
<td>100 * D24 / 10</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Number of EPT Taxa/(Number of Tolerant Taxa + 1) (-)</td>
<td>100 * (E24/(F24+1))</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Percent Worm, Leech and Lunged Snail Individuals (+)</td>
<td>100 * (64.7 – I25) / (64.7-0)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Number of Tolerant Taxa (+)</td>
<td>100 * (4- H24) / (4-2)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 45</td>
<td>Stressed</td>
</tr>
<tr>
<td>46 - 74</td>
<td>Undetermined</td>
</tr>
<tr>
<td>≥ 75</td>
<td>Healthy</td>
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</tbody>
</table>
### Volunteer Coastal Plains Macroinvertebrate Index

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Count</th>
<th># EPT Taxa</th>
<th>% Non Insect Taxa</th>
<th>Biotic Index</th>
<th>% Intolerant Taxa</th>
<th>% Worm, Leech, Lunged Snail</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollution Intolerant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Mayfly</td>
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<td></td>
<td></td>
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<tr>
<td>2 Stonefly</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3 Caddisfly (case-building)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4 Heligrammite/Dobsonfly</td>
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<tr>
<td>5 Watersnipe Fly</td>
<td></td>
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<td></td>
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<tr>
<td>6 Riffle Beetle</td>
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<td></td>
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<tr>
<td>7 Water Penny</td>
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<tr>
<td>8 Gilled Snail</td>
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<tr>
<td><strong>Pollution Sensitive</strong></td>
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<td></td>
</tr>
<tr>
<td>9 Net-Spinning Caddisfly</td>
<td></td>
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<td></td>
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<tr>
<td>10 Alderfly</td>
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<tr>
<td>11 Damselfly</td>
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<td>12 Dragonfly</td>
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<td>13 Crane Fly</td>
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<tr>
<td>14 Sowbug</td>
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<tr>
<td>15 Scud</td>
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<td>16 Crayfish</td>
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<td>17 Clams/Mussels</td>
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<tr>
<td><strong>Pollution Tolerant</strong></td>
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<tr>
<td>18 Black Fly</td>
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<tr>
<td>19 Midge Fly</td>
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<td>20 Lunged Snail</td>
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<tr>
<td>21 Aquatic Worm</td>
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<td>22 Leech</td>
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<tr>
<td>23 Total Individuals</td>
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<tr>
<td>24 Total Taxa</td>
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<tr>
<td>25 Percent</td>
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</tr>
</tbody>
</table>
1. **Check Box**

   **Step**

   1. **Column B** - Record the number of individual organisms present in each group (taxa) in your sample. Record total number of individuals in box B23. [Aim for approximately 100 macros – you must have 100 macros +/- 10% (90-110 macros) in order for the VCPMI to work]

   2. **Column B** - Total the number of taxa which had individual organisms present and record in box B24.

   3. **Column C & D** - Mark an X in each box where taxa for that category were present.

   4. **Columns C & D** - Total the X’s in each column and record in boxes C24 & D24, respectively.

   5. **Column D** – Calculate the % non-insect taxa: box D24/ box B24*100. Enter result in Box D25.

   6. **Column E** - For each taxa present in the Pollution Intolerant Category enter a score of 2. For each taxa present in the Pollution Sensitive Category enter a score of 1.

   7. **Column E** - Add the total (all of the 2s and 1s) for Column E and record in box E24 (this is not Total Taxa but rather Taxa Score Total)

   8. **Column G** – Place an X in each box where taxa for that category were present.

   9. **Column G** – Total the X’s in Column G and record in box G24.

   10. **Column G** – Calculate the % Intolerant taxa: box G24/ box B24*100. Enter result in box G25.

   11. **Column H** – Record the number of individuals present for each taxa in this category. Add total and record in box H23

   12. **Column H** – Calculate the % Worm, Leech and Lunged Snail: box H23/ box B23*100. Enter result in box H25.

   13. Enter the numbers from the specified boxes into the formulas in the Metrics Table below and calculate the scores for each Metric

   14. Total the Score Column in the Metrics Table and record this number in the Total box of the Metrics Table. Divide this number by 5 to find the Average Metrics Score.

   15. Compare the Average Score in the Metrics Table to the chart below to find your final stream score.

---

**Metrics Table** (The scoring scale is 0 – 100. Direction of metric change with increasing stress is shown with + or – signs)

<table>
<thead>
<tr>
<th>Metric #</th>
<th>Metric Name</th>
<th>Scoring Formula</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of EPT Taxa (-)</td>
<td>$100 \times \frac{C24}{3}$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Percent Noninsect Taxa (+)</td>
<td>$100 \times \frac{62.5 - D25}{(62.5-16.67)}$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Beck’s Biotic Index (-)</td>
<td>$100 \times \frac{E24}{14}$ (if score &gt; 100, use 100 as default score)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Percent Intolerant Taxa (-)</td>
<td>$100 \times \frac{G25}{44.4}$</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Percent Worm, Leech and Lunged Snail Individuals (+)</td>
<td>$100 \times \frac{46.2 - H25}{(46.2-1.85)}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>Average</strong></td>
<td></td>
</tr>
<tr>
<td>≤ 35</td>
<td>Stressed</td>
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<td></td>
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<tr>
<td>36–64</td>
<td>Undetermined</td>
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<tr>
<td>≥ 65</td>
<td>Healthy</td>
<td></td>
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</table>
## Volunteer High Gradient Macroinvertebrate Index

<table>
<thead>
<tr>
<th>Organisms</th>
<th>Count</th>
<th>Biotic Index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollution Intolerant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Mayfly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Stonefly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Caddisfly (case-building)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Hellgrammite/Dobsonfly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Watersnipe Fly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Riffle Beetle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Water Penny</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Gilled Snail</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pollution Sensitive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Net Spinning Caddisfly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Alderfly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Damselfly</td>
<td></td>
<td></td>
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<tr>
<td>12 Dragonfly</td>
<td></td>
<td></td>
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<tr>
<td>13 Crane Fly</td>
<td></td>
<td></td>
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<tr>
<td>14 Sowbug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Scud</td>
<td></td>
<td></td>
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<tr>
<td>16 Crayfish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Clams/Mussels</td>
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<td></td>
</tr>
<tr>
<td><strong>Pollution Tolerant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Black Fly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 Midge Fly</td>
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<td></td>
</tr>
<tr>
<td>20 Lunged Snail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 Aquatic Worm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 Leech</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Check Box | Step
---|---
1 | Column B - Record the number of individual organisms present in each group (taxa) in your sample. Record total number of individuals in box B23 [Aim for approximately 100 macros – you must have 100 macros +/- 10% (90-110 macros) in order for the VPMI to work]
2 | Column C- For each taxa present in the Pollution Intolerant Category enter a score of 3. For each taxa present in the Pollution Sensitive Category enter a score of 2. For each taxa present in the Pollution Tolerant Category enter a score of 1.
3 | Column C- Add the total for Column C and record in box C23.
4 | Compare the Total from Column C to the chart below to find your stream rating.

<table>
<thead>
<tr>
<th>Score</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 12</td>
<td>Stressed</td>
</tr>
<tr>
<td>13 - 19</td>
<td>Undetermined</td>
</tr>
<tr>
<td>≥ 20</td>
<td>Healthy</td>
</tr>
</tbody>
</table>
Appendix D. Regional Macroinvertebrate Indices

Volunteer Coastal Plains Macroinvertebrate Index (VCPMI):

<table>
<thead>
<tr>
<th>Metric #</th>
<th>Metric Name</th>
<th>Scoring Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of EPT Taxa (-)</td>
<td>100 * metric #1 / 3</td>
</tr>
<tr>
<td>2</td>
<td>Percent NonInsect Taxa (+)</td>
<td>100 * (62.5- metric # 2) / (62.5-16.67)</td>
</tr>
<tr>
<td>3</td>
<td>Beck's Biotic Index (-)</td>
<td>100 * metric #3 / 14 (if score &gt;100, use 100 as default score)</td>
</tr>
<tr>
<td>4</td>
<td>Percent Intolerant Taxa (-)</td>
<td>100 * metric #4 / 44.4</td>
</tr>
<tr>
<td>5</td>
<td>Percent Worm, Leech and Lunged Snail Individuals (+)</td>
<td>100 * (46.2- metric #5) / (46.2-1.85)</td>
</tr>
</tbody>
</table>

Volunteer Pinelands Macroinvertebrate Index (VPMI):

<table>
<thead>
<tr>
<th>Metric #</th>
<th>Metric Name</th>
<th>Scoring Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Percent Crustacea &amp; Mollusca Taxa (+)</td>
<td>100 * (47.2- metric # 1) / (47.2-0)</td>
</tr>
<tr>
<td>2</td>
<td>Number of Insect Taxa (-)</td>
<td>100 * metric #2 / 10</td>
</tr>
<tr>
<td>3</td>
<td>Number of EPT Taxa/(Number of Tolerant Taxa + 1) (-)</td>
<td>100 * metric # 3 / 1</td>
</tr>
<tr>
<td>4</td>
<td>Percent Worm, Leech and Lunged Snail Individuals (+)</td>
<td>100 * (64.7 - metric # 4) / (64.7-0)</td>
</tr>
<tr>
<td>5</td>
<td>Number of Tolerant Taxa (+)</td>
<td>100 * (4- metric # 5) / (4-2)</td>
</tr>
</tbody>
</table>

