

## NEW JERSEY COMMUNITY WATER MONITORING GUIDE TO TIER 3 MACROINVERTEBRATE AND HABITAT ASSESSMENTS

The term *community water monitoring* (CWM) refers to nongovernmental groups conducting water monitoring activities, including physical, visual, chemical, or biological sampling and assessment. CWM groups are commonly assembled by nonprofit organizations, community groups, high school and college classes and clubs, resident and lake associations, etc. See *below for a note on academia*.

CWM groups use the data they collect for a number of purposes, one of which is to contribute to state governmental assessments of water quality. When CWM data is submitted to NJDEP for regulatory use, it is referred to as “external data” by NJDEP for deliverables such as the [Integrated Report](#) (IR).

**The purpose of this guide is to assist CWM groups in meeting their water quality monitoring goals by outlining the requirements for CWM habitat and macroinvertebrate data collected on freshwater non-tidal streams to be submitted for use by NJDEP.** Groups that are interested in collecting water quality data in New Jersey will find relevant information about how to submit their data for use by NJDEP in regulatory assessments for the IR and category redesignation. Data used in regulatory assessment must meet the necessary conditions and quality assurance standards as defined by NJDEP in this document and in the most current [IR Methods](#) document and deadlines for data collection and submission in the [IR data solicitation notice](#). All relevant study design and quality assurance elements must be incorporated into a Quality Assurance Project Plan (QAPP) and submitted to NJDEP for approval prior to the start of data collection.

CWM groups may also be interested in collecting in situ or analytical water quality data like pH, dissolved oxygen, or nutrient concentrations. The scope of this document refers only to habitat and macroinvertebrate assessment. To find the requirements for other types of data to be submitted to NJDEP, refer to the IR Methods document and the [NJDEP Office of Quality Assurance](#) information on lab and meter certification.

*Note:* Data collected as part of academic experiential research is typically not intended for baseline regulatory use and is typically considered separately from other external data sources. Academic data is welcome for submission should the study design meet observational data conditions, in addition to the other data quality requirements listed herein.

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## 1. MONITORING GOALS AND USES

State the reasons you wish to start monitoring your stream or lake. This worksheet will help to narrow down those reasons and to develop an idea of how the data will be used, and by whom.

- See [Water Data Collaborative Worksheet 6.3.a](#)

New Jersey has developed a three-tiered system to define its relationship with CWM data. Review the NJ Data Quality Tiers to identify the tier that most closely matches your intended monitoring goals (see link below). To submit water quality data to NJDEP, your goals and data quality must adhere to Tier 3 requirements (see Table 1).

**Table 1: Community Water Monitoring Tiered Data Quality Framework**

	TIER 1 <i>Educational</i>	TIER 2 <i>Targeting</i>	TIER 3 <i>Regulatory</i>
<b>Data Uses</b>	<ul style="list-style-type: none"> <li>• Community education</li> <li>• Municipal engagement</li> </ul>	Includes Tier 1 uses, plus: <ul style="list-style-type: none"> <li>• Project-specific monitoring</li> <li>• Water quality report cards</li> <li>• BMP effectiveness monitoring</li> <li>• Targeting installation of BMPs</li> <li>• Targeting advanced monitoring</li> <li>• NJDEP Comprehensive Regional Assessments</li> </ul>	Includes Tier 2 uses, plus: <ul style="list-style-type: none"> <li>• Regulatory assessments of water quality standard attainment</li> </ul>
<b>Data Quality Requirements</b>	<i>Suggested:</i> At a minimum, a <b>Study Design</b> available for review by potential data users, with: <ul style="list-style-type: none"> <li>• Documentation of methods, locations, and timeframe</li> </ul>	<b>QAPP</b> approved at Tier 2 by NJDEP Bureau of Environmental Assessment, Restoration and Standards or NJ Watershed Watch Network with: <ul style="list-style-type: none"> <li>• Use of standard operating procedures with defined levels of accuracy and precision</li> </ul>	<b>QAPP</b> approved at Tier 3 by NJDEP Office of Quality Assurance, with: <ul style="list-style-type: none"> <li>• Use of NJDEP-Certified field and/or laboratory methods for chemical and microbiological analyses</li> <li>• Use of EPA Rapid Bioassessment Protocol for habitat assessments</li> <li>• Use of a defined NJ Watershed Watch Network method for macroinvertebrates (see Table 2)</li> </ul>

## 2. STUDY DESIGN CONSIDERATIONS

### 2.1. Who will conduct the monitoring work?

Tier 3 monitoring personnel must become accredited for field work before the data they collect is eligible for Tier 3. See Section 5 for more information.

