A1. Title and Approval Sheet

Quality Assurance Project Plan for
Lower Manistee River Watershed Volunteer Monitoring Program

Date: 2/20/21
Version # 1
Organization: Manistee Conservation District

QAPP Prepared by: Renee Mallison (original version created by Kayla Knoll, 2016)
Title: Executive Director

Signature: Renee Mallison 2/20/2021 ______________________________

MiCorps Staff Use

Tracking Number:

MiCorps Reviewer: ____

☐ Approved ☐ Returned for modifications

____
Signature of reviewer Date

Section A: Project Description and Quality Objectives

Section B: Program Design and Procedures

Section C: System Assessment, Correction, and Reporting

Appendices

SECTION A: PROJECT DESCRIPTION AND QUALITY OBJECTIVES

A3. Distribution List

- Renee Mallison, Executive Director, Manistee Conservation District (MCD)
- Joyce Durdel, Field Technician, Little Manistee Watershed Conservation Council (LMWCC)
- Paul Steen, MiCorps Program Manager Huron River Watershed Council

A4. Program Organization

Management Responsibilities:
Renee Mallison, Program Manager, Manistee Conservation District, 8840 Chippewa Highway, Bear Lake, MI 49614, (231) 889-9666, manisteecd@macd.org

Renee is the Program Manager for the volunteer stream monitoring program and will oversee field activities. She is also responsible for maintaining quality assurance oversight (QA Manager) and reports to the Board of Directors. Her responsibilities include:

- Develop, implement, and maintain oversight of the Quality Assurance Project Plan.
- Attend 8-hour training session provided by MiCorps.
- Promote volunteer stream monitoring activities and recruit volunteers.
- Research and purchase necessary equipment for performing stream monitoring activities.
- Coordinate and conduct volunteer stream monitoring training sessions for volunteer leaders.
- Coordinate volunteer stream monitoring field data collection sessions.
- Coordinate macroinvertebrate identification review sessions for experts.
- Implement database development, data entry, and data analysis.
- Develop reports and make presentations for local governments, special interest groups, and lake/stream associations.
- Promote program at regular Conservation District events and on social media and Conservation District web-pages.
- Develop quarterly narrative reports for open grants.
- Debrief with Field Technician and volunteer Team Leaders after each sampling event.
- Attend MiCorps conferences in 2021 & 2022.
- Develop and submit a final report, following MiCorps guidance, at the end of the project when grants are awarded and open.

Joyce Durdel, Field Technician, Little Manistee Watershed Conservation Council, 9182 West River Rd, Irons, MI 49644, 231-590-0046, whitepine50@gmail.com

Joyce Durdel is the contracted Field Technician for the Lower Manistee River Watershed Volunteer Monitoring Program. Joyce also assists the Program Manager with some management activities and reports to the Program Manager. Her responsibilities include:

- Attend 8-hour training session provided by MiCorps.
- Coordinate and conduct volunteer stream monitoring training sessions.
- Coordinate and implement volunteer stream monitoring field data collection sessions.
- Coordinate and implement macroinvertebrate identification review sessions for experts.
- Debrief with Program Manager and Team Leaders after each sampling event.
- Attend MiCorps conferences in 2021 & 2022.

Renee Mallison, Executive Director, Manistee Conservation District, 8840 Chippewa Highway, Manistee, MI 49614, (231) 889-9666, manisteecd@macd.org.

Renee provides administrative and budget oversight for the program and takes on the Program Manager role when necessary. Her responsibilities include:

- Assist with volunteer recruitment, liaison and retention.
- Assist with budget oversight and development of quality financial reports.
- Assist in the development and submittal of a final report, following MiCorps guidance, at the end of the project.
- Submit a release of claims statement at the end of the project.

Field Responsibilities
Oversight of all field activities will be the responsibility of the Program Manager and the Field Technician. Individual field roles are as follows:

Stream Team Leaders – Volunteers trained in MiCorps collectionprotocols and methods responsible for leading a volunteer group through monitoring procedures at one sampling site during each monitoring event. Team Leaders are also responsible for returning all equipment, biological samples, and data sheets for Program Manager.

Volunteers – Participate as collectors and pickers under the direction and oversight of Stream Team Leaders during monitoring events. May assist stream Team Leaders in habitat assessment.

Laboratory Responsibilities
Program Manager will assume all identification responsibilities. Manistee Conservation District will provide laboratory space and equipment.

Corrective Action
Program Manager will assume the role of initiating, developing, approving, and implementing corrective actions. Reports to Administrator.

A5. Problem Definition/Background

The Manistee River watershed is a regionally important Lake Michigan tributary that supports a nationally recognized fishery. The health of the Manistee River watershed is essential to the local economy and way of life for the residents in this region. In surveys conducted in 2015 by the MCD, local citizens overwhelmingly voted watershed protection as the most important conservation concern in Manistee County.