Volunteer High Gradient Macroinvertebrate Index (VHGMI):

<table>
<thead>
<tr>
<th>Metric #</th>
<th>Metric Name</th>
<th>Scoring Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Biotic Index</td>
<td>$\sum$ [Pollution Intolerant Taxa (score 3), Pollution Sensitive Taxa (score 2) and Pollution Tolerant Taxa (score 1)]</td>
</tr>
</tbody>
</table>

Ratings:

<table>
<thead>
<tr>
<th></th>
<th>VCPMI</th>
<th>VPMI</th>
<th>VHGMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stressed</td>
<td>≤ 35</td>
<td>≤ 45</td>
<td>≤ 12</td>
</tr>
<tr>
<td>Undetermined</td>
<td>36-64</td>
<td>46-74</td>
<td>13-19</td>
</tr>
<tr>
<td>Healthy</td>
<td>≥ 65</td>
<td>≥ 75</td>
<td>≥ 20</td>
</tr>
</tbody>
</table>

Appendix E. Data Quality Tiers
## Table 1. Community Water Monitoring Tiered Data Quality Framework

<table>
<thead>
<tr>
<th>Tier</th>
<th>Data Uses</th>
<th>General Requirements</th>
</tr>
</thead>
</table>
| **TIER 1** | - Community education  
             | - Municipal engagement                                                      | **Study design** available for review by potential data users, with:  
                                                                 |   - Documentation of methods, locations, and timeframe                             |
| **TIER 2** | Includes Tier 1 uses, plus:  
             | - Project-specific monitoring  
             | - Water quality report cards  
             | - BMP effectiveness monitoring  
             | - Targeting installation of BMPs  
             | - Targeting advanced monitoring  
             | - NJ DEP Comprehensive Regional Assessments                                      | **QAPP\(^1\)** approved at Tier 2 by NJ DEP BEARS\(^2\) or NJ Watershed Watch Network with:  
                                                                 |   - Use of standard operating procedures with defined levels of accuracy and precision |
| **TIER 3** | Includes Tier 2 uses, plus:  
             | - Regulatory assessments of water quality standard attainment                  | **QAPP\(^1\)** approved at Tier 3 by NJ DEP Office of Quality Assurance, with:  
                                                                 |   - Use of NJ DEP-Certified field and/or laboratory methods for chemical and microbiological analyses  
                                                                 |   - Use of EPA Rapid Bioassessment Protocol for habitat assessments  
                                                                 |   - Use of a defined NJ Watershed Watch Network method for macroinvertebrates (see Table 2) |

1\(^{\text{QAPP = Quality Assurance Project Plan, a technical document that describes exactly how your data is being collected, analyzed, and stored for future potential data users to review. NJ Watershed Watch Network will help you to prepare according to the guidelines set forth by NJ DEP Office of Quality Assurance and the EPA Citizen Science Handbook.}}\)

2\(^{\text{NJ DEP Bureau of Environmental Assessment, Restoration and Standards}}\)
Table 2. A Deep Dive into Tier 3 Macroinvertebrate Assessments

<table>
<thead>
<tr>
<th>Method</th>
<th>MACROS 3.1 Good (AmeriCorps method)</th>
<th>MACROS 3.2 Better</th>
<th>MACROS 3.3 Best</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Sample collection with D-frame net using multi-habitat technique</td>
<td>• Sample collection with D-frame net using multi-habitat technique</td>
<td>• Sample collection with D-frame net using multi-habitat technique</td>
</tr>
<tr>
<td></td>
<td>• Subsampling and identification performed by volunteers in the field</td>
<td>• Sample preservation in the field, with 95% ethanol</td>
<td>• Sample preservation in the field, with 95% ethanol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sample sorting, subsampling, and identification performed by volunteers in</td>
<td>• Sample preservation in the field, with 95% ethanol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a controlled environment</td>
<td>• Sample sent to laboratory for sorting, subsampling, and identification</td>
</tr>
<tr>
<td>Taxonomic Level</td>
<td>• Mix of Class, Order, and Family, limited to 22 target organisms</td>
<td>• Family (except Annelids at Class level)</td>
<td>• Genus or Species</td>
</tr>
<tr>
<td>Assessment Indices</td>
<td>• Volunteer High Gradient Index</td>
<td>• HGMI – family (high gradient only)</td>
<td>• HGMI</td>
</tr>
<tr>
<td></td>
<td>• Volunteer Coastal Plain Index</td>
<td></td>
<td>• CPMI</td>
</tr>
<tr>
<td></td>
<td>• Volunteer Pinelands Index</td>
<td></td>
<td>• PMI</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>• 50-organism identification proficiency test before first sample and every 3 years thereafter</td>
<td>• 10% of group samples re-identified annually by approved lab</td>
<td>• All identifications performed by approved lab</td>
</tr>
<tr>
<td></td>
<td>• Field audit of sampling technique before first sample and every 3 years thereafter</td>
<td>• Field audit of sampling technique before first sample and every 3 years</td>
<td>• Field audit of sampling technique before first sample and every 3 years there</td>
</tr>
<tr>
<td>Training</td>
<td>• Two-day training</td>
<td></td>
<td>after</td>
</tr>
<tr>
<td>Volunteer Time Commitment</td>
<td>• Field work – approximately 3 hours per sample</td>
<td>• Field work – approximately 1 hour per sample</td>
<td>• Field work – approximately 1 hour per sample</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lab work – approximately 3-4 hours per sample</td>
<td></td>
</tr>
<tr>
<td>Financial Resources Required</td>
<td>• Up-front costs to include sampling materials like waders, nets, trays, buckets, sieves, rinse bottles, and utensils</td>
<td>• Up-front costs to include sampling materials (see 3.1) and preservation jars plus laboratory materials like dissecting microscopes, desk lamps, gridded sorting trays, 12-sided die, petri dishes, forceps, and vials</td>
<td>• Up-front costs to include sampling materials (see 3.1) and preservation jars plus laboratory materials like dissecting microscopes, desk lamps, gridded sorting trays, 12-sided die, petri dishes, forceps, and vials</td>
</tr>
</tbody>
</table>

- **MACROS 3.1 Good (AmeriCorps method)**: Sample collection with D-frame net using multi-habitat technique, subsampling and identification performed by volunteers in the field. Sample preservation in the field, 95% ethanol. Sample sorting, subsampling, and identification performed by volunteers in a controlled environment.
- **MACROS 3.2 Better**: Sample collection with D-frame net using multi-habitat technique, sample preservation in the field, 95% ethanol. Sample sorting, subsampling, and identification performed by volunteers in a controlled environment.
- **MACROS 3.3 Best**: Sample collection with D-frame net using multi-habitat technique, sample preservation in the field, 95% ethanol. Sample sent to laboratory for sorting, subsampling, and identification.

- **Taxonomic Level**: MACROS 3.1 offers a mix of Class, Order, and Family, limited to 22 target organisms. MACROS 3.2 offers family level identification (except Annelids at Class level), while MACROS 3.3 offers genus or species level identification.

- **Assessment Indices**: MACROS 3.1 includes Volunteer High Gradient Index, Volunteer Coastal Plain Index, and Volunteer Pinelands Index. MACROS 3.2 includes HGMI – family (high gradient only), while MACROS 3.3 includes HGMI, CPMI, and PMI.

- **Quality Assurance**: MACROS 3.1 requires a 50-organism identification proficiency test before first sample and every 3 years thereafter. MACROS 3.2 requires a 10% of group samples re-identified annually by approved lab. MACROS 3.3 requires all identifications performed by approved lab.

- **Training**: MACROS 3.1 requires two-day training. MACROS 3.2 requires three-day training. MACROS 3.3 requires half-day training.

- **Volunteer Time Commitment**: MACROS 3.1 requires field work – approximately 3 hours per sample. MACROS 3.2 requires field work – approximately 1 hour per sample. Lab work – approximately 3-4 hours per sample. MACROS 3.3 requires field work – approximately 1 hour per sample.

- **Financial Resources Required**: MACROS 3.1 includes up-front costs to include sampling materials like waders, nets, trays, buckets, sieves, rinse bottles, and utensils. MACROS 3.2 includes up-front costs to include sampling materials (see 3.1) and preservation jars plus laboratory materials like dissecting microscopes, desk lamps, gridded sorting trays, 12-sided die, petri dishes, forceps, and vials. Ethanol for preservation. MACROS 3.3 includes up-front costs to include sampling materials (see 3.1) and preservation jars. Ethanol for preservation. Lab identification – approximately $150-250 per sample, plus shipping.
Appendix F. Accreditation/Audit Checklists
Instructions: Observe the volunteer monitor in the field as they run through a full macroinvertebrate and habitat assessment and check off as they perform the following tasks:

- All necessary sampling gear present
- Identify 100 meter stretch
- Identify macroinvertebrate habitat types present
- Begin macroinvertebrate sampling at downstream end
- Used appropriate method for habitat type
  - Disturb 1 foot square area upstream of D-net in riffle area or other sediment
  - Scrape submerged woody debris
  - Jab and sweep vegetation and vegetated banks
  - Rub leaf packs and vegetation
- Take 20 samples from the stream reach, proportional to most productive habitat present at site
- Empty contents of net into sieve bucket after each sample
- Rinse net and sieve bucket into bucket at conclusion of sampling. Check both for clinging organisms and add them to sample bucket.
- Remove larger pieces of debris from sample, checking for clinging macros and adding them to the sample bucket.
- Mix up contents of bucket to take a sub-sample
- Remove all organisms from subsample tray
- Take additional subsamples to obtain at least 100 macros
- Tally macros using sheet, down to order or family level
- Complete biological data sheet
- Collect physical measurements (ex. temperature, width, depth) as needed
- Complete habitat assessment data sheet in full using appropriate sheet
- Decontaminate equipment

Timing Notes:

If after 20 minutes you have not found 25 macroinvertebrates you are to return to the stream to collect more macroinvertebrates to add to the bucket.