### 2.2. Where will you monitor?

This guide refers to the monitoring of freshwater non-tidal streams. Sites should be representative of the water body and [HUC-14 subwatershed](#) as a whole, preferably located near the furthest downstream point of a HUC-14. Additional monitoring locations may be placed upstream and on tributaries as

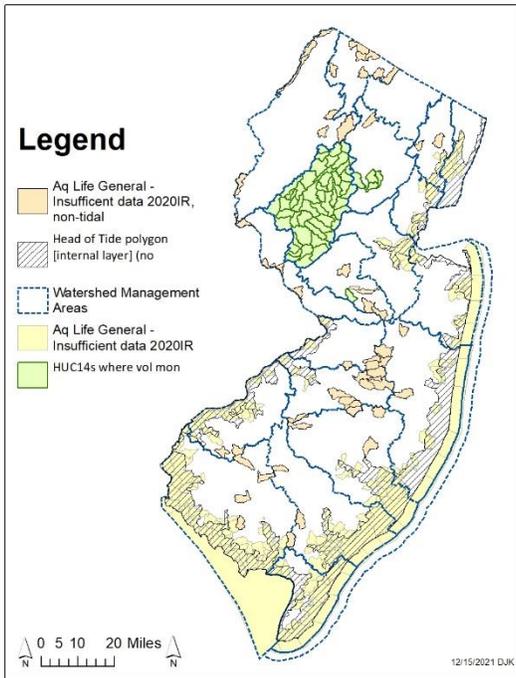


Figure 1: HUCs with Insufficient Aquatic Life Data, NJDEP

desired, though the sites should still be indicative of general water quality and habitat conditions. Sites should be located at least 500 feet downstream of dams or other impoundments.

Latitude and longitude must be established for all monitoring sites, with each site assigned a unique alphanumeric code as its Site ID. While monitoring sites should be fixed stations, these locations may change during the course of a monitoring program or project. This does not require a full QAPP update, but should be submitted to NJDEP as a QAPP amendment.

As of the 2020 IR, there are 54 HUC-14 subwatersheds in New Jersey with insufficient data to assess the biological health of their freshwater nontidal streams, represented in Figure 1. CWM groups are encouraged to monitor in these areas to help reduce data gaps across the state. Check the [list of NJ HUC-14s with insufficient data to assess aquatic life condition](#) for detailed information.

### 2.3. When and how often will you monitor?

Water quality data used by NJDEP as regulatory assessment must reflect baseline conditions. If monitoring is conducted when stream flow is far lower or greater than baseflow conditions, the sample may not be representative of the stream under baseline conditions.

Macroinvertebrate sampling is typically performed between April 1–November 30. There is no requirement for monitoring frequency, though many programs will perform macroinvertebrate and habitat assessments once or twice per year.

Table 2: Overview of Volunteer and Financial Commitments by Tier

	MACROS 3.1 <i>Good</i>	MACROS 3.2 <i>Better</i>	MACROS 3.3 <i>Best</i>
<b>Training and Testing Required</b>	<ul style="list-style-type: none"> <li>Two-day training</li> <li>Field accreditation every 3 years</li> <li>Streamside ID testing</li> </ul>	<ul style="list-style-type: none"> <li>Three-day training</li> <li>Field accreditation every 3 years</li> <li>Lab ID testing</li> </ul>	<ul style="list-style-type: none"> <li>Half-day training</li> <li>Field accreditation every 3 years</li> </ul>
<b>Volunteer Time Commitment</b>	<ul style="list-style-type: none"> <li>Field work: approximately 3 hours per sample</li> </ul>	<ul style="list-style-type: none"> <li>Field work: approximately 1-2 hours per sample</li> <li>Lab work: approximately 3-4 hours per sample</li> </ul>	<ul style="list-style-type: none"> <li>Field work: approximately 1-2 hours per sample</li> </ul>
<b>Financial Resources Required</b>	<ul style="list-style-type: none"> <li>Up-front costs include sampling materials like waders, nets, trays, buckets, sieves, rinse bottles, and utensils</li> </ul>	<ul style="list-style-type: none"> <li>Up-front costs 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</li> <li>Alcohol for preservation</li> </ul>	<ul style="list-style-type: none"> <li>Up-front costs include sampling materials (see 3.1) and preservation jars</li> <li>Alcohol for preservation</li> <li>Lab identification – approximately \$150-250 per sample, plus shipping</li> </ul>

### 3. QUALITY ASSURANCE

Review the QAPP template to identify the required elements of quality assurance that must be incorporated into a Tier 3 program. All CWM groups must prepare a QAPP for NJDEP approval prior to the start of the project.