Overall, the Manistee River watershed has good water quality but is degraded in many portions due to human activities. According to the Manistee River Assessment conducted by the Michigan Department of Natural Resources (MDNR) in 1998, the primary source of pollution in the watershed is sediment. Many of the road/stream crossings in this watershed are degraded, inadequately sized or improperly constructed causing sediment deposition and degradation of important instream habitat. Other threats to the watershed include non-point source pollution, residential development, sedimentation and bank erosion, potential oil and gas exploration, and recreational impacts. The presence of these threats makes it vital to implement frequent monitoring in the watershed.

Through the Lower Manistee River Watershed Volunteer Monitoring Program, the MCD will produce baseline water quality data for the lower portion of the watershed, as well as build long-term partnerships and foster stewardship of water resources. This program will also further the initiatives of three local watershed groups including the Little Manistee Watershed Conservation Council, the Greater Bear Watershed, and Portage Lake Watershed Forever by implementing a sustainable stream monitoring program in the Lower Manistee River watershed.

The specific goals of the Lower Manistee River Watershed Volunteer Stream Monitoring Program are as follows:

1. Foster stewardship by educating watershed residents on water quality issues and protection.
2. Engage local citizens and partners as stakeholders to monitor and identify threats to the health of the waterways.
3. Generate water quality and habitat data to identify problem areas within the lower Manistee River watershed where quality has been degraded and best management practices can be implemented.
4. Create asustainable monitoring project that will transcend the MiCorps funding period.

A6. Program Description

The Lower Manistee River Watershed Volunteer Stream Monitoring Program will utilize citizen science to collect water quality data for the lower portion of the Manistee Watershed while also fostering stewardship of water resources. This program will serve as a tool to educate residents on water quality issues in the Lower Manistee watershed. Volunteer participation is paramount to the success of the program and members of the Greater Bear Watershed, Portage Lake Watershed Forever, Little Manistee Watershed Conservation Council, as well as personnel from Mason-Lake Conservation District and have pledged volunteer service. Volunteers are also recruited from the district's Conservation Crew, a volunteer team dedicated to helping us with projects. Additional volunteers are recruited from the local community via MCD's newsletters, email announcements, web page, and Facebook page.

The Lower Manistee River Volunteer Monitoring Program focuses on macroinvertebrate and stream habitat assessments on the lower Manistee River watershed (Below US131). The lower portion of the Manistee River watershed was chosen for monitoring based on its cold water fisheries habitat values, its public accessibility (the majority of the watershed is located in the Manistee National Forest) and its relation to current conservation goals of local watershed groups. The MCD will sample and assess nine locations within the lower Portion of the Manistee River watershed, focusing on three main sub-watersheds: the lower portion of the Big Manistee River, Bear Creek, and the Little Manistee River.

Biological monitoring will be conducted twice per year, once in May and once in October. In addition to biological monitoring, habitat assessments will be conducted once per year during the fall sampling event. Training sessions will be held twice per year, about two weeks before each sampling event. Stream Team Leaders are required to attend at least one training session prior to the sampling period where they will be trained habitat assessment and macroinvertebrate collection and identification.

Data generated from monitoring will be added to the MiCorps Data Exchange platform to be utilized by non-profit, local, state, and federal agencies for prioritizing watershed restoration projects. If data indicates that any waterways have been degraded, MCD will work with partners to pursue funds in order to implement restoration actions and Best Management Practices.

A7. Data Quality Objectives

Precision & Accuracy: Accuracy is the degree of agreement between the sampling result and the true value of the parameter or condition being measured. Accuracy is most affected by the equipment and the procedure used to measure the parameter. Precision refers to how well you are able to reproduce the result on the same sample, regardless of accuracy.

The purpose of this project is to gauge stream health by measuring the total diversity of macroinvertebrate taxa. Since there is inherent variability in accessing the less common taxa in any stream site and program resources do not allow Program Managers to perform multiple independent (duplicate) collections of the sampling sites, our goal for quality assurance is conservative. A given site's Stream Quality)ndex (SQ)) score or total diversity (D) is measured across macroinvertebrate taxa will be noted as "preliminary" until three spring sampling events and three fall sampling events have been completed.

Precision and accuracy will be maintained through following standardized MiCorps procedures. The Program Manager must be trained in MiCorps procedures at the annual MiCorps training led by MiCorps staff. MiCorps staff also conduct a method validation review (the "side-by-side" visit) with the Program Manager to ensure their expertise, preferably prior to the first volunteer leader training session. This review consists of supervising the Program Manager's macroinvertebrate sampling and sorting methodology to ensure that they are consistent with MiCorps protocol. All cases of collecting deficiencies are promptly followed (during that visit) by additional training in the deficient tasks and a subsequent method validation review may be scheduled for the following collecting season. Upon request, MiCorps staff may also verify the accuracy of the program's macroinvertebrate identification. If a problem arises with a subset of macroinvertebrates, a thorough check may be requested. Precision and accuracy will be maintained by conducting consistent volunteer Team Leader training. Stream Team Leaders will be trained when joining the program, and retrained every two years (at a minimum). Techniques under review shall include:

- Collecting style (must be thorough and vigorous)
- Habitat diversity (must include all available habitats and be meticulous in each one)
- Picking style (must be able to pick methodically through all materials collected and pick all sizes and types of macroinvertebrates)
- Variety and quantity of organisms (must ensure that diversity and abundance at site is represented in sample)
- Transfer of collected macroinvertebrates from the net to the sample jars (specimens must be properly handled and jars correctly labeled)

Precision and accuracy will be maintained through careful macroinvertebrate identification. Volunteers may identify macroinvertebrates in the field, but these identifications and counts are not official. All macroinvertebrate samples are stored in alcohol to be identified at a later identification session. Volunteers can be designated as identification experts as determined by the judgment of the Program Manager. All field identifications and counts will be checked by an expert with access to a scope, keys, and field guides. The Program Manager will check at least 10% of the specimens processed by experts to verify results (with a concentration on hard to identify taxa). If more than 10% of specimens checked were misidentified, then the Program Manager will review all the specimens processed by that expert and reassess if that person should be considered an expert for future sampling events.

Bias: At every sample site, a different team will sample at least once every three years to examine the effects of bias in individual collection styles. Measures of D and SQI for these samples will be compared to the median results from the past three years and each should be within two standard deviations of the median. If the sample falls outside this range, then the Program Manager needs to conduct a more thorough investigation to determine which team is likely at fault. The Program Manager will accompany teams to observe their collection techniques and note any divergence from protocols. The Program Manager may also perform an independent collection (duplicate sample) no less than a week after the team's original collection and no more than two weeks after.

The following describes the analysis used for the Program Manager's duplicate sampling:

Resulting diversity measures by teams are compared to Program Manager's results and each should have a relative percent difference (RPD) of less than 40%. This statistic is measured using the following formula:

RPD = [(Xm - Xv) / (mean of Xm and Xv)] x 100, where Xe is the Program Manager measurement and Xv is the volunteer measurement for each parameter.

Teams that do not meet quality standards are retrained in the relevant methods and the Program Manager and Technician will reevaluate their collection during the subsequent sampling event.

Completeness: Completeness is a measure of the amount of valid data actually obtained versus the amount expected to be obtained as a specified in the original sampling design. It is usually expressed as a percentage. For example, if 100 samples were scheduled but volunteers sampled only 90 times due to bad weather or broken equipment, the completeness record would be 90%.

Following a quality assurance review of all collected and analyzed data, data completeness is assessed by dividing the number of measurements judged valid by the number of total measurements performed. The data quality objective for completeness for each parameter for each sampling event is 90%. If the program does not meet this standard, the Program Manager will consult with MiCorps staff to determine the main causes of data invalidation and develops a course of action to improve the completeness of future sampling events.

Representativeness: Study sites are selected to represent the full variety of stream habitat types available locally, emphasizing the inclusion of riffle habitat. All available habitats within the study site will be sampled and documented to ensure a thorough sampling of all of the organisms inhabiting the site. Resulting data from the monitoring program will be used to represent the ecological conditions of the contributing subwatershed. Since not enough resources are available to allow the program to cover the entire watershed, some subwatersheds will not initially be represented. Additional subwatershed sites will be added as resources and volunteers allow.

Sampling after extreme weather conditions may result in samples not being representative of the normal stream conditions. The Program Manager will compare suspect samples to the long term record as follows:

Measures of D and SQI for every sample will be compared to the median results from the past three years and each should be within two standard deviations of the median. If the sample falls outside this range, it should not be included in the long-term data record (though can be included in an "outlier" database.)

Comparability: Comparability represents how well data from one stream or study site can be compared to data from another. To ensure data comparability, all volunteers participating in the monitoring program follow the same sampling methods and use the same units of reporting. The methods for sampling and reporting are based on MiCorps standards that are taught at annual trainings by MiCorps staff. The Program Manager will train volunteers to follow those same methods to ensure comparability of monitoring results among other MiCorps programs. To the extent possible, the monitoring of all study sites will be completed on a single day, and certainly within a two-week time frame.

If a Program Manager leaves the position and a new Program Manager is hired, the new hire will attend the next available training given by MiCorps staff.

A8. Special Training/Certifications

Volunteers interested in becoming Stream Team Leaders must attend a daylong water quality training session prior to leading sampling efforts in the field. The purpose of these trainings is to certify volunteers in MiCorps stream monitoring procedures. Stream Team Leaders will be required to attend at least one water quality training every two years.

Training sessions will be offered twice a year 2-3 weeks prior to that season's collection event. These trainings will consist of a morning session indoors discussing project background, goals, and procedures as well as aquatic macroinvertebrate identification practice. The afternoon session will take place at a nearby stream under the direction of the Program Manager and other certified Stream Team Leaders. The afternoon session will cover the following topics:

- Description of equipment and sampling kit
- Explanation of fields sheets (stream macroinvertebrate datasheet and stream habitat datasheet)
- Demonstration of macroinvertebrate collection using proper techniques, followed by identification and filling out macroinvertebrate datasheet.

The Program Manager will maintain all volunteer records ensuring that there are a sufficient number of Stream Team Leaders available for each collection event.