If after 40 minutes of sorting you have not found 50 macroinvertebrates you are to return to the stream again to collect a third round of samples to add to the bucket.

If after an hour and a half, and three separate attempts to collect macroinvertebrates to add to the sample in the bucket you are still unable to sort and identify 100 macroinvertebrates you will stop sorting and check the box on the assessment form indicating that you were unable to find 100 macroinvertebrates.
# NEW JERSEY COMMUNITY WATER MONITORING FIELD AUDIT DOCUMENTATION FORM

<table>
<thead>
<tr>
<th>Organization:</th>
<th>Monitoring Tier (circle one):</th>
<th>3.2 &amp; 3.3 preservation</th>
<th>3.1 streamside ID</th>
<th>other</th>
</tr>
</thead>
</table>

## Auditor

<table>
<thead>
<tr>
<th>Name:</th>
<th>Audit Location:</th>
</tr>
</thead>
</table>

## Audit Notes:

## Auditor Signature:  

## Audit Date:

### Monitor 1

<table>
<thead>
<tr>
<th>Name:</th>
<th>Outcome (Pass/Fail):</th>
<th>Corrective Actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro. Collection &amp; ID or Preservation Habitat Assessment</td>
<td>Monitor Signature:</td>
</tr>
</tbody>
</table>

### Monitor 2

<table>
<thead>
<tr>
<th>Name:</th>
<th>Outcome (Pass/Fail):</th>
<th>Corrective Actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro. Collection &amp; ID or Preservation Habitat Assessment</td>
<td>Monitor Signature:</td>
</tr>
</tbody>
</table>

### Monitor 3

<table>
<thead>
<tr>
<th>Name:</th>
<th>Outcome (Pass/Fail):</th>
<th>Corrective Actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro. Collection &amp; ID or Preservation Habitat Assessment</td>
<td>Monitor Signature:</td>
</tr>
</tbody>
</table>

### Monitor 4

<table>
<thead>
<tr>
<th>Name:</th>
<th>Outcome (Pass/Fail):</th>
<th>Corrective Actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro. Collection &amp; ID or Preservation Habitat Assessment</td>
<td>Monitor Signature:</td>
</tr>
</tbody>
</table>

### Monitor 5

<table>
<thead>
<tr>
<th>Name:</th>
<th>Outcome (Pass/Fail):</th>
<th>Corrective Actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro. Collection &amp; ID or Preservation Habitat Assessment</td>
<td>Monitor Signature:</td>
</tr>
</tbody>
</table>

### Monitor 6

<table>
<thead>
<tr>
<th>Name:</th>
<th>Outcome (Pass/Fail):</th>
<th>Corrective Actions:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Macro. Collection &amp; ID or Preservation Habitat Assessment</td>
<td>Monitor Signature:</td>
</tr>
</tbody>
</table>
### Appendix G. Summary of AmeriCorps Schedule and Reference Sites

#### AmeriCorps Assessment Schedule

<table>
<thead>
<tr>
<th>Activity</th>
<th>Projected Start Date</th>
<th>Anticipated Date of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member trainings</td>
<td>September and March/April</td>
<td>September and March/April</td>
</tr>
<tr>
<td>Member QC Check</td>
<td>September and March/April</td>
<td>October and March/April</td>
</tr>
<tr>
<td>Member winter macro ID quizzes</td>
<td>December to February</td>
<td>December to February</td>
</tr>
<tr>
<td>Member macro ID refresher</td>
<td>March</td>
<td>March</td>
</tr>
<tr>
<td>Data collection</td>
<td>October</td>
<td>July</td>
</tr>
</tbody>
</table>

#### AmeriCorps Training Logistical Arrangements:

<table>
<thead>
<tr>
<th>Type of Volunteer Training</th>
<th>Who Will Conduct Training</th>
<th>Frequency of Training/Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sampling Techniques</td>
<td>NJDEP Staff/ The Watershed Institute</td>
<td>Twice per program year: once during orientation and following orientation</td>
</tr>
<tr>
<td>Macroinvertebrate Identification</td>
<td>NJDEP Staff/The Watershed Institute</td>
<td>At least twice per program year: once during orientation and following orientation</td>
</tr>
</tbody>
</table>

#### Sampling Design Logistics for Each WMA

<table>
<thead>
<tr>
<th>Type of Sample/Parameter</th>
<th>Number of Stations</th>
<th>Sampling Frequency</th>
<th>Sampling Period*</th>
<th>Sampling Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td>A minimum of 3</td>
<td>Once/year</td>
<td>October to December</td>
<td>TBD in each WMA according to Department and local priorities</td>
</tr>
<tr>
<td>Habitat</td>
<td>A minimum of 5</td>
<td>Once/year</td>
<td>October to December</td>
<td></td>
</tr>
<tr>
<td>Biological &amp; Habitat</td>
<td>A minimum of 10</td>
<td>Ambassadors are given the option to repeat up to 2 of the fall assessments.</td>
<td>March to July</td>
<td></td>
</tr>
<tr>
<td>Biological &amp; Habitat</td>
<td>1</td>
<td>Once/year</td>
<td>Last week in May</td>
<td>Climate Change Site</td>
</tr>
</tbody>
</table>

*Exact dates vary, but biological assessments should not be done when Air °F + Water °F < 100°F.

#### AmeriCorps Reference Site Locations

<table>
<thead>
<tr>
<th>Region</th>
<th>WMAs in Region</th>
<th>Site</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Delaware</td>
<td>1, 2, 11</td>
<td>Hakhokake Creek</td>
<td>40.619589</td>
<td>-75.077796</td>
</tr>
<tr>
<td>Northeast</td>
<td>3, 4, 5, 6</td>
<td>Primrose Brook</td>
<td>40.768281</td>
<td>-74.532419</td>
</tr>
<tr>
<td>Raritan</td>
<td>7, 8, 9, 10</td>
<td>Little Brook</td>
<td>40.737141</td>
<td>-74.622499</td>
</tr>
<tr>
<td>Atlantic Coastal</td>
<td>12, 13, 14, 15, 16</td>
<td>Toms River</td>
<td>40.095908</td>
<td>-74.320107</td>
</tr>
<tr>
<td>Lower Delaware</td>
<td>17, 18, 19, 20</td>
<td>Mt Misery Brook</td>
<td>39.929073</td>
<td>-74.531229</td>
</tr>
</tbody>
</table>
Appendix H. Maps of WMAs and Bioassessment Regions

New Jersey's Watershed Management Areas

1. Upper Delaware
2. Wallkill
3. Pompton, Pequannock, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack, Hudson, and Pascack
6. Upper Passaic, Whippany, and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River, and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem, and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks, and Doctors

Water Regions
- Upper Delaware Region
- Passaic Region
- Raritan Region
- Atlantic Coastal Region
- Lower Delaware Region

Legend
- Climate Change Sites
  - WMAs
  - HGBM Boundary
  - CPMI Boundary

High Gradient
“Rocky Bottom” Streams

Low Gradient
“Muddy Bottom” Streams

Pinelands
“Muddy Bottom” Streams
Appendix I. Summary of Tier 3.1/AmeriCorps Data Quality Requirements and Assessments

Refer to the Biological and Habitat Quality Assurance Project Plan for details.

Measurement Quality Objectives (from QAPP Section 12.1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measurement Range</th>
<th>Accuracy</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic Coordinates via Smartphone and/or Google maps</td>
<td>± 90°N and ± 90°E depending on satellite availability</td>
<td>Unbiased</td>
<td>±100 feet</td>
</tr>
<tr>
<td>Biological Assessment Score</td>
<td>See Appendix F for Indices/Ratings</td>
<td>5 % margin of error allowed</td>
<td></td>
</tr>
<tr>
<td>Macroinvertebrate ID QA/QC Check</td>
<td>See QC section</td>
<td>90% accuracy compared with known sample</td>
<td></td>
</tr>
<tr>
<td>Thermometer</td>
<td>0 °C - 40 °C</td>
<td>Must be calibrated within +/- 0.5°C</td>
<td>0.1 °C</td>
</tr>
<tr>
<td>Reference Site Visits to verify field protocols</td>
<td>See QC section</td>
<td>Ambassador must not deviate significantly from appropriate techniques</td>
<td></td>
</tr>
</tbody>
</table>

Data Representativeness
Each AmeriCorps member will be monitoring one of the 20 watersheds throughout the state. Within the state we have diverse land uses and three defined ecoregions: Coastal Plains, Pinelands and High Gradient. Land uses include rural, suburban and urban classifications. Each watershed differs depending on these ecoregions and land use classifications. The training designed for the Ambassadors has been tailored to cut down on regional biases as much as possible so sites across watershed boundaries are comparable to each other. Members are also individually evaluated to determine their accuracy in identifying the organisms used for the assessment protocol.