QAPPs should be submitted to Deborah Kratzer at [Deborah.Kratzer@dep.nj.gov](mailto:Deborah.Kratzer@dep.nj.gov). You may expect a 30-day turnaround time for comments from relevant NJDEP staff (see QAPP Template). Allow for additional time to address comments and resubmit for approval. For this reason, you should submit your QAPP at least 60 days before you plan to begin sampling.

- See [Tier 3.1 QAPP Template](#)

**Table 3: Summary of Habitat and Macroinvertebrate Assessment Requirements**

	MACROS 3.1 <i>Good</i>	MACROS 3.2 <i>Better</i>	MACROS 3.3 <i>Best</i>
<b>Macroinvertebrate Sampling</b>	<ul style="list-style-type: none"> <li>• Sample collection with D-frame net using multi-habitat technique</li> </ul>		
<b>Macroinvertebrate Preservation</b>	<ul style="list-style-type: none"> <li>• No preservation required, organisms are returned to stream</li> </ul>	<ul style="list-style-type: none"> <li>• Sample preservation in the field</li> </ul>	
<b>Habitat Assessment</b>	<ul style="list-style-type: none"> <li>• At a minimum, the assessment should include the 10 questions from the EPA Rapid Bioassessment Protocols</li> </ul>		
<b>Quality Assurance in the Field</b>	<ul style="list-style-type: none"> <li>• Field accreditation of sampling technique before first sample and every 3 years thereafter</li> <li>• Duplicative samples at 10% of sites every year</li> <li>• Field audit of 5% of sites every year</li> </ul>		
<b>Macroinvertebrate Identification</b>	<ul style="list-style-type: none"> <li>• Performed streamside by volunteers</li> <li>• Mix of Class, Order, and Family, limited to 22 target organisms</li> </ul>	<ul style="list-style-type: none"> <li>• Sample sorting, subsampling, and identification performed by volunteers with microscope</li> <li>• Family (except Annelids at Class level)</li> </ul>	<ul style="list-style-type: none"> <li>• Sample sent to NJDEP-approved laboratory for sorting, subsampling, and identification</li> <li>• Lowest practicable taxonomic level (Genus or Species)</li> </ul>
<b>Quality Assurance for Macroinvertebrate Identification</b>	<ul style="list-style-type: none"> <li>• 50-organism proficiency test administered by NJ-WWN before first sample and every 3 years thereafter</li> </ul>	<ul style="list-style-type: none"> <li>• 50-organism Family-level proficiency test administered by NJ-WWN OR <a href="#">SFS Taxonomic Certification Exam</a><sup>1</sup> before first sample and every 3 years thereafter</li> <li>• 10% of group samples re-identified annually by approved lab</li> </ul>	<ul style="list-style-type: none"> <li>• All identifications performed by approved lab</li> </ul>
<b>Macroinvertebrate Assessment Indices</b>	<ul style="list-style-type: none"> <li>• Volunteer HGMI</li> <li>• Volunteer CPMI</li> <li>• Volunteer PMI</li> </ul>	<ul style="list-style-type: none"> <li>• HGMI – family (high gradient only)</li> </ul>	<ul style="list-style-type: none"> <li>• HGMI - genus</li> <li>• CPMI</li> <li>• PMI</li> </ul>

<sup>1</sup> Society for Freshwater Science Taxonomic Certification Exam administered by Stroud Water Research Center (<https://stroudcenter.org/sfstcp>)

## 4. DATA COLLECTION

### 4.1. Habitat Data

A habitat assessment must be performed during each macroinvertebrate sampling event. At a minimum, the assessment should include the 10-questions from the EPA Rapid Bioassessment Protocols [Habitat Assessment Field Data Sheet](#).

A standardized data sheet for the state of New Jersey has been provided for ease of use, though it is not required.

- See [Habitat and Macroinvertebrate Assessment Data Sheet](#)

### 4.2. Macroinvertebrate Data

Macroinvertebrate collection, subsampling, and identification methods are outlined in Section 8.2 of the QAPP template. Programs using Tier 3.1 will use a Macroinvertebrate Tally Sheet for macroinvertebrate identification in the field. Macroinvertebrates collected under Tier 3.3 protocols will be preserved in the field and should be accompanied by a Chain of Custody Form.