A9. Decontamination Procedure

Decontamination is of utmost importance in stopping the spread of invasive species and the transport of aquatic diseases. Team leaders will ensure the following decontamination steps are completed: 1. Conduct a visual inspection of gear before and after field work. 2. If going to another monitoring site, thoroughly inspect and remove all plants, dirt, mud, and any other visible debris like seeds, shoots, animals, insects, and eggs from clothing and equipment. If going to another site on the same sampling day, Team Leaders will supervise the use of a decontamination kits to disinfect all equipment with dilute bleach and allow it to sit for 10 minutes before rinsing with tap water and towel dry all equipment before leaving the site. (See section B1 for a list of the decontamination kit contents). 3. Remove plant and debris from equipment and let it dry for at least 5 days. 4. If necessary, Team Leaders should use high pressure hot washes to clean monitoring equipment if areas are known to be infected by invasive species. 5. Be on the lookout for New Zealand mudsnails. Decontamination procedures will be part of all training and outreach events.

B. PROGRAM DESIGN AND PROCEDURES

B1. Study Design and Methods

Site selection: Sites were chosen based on the flowing criteria:

α. Representation of segments along the river or stream that are substantially different from the rest of the watershed. Distinct segments were determined by differences in habitat types, fish communities, gradient, and large independent tributaries.
β. Site-level concerns such as problem road/stream crossings, former dam sites, or recreational impacts.
χ. Public accessibility

Study Locations: The MCD will sample and assess nine locations within the lower Portion of the

Manistee River watershed, focusing on three main sub-watersheds: the (lower portion of) Big Manistee River, Bear Creek, and the Little Manistee River (watershed map showing all study site location is included as Appendix 1).

The **Big Manistee River** watershed includes 250 miles of mainstem, has over 100 tributaries, and drains 1,800 square miles. The Manistee flows through 7 counties and into Manistee Lake which is connected to Lake Michigan. The Big Manistee River has 2 hydropower dams, including Hodenpyl and Tippy Dams. The Manistee River has one of the most stable flow patterns in the country, producing good conditions for fish reproduction and survival.

Sampling sites for the Big Manistee River watershed:

1. **BM01 – Big Manistee River, Adams Creek at 16 Road** (44.40996, -85.61461). This road/stream crossing is located Wexford County.
2. **BM02 – Big Manistee River, Fletcher Creek at Fletcher Park Road** (44.404896, -85.747899). This site is located within Fetcher Creek Campground within Wexford County.
3. **BM03 – Big Manistee River, Hinton Creek at N Warfield Road** (44.277361, -85.831611)**.** This road/stream crossing is located within Manistee County, within the Manistee National forest. Hinton Creek is a small, cold water tributary to the Manistee River.
4. **BM04 – Big Manistee River, Sickle Creek at River Road** (44.295754, -86.154444). This open bottom culvert is located in Manistee County, within the Manistee National Forest near the Rainbow Bend boat launch.

Bear Creek is a Michigan Blue Ribbon Trout Stream and has a naturally reproducing population of brook trout in the headwaters. Bear Creek is a main tributary to the Manistee River, its confluence is downstream of Tippy Dam. Bear Creek is 28 miles long and covers 184 square miles.

Sampling sites for the Bear Creek watershed:

5. **BC01 - Bear Creek at Leffew road** (44.456039, -86.031550). Located in Manistee county within the Pere Marquette State Forest this road stream crossing is an abandoned bridge with adjacent wetlands. This location was adopted as a Fixed Site in the MDNR Fisheries Division's Stream Status and Trends Program in 2005.

6. **BC02 - Bear Creek at Spirit of the Woods Conservation Club:** (44.312368, -86.050584). Located in Manistee county, this site falls within the Spirit of the Woods Conservation Club property. This site is heavily fished by anglers, is easily accessible and is downstream of an old weir.

The Little Manistee River originates from several swamps in eastern Lake County and flows through Mason and Manistee County. The Little Manistee River watershed drains 145,280 acres which includes approximately 63 miles of river and ultimately flows into Manistee Lake. The watershed includes two permanent dams as well as several large wetland complexes. The Little Manistee River is surrounded by abundant hardwood and conifer forests and is relatively undeveloped. The combination of large stretches of undeveloped forests and ground-fed streams create one of the coldest and most stable streams in Michigan. All named tributaries of the Little Manistee River are Designated Trout Streams.

Sampling sites for the Little Manistee River watershed:

7. **LM01 - Little Manistee River at 6 Mile Bridge** (44.183491, -86.16764). Located in Manistee County within Manistee National Forest, this site has been previously sampled by the DEQ and the Little Manistee Watershed Conservation Council (LMWCC). This is an accessible site that has high traffic and is located less than two miles upstream from Little Manistee weir (MDNR egg-take and salmon harvest facility).
8. **LM02 - Little Manistee River, Cool Creek at Hamilton road** (44.161359, -86.0017). This crossing is located in Lake County within Manistee National Forest. This triple culvert was identified by the CRA as a problem crossing due to improper construction, resulting in sediment deposition into the river.
9. **LM03 – Little Manistee River at Johnson's Bridge** (44.10537, -85.927329). Located within Lake County, this road/stream crossing has been previously sampled by the LMWCC, is easy to access, and is a potential culvert replacement site.