Data Comparability
Members are trained on how to collect, sort and analyze samples in accordance with NJDEP procedures. They are trained to identify the best possible habitat within their 100 meter stream reach for collection purposes. Because sorting macroinvertebrates to the order/family level is critical to properly scoring the stream segment, members are evaluated multiple times throughout the year. If a member fails the QA/QC check and does poorly on the lab review and pre and post testing for training, the NJDEP will determine if the data collected is within the defined QA/QC requirements. Members not able to achieve the accuracy needed will still submit the data as needed for their requirements, however the data will not be used for assessment purposes and will be flagged.

Naming Sites
Members are asked to check whether a site has already been named by a previous Ambassador, USGS or is currently one of the Department’s Bureau of Freshwater and Biological Monitoring’s sites. Sites will be named in accordance with procedures documented in the Quality Assurance Project Plan. Site naming will be consistent for all monitoring activities.
**Data Completeness**

Data will be checked for completeness first by the AmeriCorps member prior to leaving the field assessment location. All fields will be checked to ensure they are filled out and the data sheet is complete. An incomplete web sheet will not count as an assessment towards their assessment goals for the program. Completeness will then be checked again when Ambassadors enter data onto the Biological Assessment GeoForm. Data will not upload properly via the GeoForm web system if fields are not filled in.

**Data Validation**

Review of the datasheets will be conducted by the Data QA Manager. If incomplete or inaccurate data appears to be submitted, the Data QA Manager will consult the Watershed Ambassador to request that the data be reviewed and corrected. Once the Data QA Manager is satisfied with the quality of data residing in GeoForm, they will move the records from GeoForm, to an internal MS Access database customized specifically for AmeriCorps. The Data QA Manager will check the data again once it is in the AmeriCorps database. The Data QA Manager will review and verify such things as the Site ID and name, site coordinates, data results are within acceptable ranges and flagging Ambassadors that do not pass the QA/QC tests.

Ambassadors will also submit hard copies of their assessments at the end of their term of service. Data that are incomplete or anomalous will be evaluated for their utility. Anomalous data will be scrutinized carefully to determine whether any portion of the data is valid, and whether questionable data can be rectified with follow-up field assessments by Program staff. Anomalous data which cannot be corrected or completed will be entered but will be flagged as preliminary and unverified data. Similarly, incomplete data will be flagged in the data sets as partial data records. Any data that does not match up with the configuration file will be rejected from the system.

If regulated pollution incidents are observed by volunteers during their surveys, they will be instructed to report the pollution incident to the NJDEP hotline at 1-877-WARN DEP (1-877-927-6337) or app and any other appropriate agencies and alert Program staff of the problem for follow-up.
Appendix J. Sites
<table>
<thead>
<tr>
<th>WMA</th>
<th>SiteType_1</th>
<th>HUC14</th>
<th>WAP_ID</th>
<th>SiteName</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fixed</td>
<td>HUC02040105050300</td>
<td>WA0024</td>
<td>Trout Brook at Stillwater Rd (Rt 521)</td>
<td>41.055834</td>
<td>-74.861704</td>
</tr>
<tr>
<td>1</td>
<td>Fixed</td>
<td>HUC02040105050500</td>
<td>WA0029</td>
<td>Jacksonburg Creek at Rt 94</td>
<td>40.987607</td>
<td>-74.978714</td>
</tr>
<tr>
<td>1</td>
<td>Fixed</td>
<td>HUC02040105070000</td>
<td>WA0039</td>
<td>Pequest River at Rt 615/Long Bridge Rd</td>
<td>40.921280</td>
<td>-74.840710</td>
</tr>
<tr>
<td>1</td>
<td>Fixed</td>
<td>HUC02040105100000</td>
<td>WA0047</td>
<td>Beaver Brook at Sarepta Rd</td>
<td>40.842010</td>
<td>-75.049158</td>
</tr>
<tr>
<td>1</td>
<td>Fixed</td>
<td>HUC02040105140000</td>
<td>WA0056</td>
<td>Brass Castle Creek at Brass Castle Rd (Rt 623)</td>
<td>40.765101</td>
<td>-75.028227</td>
</tr>
<tr>
<td>1</td>
<td>Targeted</td>
<td>HUC02040104150000</td>
<td>WAFLBK1</td>
<td>Flat Brook at Walpack Rd</td>
<td>41.183318</td>
<td>-74.857707</td>
</tr>
<tr>
<td>1</td>
<td>Targeted</td>
<td>HUC02040105030000</td>
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<td>Pequannock River Trib at Vernon Stockholm Rd</td>
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<td>Stone House Brook at Kakeout Rd</td>
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<td>Blue Mine Brook at Snake Den Rd</td>
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<td>Ringwood Creek at Ringwood Park</td>
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<td>Bear Swamp Brook at Bear Swamp Rd/Cannonball Rd</td>
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<td>Goffle Brook at Lake Ave</td>
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<td>Hohokus Brook at Park Ave</td>
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<td>Saddle River at Old Stone Church Rd</td>
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<td>West Branch Saddle River at Old Stone Church Rd</td>
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<td>Hackensack River at E Ridgewood Ave</td>
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<td>Diamond Brook at Thielke Arboretum</td>
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<td>Third River behind Burlington Department Store</td>
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<td>Nishvane Brook at Canterbury Park</td>
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<td>McDonald Brook at Garfield Ave/Mayor Johnson Park</td>
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<td>Tenakill Brook at Closter Dock Rd (Cedar Ln)</td>
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<td>Dwars Kill at the end of Anderson Ave</td>
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<td>41.010142</td>
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<td>Musquapsink Brook at Hillsdale Ave</td>
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<td>Hillsdale Brook at Beechcrest Dr</td>
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<td>Holdrum Brook at Pascack Valley High School</td>
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<td>Indian Grave Brook at Hardscrabble Rd</td>
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<td>WA0215B</td>
<td>Primrose Brook at Jockey Hollow Rd</td>
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<td>Whippany River at Morris Rd</td>
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<td>Russia Brook at Dover-Milton Rd</td>
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<td>Beaver Brook at Lyonville Rd</td>
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<td>Foulertons Brook Behind Speech and Hearing Associates</td>
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<td>Whippny River at Patriots Path (former site name Lewis Morris Park)</td>
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<td>Whippany River NB Trib at Koch Ave</td>
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<td>WAJACKBROOK2</td>
<td>Jackson Brook at Hedden Park</td>
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<td>WASTONTRIB01</td>
<td>Stony Brook at Pyramid Mountain, by Blue Trail Bridge</td>
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<td>Whippany River On Washington Valley Road</td>
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<td>WAWHIP03</td>
<td>Whippany River near Morristown NJ</td>
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<td>Elizabeth River at North Ave</td>
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<td>Rahway River at Brookside Dr</td>
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<td>Rahway River at River Rd &amp; Church St</td>
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<td>Blackwater Branch near Maurice River Parkway</td>
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<td>Big Timber Creek North Branch at Park Ave (Rt 696)</td>
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<td>South Branch Rancocas Creek at Bed Bug Hill Rd</td>
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<td>Barton Run Trib at Dutch Rd</td>
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<td>Assiscunk Creek Trib at Oxmead Rd</td>
<td>40.052216</td>
<td>-74.820489</td>
</tr>
<tr>
<td>20</td>
<td>Targeted</td>
<td>HUC02040201050070</td>
<td>WACROSTrib1</td>
<td>Crosswicks Creek at Ward Ave</td>
<td>40.154370</td>
<td>-74.655178</td>
</tr>
<tr>
<td>20</td>
<td>Targeted</td>
<td>HUC02040201060010</td>
<td>WA0127A</td>
<td>Doctors Creek at Yellow Meeting House Rd</td>
<td>40.177000</td>
<td>-74.457000</td>
</tr>
<tr>
<td>20</td>
<td>Targeted</td>
<td>HUC02040201060030</td>
<td>WAINDI2</td>
<td>Indian Run at Breza Rd</td>
<td>40.180237</td>
<td>-74.599203</td>
</tr>
<tr>
<td>20</td>
<td>Targeted</td>
<td>HUC02040201070020</td>
<td>WATHOR4</td>
<td>Thorton Creek at Spring Street Park</td>
<td>40.150163</td>
<td>-74.706559</td>
</tr>
<tr>
<td>20</td>
<td>Targeted</td>
<td>HUC02040201100030</td>
<td>WA01464585</td>
<td>Barkers Brook Trib at Heddin Jacksonville Rd</td>
<td>40.041773</td>
<td>-74.766937</td>
</tr>
</tbody>
</table>
Appendix K. Site Reconnaissance Forms
# SITE RECONNAISSANCE DATA SHEET