- See [Tier 3.1 Macroinvertebrate Tally Sheet](#)
- See [Macroinvertebrate Sample Chain of Custody Form](#)

Duplicate macroinvertebrate samples must be collected at 10% of each CWM group's sites every year. Duplicate samples will be collected on the same day in an adjacent reach in similar habitats, avoiding areas that have already been sampled. The results of duplicate samples should be submitted to WQX in addition to the primary sample, but they must be labeled as a duplicate. To do so, use the same WQX Activity ID as the primary sample and add the extension "\_duplicate".

CWM groups are subject to field audits by NJDEP staff to assess the quality of data collection. Up to 5% of CWM group sites will be subject to audit. NJDEP staff will contact the group coordinator to schedule an audit on a regularly-scheduled field day.

Macroinvertebrate samples may be identified by volunteers at Tier 3.1 and 3.2 or an approved external laboratory at Tier 3.3. The contract laboratory must submit their qualifications and quality assurance protocols, as a QAPP appendix, which must be acceptable to NJDEP Bureau of Freshwater and Biological Monitoring (BFBM).

## 5. MONITOR TRAINING AND TESTING REQUIREMENTS

A note on volunteer training: NJ-WWN provides free training for groups seeking Tier 3 status. To schedule training, accreditation, and identification tests, contact NJ-WWN Coordinator Erin Stretz at [estretz@thewatershed.org](mailto:estretz@thewatershed.org). [AmeriCorps Watershed Ambassadors](#) can provide Tier 1 or 2 training.

### 5.1. How can NJDEP and NJ-WWN ensure volunteer monitors know how to perform field assessments and collections correctly?

Volunteers must be accredited prior to collecting Tier 3 data and every three years thereafter. During an accreditation, a representative from NJDEP or NJ-WWN will oversee a practice session, looking for the completion of the tasks and skills identified in the Field Accreditation Checklist. Independent habitat evaluation results should agree with the auditor's assessment (optimal, sub-optimal, marginal or poor).

- See [Tier 3.1 \(field identification\) Checklist](#) or [Tier 3.3 \(field preservation\) Checklist](#)

Duplicate macroinvertebrate samples must be collected at 10% of each CWM group's sites every year. See Section 4.2 for more information.

## 5.2. How can NJDEP and NJ-WWN ensure volunteer monitors are identifying macroinvertebrate taxa correctly?

Macroinvertebrate identification testing is required for all monitors performing their own identifications (Tier 3.1 and 3.2). Monitors must correctly identify at least 90% of at least 50 preserved and/or live macroinvertebrate specimens. Tests will be prepared and administered by NJDEP in coordination with NJ-WWN.

Tier 3.1 monitors will be tested on 22 target macroinvertebrate taxa at the class, order, and family level as demonstrated by the Tier 3.1 macroinvertebrate tally sheet.

Tier 3.2 monitors will be tested on a wider range of freshwater macroinvertebrate taxa that occur in New Jersey. The following taxa are included in the High Gradient Macroinvertebrate Macroinvertebrate Index family-level index (see Section 6.2 for details about indices): Mayflies (Ephemeroptera), Stoneflies (Plecoptera), Caddisflies (Trichoptera), True Flies (Diptera), Beetles (Coleoptera), Damselflies and Dragonflies (Odonata), Dobsonflies and Alderflies (Corydalidae), Scuds (Gastropoda), Sowbugs (Isopoda), Crayfish (Decapoda), Snails (Gastropoda), Clams and Mussels (Pelecypoda), True Bugs (Hemiptera), Segmented Worms (Phylum Annelida), and Leeches (Subclass Hirudinea).

- See [NJDEP List of Genus and Family Level Macroinvertebrate Pollution Tolerance Values](#)

## 6. DATA MANAGEMENT AND ASSESSMENT

### 6.1. Recordkeeping and Data Retention

Here are some questions to consider when storing your data. Will you lose data if your:

- Notebook goes missing?
- Local server goes down?
- Cloud server is corrupted?
- Office building catches fire?

Data recorded on paper data sheets should be transferred to a local or cloud-based database or spreadsheet program. Paper copies should be retained for at least 5 years. If individual volunteers submit data digitally to a group's central database, they should also submit a photo or scan of the raw data sheet or field notebook to confirm digital entries. Databases should be backed up regularly in multiple locations to avoid data loss. These procedures, as well as who is responsible, should be documented in the QAPP.