Frequency and Timing: Macroinvertebrate communities are sampled twice per year, once in May and once in October. Sites are sampled within the same two-week time frame each year to minimize seasonal variability in macroinvertebrate distribution and abundance. New sites are added based on volunteer involvement or new problems within the watershed are detected.

For each sampling event that is not completed on a single day, monitoring by volunteers will be completed within the same two-week period. If a site is temporarily inaccessible, such as due to prolonged high water, the monitoring time may be extended for two additional weeks. If the issue concerning inaccessibility is continued beyond the extended dates, then no monitoring data will be collected during that time and there will be a gap in the data. If a team is unable to monitor their site during the specified time, the Stream Team Leader will contact the Program Manager as soon as possible and no later than the end of the first week in the sampling window in order for the Manager to arrange for another team to complete the monitoring. If no team is available, the Program Manager will, if feasible, sample the site. Otherwise, the site will go unmonitored for that season.

Macroinvertebrate Sampling Procedure: Before entering the stream, the Team Leader and Collector inspect all sampling gear to ensure that it is clean. If any aquatic life or debris on equipment, volunteers will use water withdrawn from the stream with a clean container to clean the equipment at a distance of no less than 100 feet from any water body. The trained Collector wades the stream and uses a D-frame kick net to obtain samples from each habitat type present at the site, including riffle, rocks or other large objects, leaf packs, submerged vegetation or roots, and depositional areas, making sure to thoroughly sample each habitat type. Meanwhile, the trained Streamside Leader will record the number of locations sampled within the monitored reach in each habitat type and note the locations sampled on a site map (Appendix 4). The Collector empties the contents of the nets into shallow white trays after each sample. The remaining volunteers (Pickers) pick out samples of all different types of macroinvertebrates from pans and puts the samples into jars of ethanol for later identification. Potential sources of variability such as weather/stream flow differences, season, and site characteristic differences will be noted for each event and discussed in study results. There are places on the data sheet to record unusual procedures or accidents, such as losing part of the collection by spilling. Any variations in procedure should be explained on the data sheet (Appendix 4). A delineation of Stream Team Roles and Duties is included in Appendix 2.

Immediately following the 30-minute in-stream collection event, the Stream Side Leader, Collector, and Pickers will continue to transfer specimen from the Collector's collection bucket for an additional 30 minutes. All observed specimen within the timeframe of the collection event are transferred to sampling jars regardless of abundance.

Prior to the collection event, all macroinvertebrate sample jars receive a label written in pencil and placed inside the jar indicating date, location, name of collector, and number of collection jars from the site. The data sheet also states the number of collection jars from the site. The Stream Team Leader is responsible for labeling and securely closing the jars in addition to returning all jars and all equipment to the Program Manager. Upon return to MCD office, the collections are checked for labels, the data sheets are checked for completeness and for correct information on the number of jars containing the collection from the site, and the jars are secured together with a rubber band and site label and placed together in one box. They are stored at the MCD office until they are examined and counted on the day of identification. The data sheets are used on the identification day; after which they remain on file for at least five years. Before leaving the site, Stream Team Leaders will make sure that all sampling equipment is clean of all debris and plant and animal life to avoid contamination if transported to another site. Sample jars and data sheets are to remain in the custody of Stream Team Leader at all times until transfer of custody is given to the Program Manager.

Macroinvertebrate Identification Procedure: The identification session will be held indoors at the MCD office, bringing together volunteers, Volunteer Leaders, and aquatic macroinvertebrate experts together to sort, identity, and count specimens collected in the field. For indentation, volunteers sort presented specimens into groups based on physical similarities, and then are joined by the Program Manager/expert who further sorts and identifies the taxa present to family level. All identifications are verified by the Program Manager. When identification of a sample is complete, the entire collection is placed in a single jar of fresh alcohol with a poly-seal cap and a printed label inside the jar and stored at room temperature at the MCD office indefinitely. The alcohol is carefully changed (to avoid losing small specimens) in the jars every few years. Old alcohol will be watered down and drained down the sink. Data is recorded on the corresponding site-specific MiCorps family level macroinvertebrate data sheet (Appendix 3).

Because our evaluation is based on the diversity in the community, we attempt to include a complete sample of the different groups present, rather than a random sub-sample. We do not assume that a single collection represents all the diversity in the community, but rather we consider our results reliable only after repeated collections spanning at least three years. Our results are compared with other locations in the same river system that has been sampled in the same way. All collectors attend an in-stream training session, and most sites are sampled by different collectors at different times to diminish the effects of bias in individual collecting styles. Samples where the diversity measures diverge substantially from past samples at the same site are resampled by a new team within two weeks. If a change is confirmed, the site becomes a high priority for the next scheduled collection. Field checks include checking all data sheets to make sure each habitat type available was sampled, and the team leader examines several picking trays to ensure that all present families have been collected.