<table>
<thead>
<tr>
<th>Date:</th>
<th>Name:</th>
<th>Organization:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Site Name (if any):</th>
<th>Stream:</th>
<th>Location Description:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Lat.:</th>
<th>Coordinates collected by: (circle)</th>
<th>GPS</th>
<th>Smart Phone Map Interpolation</th>
<th>Parking and Access Notes:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Long.:</th>
<th>Property Owner:</th>
<th>Permission Received: (circle/explain)</th>
<th>Verbal</th>
<th>Written</th>
<th>None</th>
<th>Habitat and Water Conditions: (riffle habitat, depth, etc)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Photos Taken?</th>
<th>Final Assessment:</th>
</tr>
</thead>
</table>

## SITE SKETCH

**IN SITE SKETCH:** Indicate roads, buildings, landmarks, parking area, access point(s) to stream, stream flow direction, in-stream habitat for macroinvertebrate sampling (i.e. riffles, pools, aquatic vegetation, woody debris).
<table>
<thead>
<tr>
<th>Site Name (if any)</th>
<th>Stream Name</th>
<th>Location Description</th>
<th>Lat/Long</th>
<th>Property Owner</th>
<th>Parking and Access Notes</th>
<th>Habitat and Water Conditions For Sampling</th>
<th>Final Site Assessment (Yes or No)</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
Appendix L. Glossary of Biomonitoring Terms

Algae: A chlorophyll-containing plant ranging from one to many cells in size that lives in fresh or salt water.

Baseflow: The portion of stream flow that is derived from groundwater; average stream discharge during low flow conditions.

Benthic (Bottom-dwelling): The plant and animal life whose habitat is the bottom of a sea, lake, or river.

Channelization: Straightening of a stream channel to make water move faster.

Channelized: The straightening and deepening of streams. Channelization reduces the ability of the stream to assimilate waste and disturbs fish breeding areas.

Culvert: A channel used for draining water, often enclosed in steel, concrete, or plastic; can be used to allow water to pass underneath a road or embankment.

Ecosystem: The interacting system of a biological community (plants, animals) and its non-living environment.

Effluent: The wastewater from a municipal or industrial source that is discharged into the water.

Embeddedness: The degree to which objects in the stream bottom are surrounded by sediment.

Erosion: The wearing away of the land surface by wind or water.

Eutrophication: A process where water bodies receive excess nutrients that stimulate excessive plant growth.

Floodplain: The flat area of land adjacent to a stream that is formed by flood processes.

Gradient: The slope or steepness of the stream.

Macrophytes: Aquatic plants, growing in or near water that are either emergent, submergent, or floating.

Macroinvertebrate: Organisms found attached to rocks or within the sediments of the stream bed, often larval stages of insects and are indicative of stream health.

Non-Point Source Pollution: “Diffuse” pollution, generated from large areas with no particular point of pollutant origin, but rather from many individual places. Urban and agricultural areas generate nonpoint source pollutants.

Nutrient: Any substance, such as fertilizer, phosphorus, and nitrogen compounds, which enhances the growth of plants and animals.

Point Source Pollution: A discharge of water pollution to a stream or other body of water, via an identifiable pipe, vent, or culvert.
Pool: An area of relatively deep slow water in a stream that offers shelter to fish.

**Quality Assurance (QA):** Quality Assurance is the larger system to see that Quality Control (QC) is maintained. QA asks if we are doing the right things (in our case are we monitoring the right things to detect changes in water quality).

**Reach:** A stream section with fairly similar characteristics.

**Riffle:** A shallow, gravelly area of streambed with swift current where water is breaking over rocks, wood, or other partly submerged debris and producing surface agitation.

**Riprap:** A sustaining wall built of rocks.

**Riparian Zone:** An area, adjacent to and along a watercourse, which is often vegetated and constitutes a buffer zone between the nearby lands and the body of water.

**Run:** A stretch of fast smooth current, deeper than a riffle.

**Runoff:** The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually returns to streams. Runoff can pick up pollutants from the air or the land and carry them to streams, lakes, and oceans.

**Sediment:** Fine soil or mineral particles that settle to the bottom of the water or are suspended in the water.

**Stormwater Runoff:** Water that washed off the land after a rainstorm. In developed watersheds it flows off of roofs and pavement into storm drains which may feed directly into the stream; often carries concentrated pollutants.

**Substrate:** The material that makes up the bottom layer of the stream, such as gravel, sand, or bedrock.

**Suspended Sediments:** Fine material or soil particles that remain suspended by the current until deposited in areas of weaker current. They create turbidity and when deposited, can smother fish eggs or early plant growth.

**Topographic:** The configuration of a surface area including its relief, or relative elevations, and the position of its natural and man-made features.

**Turbidity:** Cloudiness of the water, caused by suspended sediments or excess organic matter.
Appendix M. Glossary of Habitat Terms

**Algae:** A chlorophyll-containing plant ranging from one to many cells in size that lives in fresh or salt water.

**Baseflow:** The portion of stream flow that is derived from groundwater; average stream discharge during low flow conditions.

**Benthic** (Bottom-dwelling): The plant and animal life whose habitat is the bottom of a sea, lake, or river.

**Channelization:** Straightening of a stream channel to make water move faster.

**Channelized:** The straightening and deepening of streams. Channelization reduces the ability of the stream to assimilate waste and disturbs fish breeding areas.

**CPOM:** Coarse Particulate Organic Matter. Material of plant or animal origin that is suspended in water.

**Culvert:** A channel used for draining water, often enclosed in steel, concrete, or plastic; can be used to allow water to pass underneath a road or embankment.

**Ecosystem:** The interacting system of a biological community (plants, animals) and its non-living environment.

**Effluent:** The wastewater from a municipal or industrial source that is discharged into the water.

**Embeddedness:** The degree to which objects in the stream bottom are surrounded by sediment.

**Erosion:** The wearing away of the land surface by wind or water.

**Eutrophication:** A process where water bodies receive excess nutrients that stimulate excessive plant growth.

**Floodplain:** The flat area of land adjacent to a stream that is formed by flood processes.

**Geospatial:** Of or relating to the relative position of things on the earth's surface.

**Gradient:** The slope or steepness of the stream.

**Habitat:** The natural environment in which a species or group of species lives.

**Macrophytes:** Aquatic plants, growing in or near water that are either emergent, submergent, or floating.

**Macroinvertebrate:** Organisms found attached to rocks or within the sediments of the stream bed, often larval stages of insects and are indicative of stream health.

**Non-Point Source Pollution:** “Diffuse” pollution, generated from large areas with no particular point of pollutant origin, but rather from many individual places. Urban and agricultural areas generate nonpoint source pollutants.
**Nutrient:** Any substance, such as fertilizer, phosphorus, and nitrogen compounds, which enhances the growth of plants and animals.

**Outfall:** The outlet or place of discharge of a river, drain, sewer, etc.

**Point Source Pollution:** A discharge of water pollution to a stream or other body of water, via an identifiable pipe, vent, or culvert.

**Pool:** An area of relatively deep slow water in a stream that offers shelter to fish.

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**Substrate:** The material that makes up the bottom layer of the stream, such as gravel, sand, or bedrock.

**Suspended Sediments:** Fine material or soil particles that remain suspended by the current until deposited in areas of weaker current. They create turbidity and when deposited, can smother fish eggs or early plant growth.

**Topographic:** The configuration of a surface area including its relief, or relative elevations, and the position of its natural and man-made features.

**Turbidity:** Cloudiness of the water, caused by suspended sediments or excess organic matter.
Vegetation: All the plants or plant life of a place, taken as a whole
Appendix N. Glossary of Quality Assurance Terms
(from www.epa.gov and www.nj.gov/dep)

**Acceptance criteria** - criteria that specify the limit below which data quality is not considered satisfactory and above which the data is considered satisfactory

**Accuracy** - how well a measurement agrees with an accepted value or acceptance criteria; the degree of agreement between an observed value and an accepted value; a data quality indicator

**Assemblage** - the association of interacting organisms of a given population in a specific waterbody

**Bias** - the distortion of a measurement that disrupts the representativeness

**Biological Assessment/Bioassessment** - an evaluation of the condition of a waterbody using biological surveys and other direct measurements of the resident biota in the waters

**Biological integrity** - the condition of an aquatic community inhabiting unimpaired waterbodies of a specified habitat by an assessment of multiple attributes of the aquatic biota; such attributes include (1) the product of the evolutionary process for the specific location, (2) inclusive of a broad range of ecological characteristics such as species richness and trophic level, and (3) is found in the biogeographic region of the study

**Biomonitoring** - multiple, routine biological assessments over time using consistent sampling and analysis methods for detection of changes in biological condition

**Calibration** - a procedure which checks or adjusts an instrument’s accuracy by comparison with a standard or reference

**Comparability** - the degree to which different methods and/or data sets agree or can be represented as similar; the ability to describe likenesses and differences in the quality and relevance of two or more data sets; a data quality indicator

**Completeness** - the amount of valid data obtained compared to the planned amount; usually expressed as a percentage; a data quality indicator

**Confidence interval** - an interval that has the stated probability of containing the true value of a fixed, but unknown, parameter

**Confidence level** - the level of certainty which an estimate can be trusted; the probability, usually expressed as a percentage, that a confidence interval will include a specific population parameter; usually range from 90 to 99 percent

**Data Quality Objectives (DQO’s)** - qualitative and quantitative statements developed by data users to specify the quality of data needed to support specific decisions; describe the decision to be made, what data are required, why they are needed, that calculations in which they will be used, and time and resource constraints

**Indicator** - characteristics of the environment, both abiotic and biotic, that provide quantitative information on ecological resources

**Measured value** - the result of an individual’s measurement of a quantifiable property

**Precision** - how well a series of measurements agree with each other; it may be determined by calculating the standard deviation, or relative difference, among samples taken from the

**Qualitative data** - information that is difficult to measure, count, or express numerically; the attributes, behavior, or opinions of the entity being measured; descriptive in character; subjective

**Quality Assurance (QA)** - an overall management plan to ensure the integrity of data
Quality Assurance Project Plan (QAPP) – a written document describing the Quality Assurance procedures, Quality Control specifications, and any other technical activities that must be followed to ensure the results of a project or task performed will meet project specifications.