### 6.2. Macroinvertebrate Index Calculation

New Jersey is divided into three regions for macroinvertebrate index calculations. Depending on where a macroinvertebrate sample is collected in the state, the data will be assessed using a different set of mathematical metrics.

The High Gradient Macroinvertebrate Index (HGMI) is applied to the orange region in Figure 2. The Coastal Plain Macroinvertebrate Index (CPMI) is applied to the yellow region. The Pinelands Macroinvertebrate Index (PMI) is applied to the green region. If a monitoring site is located near the boundary of the coastal plain and pinelands regions, confirm with NJDEP on the correct index to use in calculations.

For Tier 3.1 monitoring, volunteer indices are used which correspond to the same three regions: VHGMI, VCPMI, and VPMI.

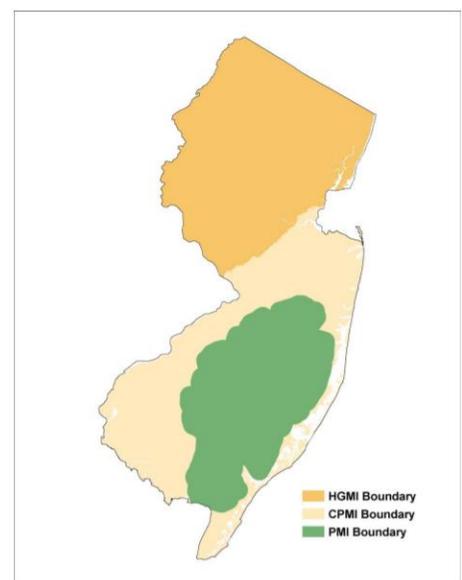


Figure 2: NJ Macroinvertebrate Indices by Region, NJDEP

### 6.3. Quality Control

Data sheets should be reviewed for completeness prior to leaving the monitoring site. Data should be reviewed before entry, upon entry, or after entry into the local or cloud-based database for accuracy and completeness. Any data that does not make sense (ex. a pH value above 14) should be rejected. A full list of quality assurance measures is included in Section 13-15 of the [Tier 3.1 QAPP Template](#).

CWM groups are subject to an audit of water quality data management and index calculation by NJDEP staff to confirm the data are recorded and stored properly.

**Table 4: New Jersey Macroinvertebrate Indices**

Habitat Type	Tier 3.1	Tier 3.2	Tier 3.3
<b>High Gradient</b>	Volunteer High Gradient Macroinvertebrate Index (VHGMI) <ul style="list-style-type: none"><li>• See <a href="#">VHGMI spreadsheet</a></li></ul>	High Gradient Macroinvertebrate Family Level Index (HGMI-family) <ul style="list-style-type: none"><li>• See <a href="#">HGMI-family fact sheet</a></li></ul>	High Gradient Macroinvertebrate Genus Level Index (HGMI) <ul style="list-style-type: none"><li>• See <a href="#">HGMI fact sheet</a></li></ul>
<b>Low Gradient</b>	Volunteer Coastal Plain Macroinvertebrate Index (VCPMI) <ul style="list-style-type: none"><li>• See <a href="#">VCPMI spreadsheet</a></li></ul>	NA	Coastal Plain Macroinvertebrate Genus Level Index (CPMI) <ul style="list-style-type: none"><li>• See <a href="#">CPMI fact sheet</a></li></ul>
<b>Pinelands</b>	Volunteer Pinelands Macroinvertebrate Index <ul style="list-style-type: none"><li>• See <a href="#">VPMI spreadsheet</a></li></ul>	NA	Pinelands Macroinvertebrate Index (PMI) <ul style="list-style-type: none"><li>• See <a href="#">PMI fact sheet</a></li></ul>

## 7. DATA SUBMISSION

Water quality data must be submitted to the Water Quality Exchange (WQX) to be considered by NJDEP. For assistance with data formatting and submission, contact NJ-WWN Coordinator Erin Stretz at [estretz@thewatershed.org](mailto:estretz@thewatershed.org).