Habitat Assessment Procedure (fall only): Stream Team Leaders and Collectors, with Pickers assisting as well will complete a Habitat Assessment once (Appendix 4) once a year during the fall season immediately following the macroinvertebrate sampling or within at least two weeks of the sampling event. A Site Sketch (Appendix 4) will accompany the Assessment. The Habitat Assessment is a critical piece of the monitoring process and will be used to monitor changes in stream habitat over time, which may result in changes in water quality and corresponding macroinvertebrate diversity. As many of the parameters within the Habitat Assessment are qualitative, personal bias is inherent. To account for bias and personal discrepancies, Stream Team Leaders will have on hand a copy of MiCorps Stream Monitoring Procedures (Appendix 5), which details the qualitative criteria, and helps clarify question aims. Stream Team Leaders will read questions aloud to their group and form consensus on question answers. Since the information reviewed in the Habitat Assessment holds considerable educational value for volunteers and the goals of the MiCorps program, it is important that Stream Team Leaders inform other group members of the purpose of the Assessment and encourage feedback from the group. However, final decision on scoring remains the responsibility of only those Stream Team Members who have undergone Stream Team Leader Training and have been certified by the Program Manager to do so. All final Habitat Assessment data sheets will be reviewed by the Program Manager for correctness and completeness. There are places on the data sheet to record unusual procedures or accidents.
Any variations in procedure should be explained on the data sheet.

As a critical role of the Habitat Assessment is to inform us of any areas of habitat degradation that could impact water quality. Any concerns noted in the data sheet will be reviewed by the Program Manager and appropriate action will be taken to resolve and/or address noted concerns including informing appropriate authorities.

Equipment Quality Control:

i. Check to make sure equipment is in working order and not damaged
ii. Clean equipment before and after taking it into the field
iii. Maintain a detailed inventory of equipment including dates of purchase and

iv. dates of last usage
v. Check the batteries of all equipment that requires them

Field Procedures Quality Control

δ. Collect replicate samples
ε. Conduct repeat and/or side-by-side tests performed by separate field crews
ϕ. At least once every three years in each season change the composition of the field crews to maintain objectivity and minimize individual bias
γ. Review field records before submitting for analysis to minimize errors

Data Analysis Quality Control

η. Field datasheets and labels will be verified by volunteers in the laboratory
ι. Specimen identification will be completed by trained volunteers
φ. Taxa identification will be verified by the Program Manager
κ. Counts will be verified by at least two volunteers
λ. Calculations will be completed by at least two volunteers and verified by the Program Manager
μ. Hard copies of computer entered data will be reviewed for errors by comparing to field data sheets

Variability: Possible sources of variably in data include team leader experience, volunteer commitment, and the subjective nature of some evaluations. Variances will be considered on a case by case basis to determine the effect the variability may have on results. Should problems with the program arise, the Program Manager and the MCD Administrator will meet to discuss and formulate corrective measures/actions to be taken.

B2. Instrument/Equipment Testing, Inspection, and Maintenance

Equipment: Team Leaders will pick up equipment at the district office prior to sampling their sites. All equipment will be stored at the MCD office. Each team will receive a sampling kit consisting of:

ν. Clipboard
ο. Folder containing directions and GPS coordinates of sampling sites and emergency contact sheet
π. MiCorps Macroinvertebrate Data Sheet
θ. MiCorps Stream Habitat Data Sheet (Fall only)
ρ. 2 Laminated identification sheets
σ. 2 Laminated MiCorps Survey/Sampling Tips Sheets
τ. 2 White trays
υ. 1 Ice cube tray
ϖ. 2 Magnifying glasses
ω. 1 Plastic cup/water bottle (for net rinsing)
ξ. 2 Eye droppers
ψ. 2 Forceps
ζ. 2 Pencils
αα. 2 D-Nets
ββ. 2 Collection jars filled ¾ with 70% ethanol with site label including location, date, and group leader names

χχ. 1 5-gallon bucket
δδ. 1 Tape measure
εε. Waders for team members
φφ. First aid kit

All equipment will be inspected and maintained by the Program Manager. All critical instruments will be tested before each sampling event to ensure proper function. Critical equipment includes D-shaped collection nets, collection jars with poly-seal caps, narrow point forceps, collection buckets and trays, waders and life jackets. Also, datasheets, labels and pencils are required for documentation. In the case that the Program Manager finds equipment insufficient for sampling, they will be responsible for repairing or replacing equipment prior to use in the field. Problems encountered in the field or laboratory will be noted and resolved accordingly. All equipment will be stored at the MCD office.

B3. Inspection/Acceptance for Supplies and Consumables

In the weeks prior to a monitoring or identification event, the Program Coordinator will check all equipment thoroughly. The Program Manager also maintains detailed records of all equipment including purchase date and when consumables should be replaced.

B4. Non-direct Measurements

Not applicable.