Quality Control (QC) - a series of analytical measurements used to assess the quality of analytical data.

Quality objectives – the upper and lower limiting values of data quality indicators as defined by the data user’s acceptable error boundaries.

Quantitative data – information that can be measured, counted, expressed numerically, or compared on a scale; non-subjective.

Raw data – data that have not been manipulated in any way.

Reference condition – the set of selected measurements or conditions of a minimally impaired waterbody that is characteristic of a waterbody in a certain region.

Reference site – a specific location on a waterbody that is minimally impaired and is representative of the expected ecological integrity of other waterbodies nearby.

Representativeness - the degree to which data accurately and precisely represent the frequency distribution of a specific variable in the population; a data quality indicator.

True value - the known acceptable value of a quantifiable property.

Validation – the process of substantiating specified performance criteria; the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set.

Verifiable – the ability to be proven.
Appendix O. Field Data Forms
**AmeriCorps Habitat and Macroinvertebrate Data Sheet - High Gradient**

**New Jersey Department of Environmental Protection**

**Date:**  
**Time:**  
**WMA:**  
**County:**  

**Investigators:**  
(Example: J. Doe)  

**Site Name:**

<table>
<thead>
<tr>
<th>Investigator(s)</th>
<th>Site Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Doe</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Approximate Reach Length (aim for 100m)</th>
<th>Days Since Last Rain</th>
<th>Air Temp (°C)</th>
<th>Water Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Today’s Weather:**  
☐ Clear  
☐ Steady Rain  
☐ Partly Cloudy  
☐ Heavy Rain  
☐ Overcast  
☐ Snow  
☐ Light Rain (no runoff)  
☐ Heavy Snow Melt

**Stream Measurements**

Width, Depth, and Velocity should all be taken in the same place (the most representative)

<table>
<thead>
<tr>
<th>Wetted Width =</th>
<th>Transect Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Use 10 feet or 3.048 meters for velocity distance</td>
</tr>
<tr>
<td></td>
<td>- Convert all measurements to meters before submitting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth ______, ______, ______, ______, ______ = Average ______ meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity ______, ______, ______, ______, ______ = Average ______ meters</td>
</tr>
</tbody>
</table>

Distance / Average Time = _____ meters/seconds

☐ Check here if this section is not completed due to non-wadable assessment.

**Water Conditions:** Choose one option from each section (the most representative)

- **Stream Flow:**  
  - ☐ Slow (barely moving or not at all)  
  - ☐ Moderate (clearly moving, surface flat)  
  - ☐ Swift (clearly moving, surface disturbed)  
  - ☐ Combination

- **Water Odor:**  
  - ☐ Normal  
  - ☐ Sewage  
  - ☐ Petroleum  
  - ☐ Chemical  
  - ☐ Anaerobic (rotten eggs)  
  - ☐ Other:

- **Turbidity:**  
  - ☐ Clear  
  - ☐ Slightly turbid  
  - ☐ Turbid

- **Surface Coating:**  
  - ☐ None  
  - ☐ Oil  
  - ☐ Foam  
  - ☐ Scum  
  - ☐ Other:

**Stream Characteristics:** Choose one option from each section (the most representative)

- **Predominant Aquatic Vegetation Types:**  
  - ☐ Rooted emergent  
  - ☐ Rooted submergent  
  - ☐ Rooted floating  
  - ☐ Free floating  
  - ☐ No vegetation

- **Algae Growth:**  
  - ☐ Abundant  
  - ☐ Moderate  
  - ☐ Scarce  
  - ☐ None

- **Algae Location:**  
  - ☐ Periphyton  
  - ☐ Filamentous  
  - ☐ None

- **Woody Debris:**  
  - ☐ Abundant  
  - ☐ Moderate  
  - ☐ Scarce  
  - ☐ None

- **Tee Canopy:**  
  - ☐ Open (0-25%)  
  - ☐ Mostly Open (25-50%)  
  - ☐ Mostly Closed (50-75%)  
  - ☐ Mostly Closed/Closed (75-100%)

- **In-Stream Structures:**  
  - ☐ Bridge  
  - ☐ Culvert  
  - ☐ Dam  
  - ☐ Other:

- **Litter Concentration:**  
  - ☐ Present, how much: _____%  
  - ☐ Absent

**COMPLETE THIS SECTION ONLY IF MACROINVERTEBRATE SAMPLING WAS PERFORMED.**

<table>
<thead>
<tr>
<th>Habitat Types Present</th>
<th>Benthic Substrate Characterization (must equal 100%)</th>
<th>Macroinvertebrate Sorting Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Fine Woody Debris</td>
<td>☐ Organic % (0.004-0.06 mm)</td>
<td>☐ Streamside Field Identification</td>
</tr>
<tr>
<td>☐ Leaf Packs</td>
<td>☐ Silt % (0.004-0.06 mm)</td>
<td>☐ Detritus Preservation</td>
</tr>
<tr>
<td>☐ Boulders</td>
<td>☐ Sand % (0.06-2mm, gritty)</td>
<td>(A) Tier 3.1: Macroinvertebrate Tally Sheet</td>
</tr>
<tr>
<td>☐ Vegetated bank Margins</td>
<td>☐ Gravel % (2-64mm, 0.1-2.5&quot;)</td>
<td>(B) Tier 3.3: Chain of Custody Form</td>
</tr>
<tr>
<td>☐ Submerged Logs</td>
<td>☐ Cobble % (6-256mm, 2.5-10&quot;)</td>
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<tr>
<td>☐ Cobble</td>
<td>☐ Boulder % (&gt;256mm, &gt;10&quot;)</td>
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</tr>
<tr>
<td>☐ Coarse Gravel</td>
<td>☐ Bedrock % (unbroken)</td>
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<tr>
<td>☐ Other:</td>
<td>☐ Other %</td>
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</table>
### Site ID: [ ] Date: [ ]

<table>
<thead>
<tr>
<th>Land Use Characteristics: Mark off features present within viewing distance of your stream reach (¼ Mile Radius)</th>
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<tbody>
<tr>
<td>- Agricultural Feed Lots</td>
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<tr>
<td>- Athletic Fields</td>
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<tr>
<td>- Camping</td>
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<tr>
<td>- Cemetery</td>
</tr>
<tr>
<td>- Commercial</td>
</tr>
<tr>
<td>- Construction</td>
</tr>
<tr>
<td>- Cropland</td>
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<tr>
<td>- Dumping</td>
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<tr>
<td>- Golfing/ Resorts</td>
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<tr>
<td>- Hiking/ Paths</td>
</tr>
<tr>
<td>- Horse Trails</td>
</tr>
<tr>
<td>- Inactive Fields</td>
</tr>
<tr>
<td>- Industrial Plants</td>
</tr>
<tr>
<td>- Livestock Use</td>
</tr>
<tr>
<td>- Maintained Lawns</td>
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<tr>
<td>- Marinas</td>
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</tbody>
</table>

#### Comments/Observations (Habitat Assessment):

#### Comments/Observations (Biological Assessment):

What do you believe to be the greatest potential threat to the stream both now and in the future?

**Site Sketch**: (Indicate roads, buildings, landmarks, parking area, access point(s) to stream, stream flow direction, in-stream habitat for macroinvertebrate sampling (i.e. riffles, pools, aquatic vegetation, woody debris), outfalls, etc.)