### 7.1. Getting Started with WQX

CWM groups must register with the EPA Central Data Exchange (CDX) to be able to submit data to WQX. To begin, send an email to [wqx@epa.gov](mailto:wqx@epa.gov) with the following information:

- First, middle, and last name
- Prefix (Mr./Mrs./Ms)
- WQX Organization ID
  - This must be a unique identifier for your organization. (ex. Raritan Headwaters Association is listed as RHA.)
- Organization Name
- Mailing Address, City, State, Zip Code
- Email Address
- Phone Number

EPA staff will reply to your email with further instruction on registering your account with CDX. Visit this website for full instructions: <https://www.epa.gov/waterdata/wqx-web-account-registration>

### 7.2. Metadata

Before any results can be submitted into WQX, the metadata on the monitoring project and locations must be in the WQX system. WQX provides step-by-step instructions to set up projects and monitoring sites using Excel templates.

### Creating Projects

"A project should define WHY a sample is being collected. A project should contain a unique ID, a name, and a description of the projects purpose. You need to have at least one project, but you can have many. A project could contain an entire year's sampling, sampling related to a specific study, or even sampling related to particular water types (i.e. a lakes project)."

[WQX Web Template User Guide](#), pg. 3

### Creating Monitoring Locations (Stations)

"A monitoring location should describe WHERE a sample is being collected. A monitoring location must contain a unique ID, a name, a monitoring location type (i.e. river/stream, lake, etc.), state/county, and latitude/longitude coordinate information including the method for getting the lat/long coordinates. A monitoring location should also contain a name and description. This will help you distinguish monitoring locations down the road."

[WQX Web Template User Guide](#), pg. 3

The templates linked in section 7.4 include spreadsheets to submit Project and Locations data prior to submitting results.

### 7.3. Required Data

The following parameters should be submitted to WQX for all habitat and biological assessments:

**Table 5: Activity Metadata to Submit to WQX**

<b>Activity Metadata</b>	Project ID <i>Include the project tier in the ID code suffix (ex. NAME_Tr3_1 to indicate a Tier 3.1 project)</i>
	Project Name
	Monitoring Location ID
	Monitoring Location Name
	Latitude, Longitude
	Activity ID <i>Note: duplicate samples should use the same Activity ID as the primary sample and add "duplicate", ex. CL1_2021-06-01_duplicate)</i>
	Activity Type
	Activity Date

**Table 6: Minimum Characteristics to Submit to WQX**

	<b>High Gradient</b>	<b>Low Gradient/ Coastal Plain</b>	<b>Pinelands</b>
<b>Biological Characteristics</b>	Individual taxa counts	Individual taxa counts	Individual taxa counts
	HGMI-genus, HGMI-family, or VHGM score	CPMI or VCPMI score	PMI or VPMI score
	<b>Habitat Characteristics</b>	Epifaunal Substrate	Epifaunal Substrate
Embeddedness		Pool Substrate Characterization	Pool Substrate Characterization
Velocity/Depth Regime		Pool Variability	Pool Variability
Sediment Deposition		Sediment Deposition	Sediment Deposition

	Channel Flow Status	Channel Flow Status	Channel Flow Status
	Channel Alteration	Channel Alteration	Channel Alteration
	Frequency of Riffles	Channel Sinuosity	Channel Sinuosity
	Bank Stability	Bank Stability	Bank Stability
	Bank Vegetative Protection	Bank Vegetative Protection	Bank Vegetative Protection
	Riparian Vegetative Zone Width – Left and Right Bank	Riparian Vegetative Zone Width – Left and Right Bank	Riparian Vegetative Zone Width – Left and Right Bank
	Habitat Assessment Total Score – Left and Right Bank	Habitat Assessment Total Score – Left and Right Bank	Habitat Assessment Total Score – Left and Right Bank
	Habitat Assessment Total Rating – Left and Right Bank	Habitat Assessment Total Rating – Left and Right Bank	Habitat Assessment Total Rating – Left and Right Bank

#### 7.4. Formatting your Data

Formatting requirements for WQX data submission are specific to the type of data to be submitted. Individual taxa counts will be submitted using the Biological template, while macroinvertebrate index scores will be submitted using the Metrics and Indices template. Habitat assessment data will be submitted using the Habitat template.

Each template below includes a spreadsheet to submit Project and Location information as well.

- See [WQX Best Practices for Submitting Benthic Macroinvertebrate Data](#)
- See [WQX Biological Results Excel Template](#)
- See [WQX Biological Metrics and Indices Excel Template](#)
- See [WQX Habitat Results Excel Template](#)

#### 7.5. Quality Control

After the data has been submitted to WQX, CWM groups should review the submission in the Water Quality Portal to ensure the data transferred correctly.

- See [Water Quality Portal](#)