B5. Data Management

Macroinvertebrate and habitat assessment data will be entered by the Program Manager into MS Excel database for long-term storage. After each sampling event is completed, all new data will be emailed to midata@glc.org utilizing the MiCorps Stream Batch Templates. Hard copies of the data sheets will be stored at the MCD for a period of a least five years. All digital data will be backed up on an external hard drive and to Google Drive quarterly.

Macroinvertebrates: Data are summarized for reporting into four metrics: all taxa, EPT (Ephemeroptera + Plecoptera + Trichoptera), and sensitive taxa. Units of measure are families counted in each metric. The Stream Quality Index (SQI) from the MiCorps datasheet is also computed. The method for calculating that metric is included in Appendix 3.

Habitat: Specific measures are used from habitat surveys to investigate problem areas at each site. The percentage of stream bed composed of fines (sand and smaller particles) is calculated and changes are tracked over time as an indicator of sediment deposition.

Data Analysis Quality Control: All calculations will be checked at least twice. Hard copies of all computer entered data are reviewed for errors by comparing to field data sheets. Data analysis methods and results are periodically reviewed by qualified professionals.

SECTION C: SYSTEM ASSESSMENT, CORRECTION, ANDREPORTING

C1. System Audits and Response Actions

Volunteer Team Leaders trained by the Program Manager ensure that quality assurance protocols are followed and report any issues possibly affecting data quality. When significant issues are reported, the Program Manager may accompany groups in the field to perform side-by-side sampling and verify the quality of work by the volunteer team. In the event that a group is determined to have done a poor job sampling, a performance audit to evaluate how people are doing their jobs of collecting and analyzing the data is accomplished through side-by-side sampling and identification. During side-by-side sampling a team of volunteers and an outside expert sample the same stream. Agreement in sample composition between the two should be 60% or greater.

A system audit is conducted following each spring and fall monitoring event to evaluate the process of the project. The system audit consists of the Program Coordinator, any other program leader, and one or two active volunteers, and is a start to end review of the monitoring process and how things could be improved for the next event.

If deviation from the QAPP is noted at any point in the sampling or data management process, the affected samples will be flagged and brought to the attention of the Program Manager and the team that collected the sample. Re-sampling is conducted as long as the deviation is noted soon after occurrence and volunteers are available (two-week window). Otherwise, a gap must be left in the monitoring record and the cause noted. All corrective actions are documented and communicated to MiCorps staff.

Details of the process for assessing data quality are outlined in section A7. Response to quality control problems is also included in section A7.

C2. Data Review, Verification, and Validation

A standardized data-collection form is used to facilitate spot-checking to ensure that forms are completely and correctly filled out. The Program Manager or a single trained volunteer reviews the data forms before they are stored in a computer or file cabinet. After data has been compiled and entered into a computer file, it is verified with raw data from field survey forms.

C3. Reconciliation with Data Quality Objectives

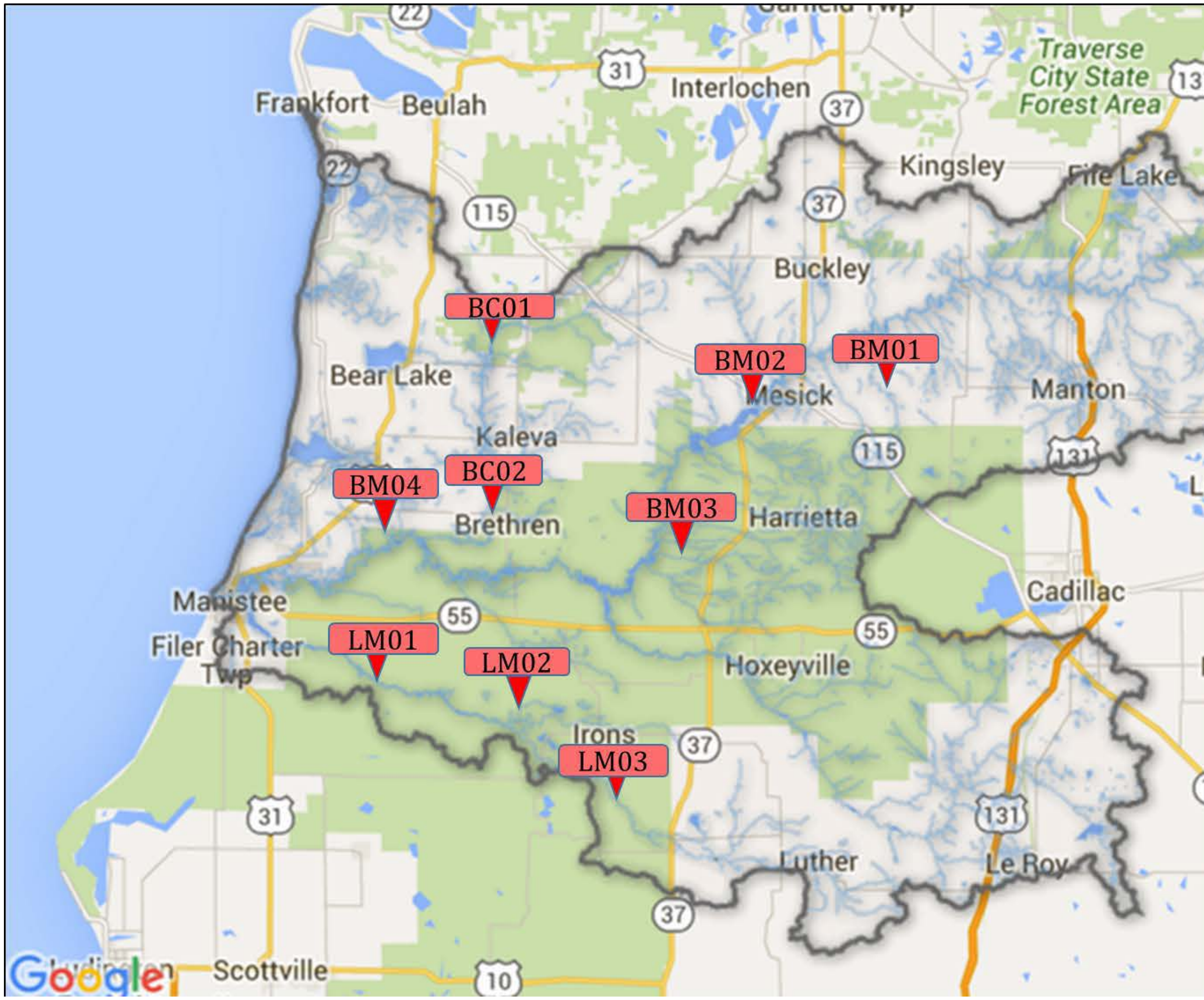
Data quality objectives are reviewed annually to ensure that objectives are being met. Deviations from the data quality objectives are reported to the Program Manager and MiCorps staff for assessment and corrective action. Also, data quality issues are recorded as a separate item in the database and are provided to the Program Manager and data users. Response to and reconciliation of problems that occur in data quality are outlined in Section A7.