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### HABITAT ASSESSMENT FOR HIGH GRADIENT STREAMS

<table>
<thead>
<tr>
<th>Habitat Parameter</th>
<th>Optimal</th>
<th>Suboptimal</th>
<th>Marginal</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Epifaunal Substrate/Available Cover</strong></td>
<td>Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).</td>
<td>40-70% mix of stable habitat; well-nurtured for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may rate at high end of scale).</td>
<td>20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.</td>
<td>Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.</td>
</tr>
<tr>
<td><strong>Score</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Embeddeness</strong></td>
<td>Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.</td>
<td>Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.</td>
<td>Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.</td>
<td>Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.</td>
</tr>
<tr>
<td><strong>Score</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Velocity/Depth Combinations</strong></td>
<td>All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is &lt;0.3 m/s, deep is &gt;0.5 m/s)</td>
<td>Only 3 of the 4 regimes present (if fast-shallow is missing, score lower if missing other regimes).</td>
<td>Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).</td>
<td>Dominated by 1 velocity / depth regime (usually slow-deep).</td>
</tr>
<tr>
<td><strong>Score</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Sediment Deposition</strong></td>
<td>Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.</td>
<td>Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.</td>
<td>Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition of pools prevalent.</td>
<td>Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.</td>
</tr>
<tr>
<td><strong>Score</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Channel Flow Status</strong></td>
<td>Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.</td>
<td>Water fills &gt;75% of the available channel; or &lt;25% of channel substrate is exposed.</td>
<td>Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.</td>
<td>Very little water in channel and mostly present as standing pools.</td>
</tr>
<tr>
<td><strong>Score</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Channel Alteration</strong></td>
<td>Channelization or dredging absent or minimal; stream with normal pattern.</td>
<td>Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.</td>
<td>Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.</td>
<td>Banks shaded with gabion or cement; over 80% of the stream reach channelized and disrupted.</td>
</tr>
<tr>
<td><strong>Score</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Frequency of Riffles</strong></td>
<td>Occurrence of riffles relatively frequent; distance between riffles is 5-7 times stream width; variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.</td>
<td>Occurrence of riffles infrequent; distance between riffles is 7 to 15 times stream width.</td>
<td>Occasional riffle or bend; bottom contours provide some habitat; distance between riffles is 15 to 25 times stream width.</td>
<td>Generally all flat water or shallow riffles; poor habitat; distance between riffles is &gt;25 times stream width.</td>
</tr>
<tr>
<td><strong>Score</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Bank Stability (score each bank, facing upstream)</strong></td>
<td>Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. &lt;5% of bank affected.</td>
<td>Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.</td>
<td>Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.</td>
<td>Unstable; many eroded areas; &quot;raw&quot; areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.</td>
</tr>
<tr>
<td><strong>Score (Lb)</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Score (Rb)</strong></td>
<td>10 9</td>
<td>8 7 6</td>
<td>5 4 3 2 1 0</td>
<td></td>
</tr>
<tr>
<td><strong>Bank Vegetation Protection (score each bank)</strong></td>
<td>More than 90% of the streambank surfaces immediately riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.</td>
<td>70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant substrate height remaining.</td>
<td>50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant substrate height remaining.</td>
<td>Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.</td>
</tr>
<tr>
<td><strong>Score (Lb)</strong></td>
<td>20 19 18 17 16</td>
<td>15 14 13 12 11</td>
<td>10 9 8 7 6</td>
<td>5 4 3 2 1 0</td>
</tr>
<tr>
<td><strong>Score (Rb)</strong></td>
<td>10 9</td>
<td>8 7 6</td>
<td>5 4 3 2 1 0</td>
<td></td>
</tr>
<tr>
<td><strong>Riparian Vegetative Zone Width</strong></td>
<td>Width of riparian zone &gt;18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.</td>
<td>Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.</td>
<td>Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.</td>
<td>Width of riparian zone &lt;6 meters; little or no riparian vegetation due to human activities.</td>
</tr>
<tr>
<td><strong>Score (Lb)</strong></td>
<td>10 9</td>
<td>8 7 6</td>
<td>5 4 3 2 1 0</td>
<td></td>
</tr>
<tr>
<td><strong>Score (Rb)</strong></td>
<td>10 9</td>
<td>8 7 6</td>
<td>5 4 3 2 1 0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Score Value:</th>
<th><strong>HABITAT SCORES</strong></th>
<th><strong>VALUE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPTIMAL</strong></td>
<td>160 – 200</td>
<td></td>
</tr>
<tr>
<td><strong>SUB-OPTIMAL</strong></td>
<td>110 – 159</td>
<td></td>
</tr>
<tr>
<td><strong>MARGINAL</strong></td>
<td>60 – 109</td>
<td></td>
</tr>
<tr>
<td><strong>POOR</strong></td>
<td>&lt; 60</td>
<td></td>
</tr>
</tbody>
</table>
## AmeriCorps Habitat and Macroinvertebrate Data Sheet - Low Gradient

### New Jersey Department of Environmental Protection

#### Date:  Time:  WMA:  County:  Investigators:

**Example:** J. Doe  **Site Name:**

**Site ID:**  **Latitude:**  **Longitude:**

#### Approximate Reach Length (aim for 100m):

#### Days Since Last Rain:

#### Air Temp (ºC):

#### Water Temp (ºC):

#### Today’s Weather:

- [ ] Clear
- [ ] Steady Rain
- [ ] Partly Cloudy
- [ ] Heavy Rain
- [ ] Overcast
- [ ] Snow
- [ ] Light Rain (no runoff)
- [ ] Heavy Snow Melt

### Stream Measurements

- **Width, Depth, and Velocity should all be taken in the same place (the most representative):**
  - Wetted Width = _______

- **Depth**:
  - ______, ______, ______, ______, ______ = Average ______ meters

- **Velocity**:
  - ______, ______, ______, ______, ______ = Average ______ meters

  Distance / Average Time = _____ meters/seconds

- [ ] Check here if this section is not completed due to non-wadable assessment.

### Water Conditions: Choose one option from each section (the most representative)

#### Stream Flow:

- [ ] Slow (barely moving or not at all)
- [ ] Moderate (clearly moving, surface flat)
- [ ] Swift (clearly moving, surface disturbed)
- [ ] Combination

#### Water Odor:

- [ ] Normal
- [ ] Sewage
- [ ] Petroleum
- [ ] Chemical
- [ ] Anaerobic (rotten eggs)
- [ ] Other:

#### Turbidity:

- [ ] Clear
- [ ] Slightly turbid
- [ ] Turbid

#### Surface Coating:

- [ ] None
- [ ] Oil
- [ ] Foam
- [ ] Scum
- [ ] Other:

### Algae Location:

- [ ] Periphyton
- [ ] Filamentous
- [ ] None

### Litter Concentration:

- [ ] Present, how much: _____%
- [ ] Absent

### In-Stream Structures:

- [ ] Bridge
- [ ] Culvert
- [ ] Dam
- [ ] Other:

### Stream Characteristics: Choose one option from each section (the most representative)

#### Predominant Aquatic Vegetation Types:

- [ ] Rooted emergent
- [ ] Rooted submergent
- [ ] Rooted floating
- [ ] Free floating
- [ ] No vegetation

#### Algae Growth:

- [ ] Abundant
- [ ] Moderate
- [ ] Scarce
- [ ] None

#### Algae Location:

- [ ] Periphyton
- [ ] Filamentous
- [ ] None

#### Woody Debris:

- [ ] Abundant
- [ ] Moderate
- [ ] Scarce
- [ ] None

#### Tree Canopy:

- [ ] Open (0-25%)
- [ ] Mostly Open (25-50%)
- [ ] Mostly Closed (50-75%)
- [ ] Mostly Closed/Closed (75-100%)

### COMPLETE THIS SECTION ONLY IF MACROINVERTEBRATE SAMPLING WAS PERFORMED.

#### Habitat Types Present:

- [ ] Fine Woody Debris
- [ ] Leaf Packs
- [ ] Boulder
- [ ] Vegetated bank margins
- [ ] Submerged Logs
- [ ] Cobble
- [ ] Coarse gravel
- [ ] Other:

#### Benthic Substrate Characterization (must equal 100%)

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic %</td>
<td>Silt % (0.004-0.06 mm)</td>
</tr>
<tr>
<td>Sand %</td>
<td>Gravel % (2-64mm, 0.1-2.5”)</td>
</tr>
<tr>
<td>Cobble %</td>
<td>Boulder % (&gt;256mm, &gt;10”)</td>
</tr>
<tr>
<td>Bedrock %</td>
<td>Other %</td>
</tr>
</tbody>
</table>

#### Macroinvertebrate Sorting Method:

- [ ] (A) Streamside Field Identification
- [ ] (B) Detritus Preservation

#### Form Attached:

- [ ] (A) Tier 3.1: Macroinvertebrate Tally Sheet
- [ ] (B) Tier 3.3: Chain of Custody Form

---

*AmeriCorps Habitat and Macroinvertebrate Data Sheet - LOW gradient  Page 1 of 3*
<table>
<thead>
<tr>
<th>Land Use Characteristics: Mark off features present within viewing distance of your stream reach (¼ Mile Radius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Agricultural Feed Lots           □ Mines/ Quarries</td>
</tr>
<tr>
<td>□ Athletic Fields              □ Orchards</td>
</tr>
<tr>
<td>□ Camping                        □ Other: _______</td>
</tr>
<tr>
<td>□ Cemetery                        □ Parking Lots</td>
</tr>
<tr>
<td>□ Commercial                      □ Pasture</td>
</tr>
<tr>
<td>□ Construction                    □ Preserved Open Space</td>
</tr>
<tr>
<td>□ Cropland                        □ Recycling/ Waste Facility</td>
</tr>
<tr>
<td>□ Dumping                         □ Residences</td>
</tr>
<tr>
<td>□ Golfing/ Resorts                □ Residential Pets/ Pet Waste</td>
</tr>
<tr>
<td>□ Hiking/ Paths                   □ Roads Paved</td>
</tr>
<tr>
<td>□ Horse Trails                    □ Roads Unpaved</td>
</tr>
<tr>
<td>□ Inactive Fields                 □ Sewage Treatment</td>
</tr>
<tr>
<td>□ Industrial Plants               □ Stormwater Basin</td>
</tr>
<tr>
<td>□ Livestock Use                   □ Swimming/ Fishing/ Canoeing/ Boating</td>
</tr>
<tr>
<td>□ Maintained Lawns                □ Waterfowl (approx. #): _______</td>
</tr>
<tr>
<td>□ Marinas                         □ Wetlands</td>
</tr>
</tbody>
</table>

**Comments/Observations (Habitat Assessment):**

**Comments/Observations (Biological Assessment):**

What do you believe to be the greatest potential threat to the stream both now and in the future?

**Site Sketch** (Indicate roads, buildings, landmarks, parking area, access point(s) to stream, stream flow direction, in-stream habitat for macroinvertebrate sampling (i.e. riffles, pools, aquatic vegetation, woody debris), outfalls, etc.):
### HABITAT ASSESSMENT FOR LOW GRADIENT STREAMS

<table>
<thead>
<tr>
<th>Habitat Parameter</th>
<th>Optimal</th>
<th>Suboptimal</th>
<th>Marginal</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Epifaunal Substrate/Available Cover</td>
<td>Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).</td>
<td>30-50% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of new fall, but not yet prepared for colonization (may take up to five years).</td>
<td>10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.</td>
<td>Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.</td>
</tr>
<tr>
<td>2. Pool Substrate Characterization</td>
<td>Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.</td>
<td>Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.</td>
<td>All mud or clay or sand bottom; little or no root mat; no submerged vegetation.</td>
<td>Hard-pan clay or bedrock; no root mat or vegetation.</td>
</tr>
<tr>
<td>3. Pool Variability</td>
<td>Even mix of large-shallow, large-deep, small-shallow, small-deep pools present. (Deep &gt; 1m; large is width or length &gt; half cross-section of stream.)</td>
<td>Mostly water filled but some areas with bar substrate present.</td>
<td>Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.</td>
<td>Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.</td>
</tr>
<tr>
<td>4. Sediment Deposition</td>
<td>Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.</td>
<td>Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.</td>
<td>Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition of pools prevalent.</td>
<td>Heavily impacted, no deposition.</td>
</tr>
<tr>
<td>5. Channel Flow Status</td>
<td>Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.</td>
<td>Water fills &gt;75% of the available channel; or &lt;25% of channel substrate is exposed.</td>
<td>Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.</td>
<td>Very little water in channel and mostly present as standing pools.</td>
</tr>
<tr>
<td>6. Channel Alteration</td>
<td>Channelization or dredging absent or minimal; stream with normal pattern.</td>
<td>Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.</td>
<td>Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.</td>
<td>Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted.</td>
</tr>
<tr>
<td>7. Channel Sinuosity</td>
<td>The bends in the stream increase the stream length by 3 to 4 times compared to if it was in a straight line.</td>
<td>The bends in the stream increase the stream length by 2 to 3 times compared to if it was in a straight line.</td>
<td>The bends in the stream increase the stream length by 1 to 2 times compared to if it was in a straight line.</td>
<td>Channel straight; waterway has been channelized for a long distance.</td>
</tr>
<tr>
<td>8. Bank Stability (score each bank, facing upstream)</td>
<td>Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems.</td>
<td>Moderately stable; infrequent, small areas of erosion mostly healed over.</td>
<td>Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.</td>
<td>Unstable; many eroded areas; &quot;raw&quot; areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.</td>
</tr>
<tr>
<td>9. Bank Vegetative Protection (score each bank)</td>
<td>More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.</td>
<td>70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.</td>
<td>50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.</td>
<td>Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.</td>
</tr>
<tr>
<td>10. Riparian Vegetative Zone Width</td>
<td>Width of riparian zone &gt;18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.</td>
<td>Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.</td>
<td>Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.</td>
<td>Width of riparian zone &lt;6 meters; little or no riparian vegetation due to human activities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date:</th>
<th>Site ID:</th>
<th>Total Score Value:</th>
<th>Score:</th>
</tr>
</thead>
</table>

**HABITAT SCORES**

- **OPTIMAL**: 160 - 200
- **SUB-OPTIMAL**: 110 - 159
- **MARGINAL**: 60 - 109
- **POOR**: <60

AmeriCorps Habitat and Macroinvertebrate Data Sheet - LOW gradient  Page 3 of 3
**MACROINVERTEBRATE TALLY SHEET - Tier 3.1**

*New Jersey Department of Environmental Protection Community Water Monitoring Program*

<table>
<thead>
<tr>
<th>Site ID:</th>
<th>Date:</th>
<th><strong>Note:</strong> Biological assessments should not be done when (Air °F) + (Water °F) &lt; 100 °F.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Macroinvertebrate</th>
<th>Tally</th>
<th>Count</th>
<th>Macroinvertebrate</th>
<th>Tally</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayflies</td>
<td></td>
<td></td>
<td>Crane Flies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stoneflies</td>
<td></td>
<td></td>
<td>Sowbugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caddisflies</td>
<td></td>
<td></td>
<td>Scuds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hellgrammite/Fish Flies</td>
<td></td>
<td></td>
<td>Crayfish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watersnipe Flies</td>
<td></td>
<td></td>
<td>Clams/Mussels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riffle Beetles</td>
<td></td>
<td></td>
<td>Black flies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Pennies</td>
<td></td>
<td></td>
<td>Midge flies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gilled Snails</td>
<td></td>
<td></td>
<td>Lunged snails</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Spinning Caddisflies</td>
<td></td>
<td></td>
<td>Worms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alderflies</td>
<td></td>
<td></td>
<td>Leeches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damselflies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragonflies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Number of Organisms in Sample**

Check one: [ ] High Gradient  [ ] Pinelands  [ ] Coastal Plain

Check here if sample count does not equal 100 macroinvertebrates  [ ]

Score using excel calculator:

*If after 20 minutes* Ambassadors have not found **25 macroinvertebrates**, Ambassadors are to return to the stream to collect more macroinvertebrates to add to the bucket. *If after 40 minutes* of sorting Ambassadors have not found **50 macroinvertebrates**, Ambassadors are to return to the stream again to collect a third round of samples to add to the bucket. *If after an hour and a half, and three separate attempts* to collect macroinvertebrates to add to the sample in the bucket Ambassadors are still unable to sort and identify **100 macroinvertebrates**, Ambassadors will stop sorting and check the box on the assessment form indicating that Ambassadors were unable to find 100 macroinvertebrates.
# Pipe & Drainage Ditch Sheet

Fill in the blanks and circle the best options for each pipe in your stream reach (add more pages as necessary)

<table>
<thead>
<tr>
<th>Lat and Long</th>
<th>NJ PDES # (if applicable)</th>
<th>Pipe Diameter (in or ft)</th>
<th>Type</th>
<th>Pipe Material</th>
<th>Pipe Location</th>
<th>Pipe Flow</th>
<th>Is stream bank at outfall eroded?</th>
<th>Is stream bed eroded downstream?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Storm Drain</td>
<td>Concrete</td>
<td>In Water</td>
<td>None</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Industrial Drain</td>
<td>Steel</td>
<td>In Bank</td>
<td>Trickle</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residential Discharge</td>
<td>Plastic</td>
<td>Near Water</td>
<td>Intermittent</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combined Sewer Overflow</td>
<td>Clay</td>
<td></td>
<td>Steady</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other</td>
<td>Other</td>
<td></td>
<td>Heavy</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

|              |                           |                          | Storm Drain | Concrete       | In Water      | None     | Yes                              | Yes                              |
|              |                           |                          | Industrial Drain | Steel          | In Bank       | Trickle  | No                               | No                               |
|              |                           |                          | Residential Discharge | Plastic       | Near Water    | Intermittent | No                               | No                               |
|              |                           |                          | Combined Sewer Overflow | Clay          |              | Steady  | Yes                              | Yes                              |
|              |                           |                          | Other | Other          |              | Heavy     | No                               | No                               |

|              |                           |                          | Storm Drain | Concrete       | In Water      | None     | Yes                              | Yes                              |
|              |                           |                          | Industrial Drain | Steel          | In Bank       | Trickle  | No                               | No                               |
|              |                           |                          | Residential Discharge | Plastic       | Near Water    | Intermittent | No                               | No                               |
|              |                           |                          | Combined Sewer Overflow | Clay          |              | Steady  | Yes                              | Yes                              |
|              |                           |                          | Other | Other          |              | Heavy     | No                               | No                               |

|              |                           |                          | Storm Drain | Concrete       | In Water      | None     | Yes                              | Yes                              |
|              |                           |                          | Industrial Drain | Steel          | In Bank       | Trickle  | No                               | No                               |
|              |                           |                          | Residential Discharge | Plastic       | Near Water    | Intermittent | No                               | No                               |
|              |                           |                          | Combined Sewer Overflow | Clay          |              | Steady  | Yes                              | Yes                              |
|              |                           |                          | Other | Other          |              | Heavy     | No                               | No                               |