C4. Reporting

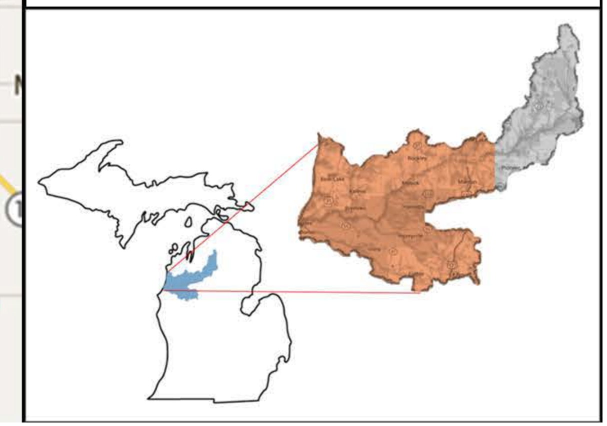
Throughout the duration of this program, quality control reports are included with quarterly project reports which are created by the Program Manager and are submitted to MiCorps. Quality control reports provide information regarding problems or issues arising in quality control of the project. These could include, but are not limited to: deviation from quality control methods outlined in this document relating to field data collection procedures, indoor identification, data input, diversity calculations and statistical analyses. Program staff generates annual reports sharing results of the program with volunteers, special interest groups, local municipalities, and relevant state agencies. Data and reports are made available via the organization's web page.

Appendix 1

Watershed Map with Sampling Sites



BM01 - Big Manistee River, Adams Creek at 16 Road
BM02- Big Manistee River, Fletcher Creek at Fletcher Park Road
BM03 - Big Manistee River, Hinton Creek at N Warfield Road
BM04 - Big Manistee River, Sickle Creek at River Road
BC01 - Bear Creek at Leffew Road
BC02 - Bear Creek at Spirit of the Woods Conservation Club
LM01 - Little Manistee River at 6 Mile Bridge
LM 02 - Little Manistee River, Cool Creek at Hamilton Road
LM03 - Little Manistee River at Johnson's Bridge



Map of study sites for the Lower Manistee Watershed Volunteer Stream Monitoring Project.

Appendix 2

Stream Team Roles

Techniques for Stream Macroinvertebrate Collecting

Team Roles

Every person on the team needs to have a role so they know their responsibilities and how they should be participating. Every river group is welcome to hold training events for all volunteer roles as they see fit, but the Huron River Watershed Council suggests that training should not be required for pickers and collector assistants, in order to boost beginner volunteer participation. Here are several suggested roles:

Picker:

γγ. New volunteers typically start out as Pickers. This job does not require getting into the stream and is a good way to get introduced to monitoring and the interesting creatures that live in the stream.

ηη. No training is required to be a Picker.

ιι. Pickers are responsible for sorting through the samples collected by the Collector, picking out the macroinvertebrates from the rocks and leaves and putting them in a collection jar.

Collector Assistant:

φφ. On a large site it is helpful to have one team member in waders assisting the Collector by carrying the trays to the team and the empties back to the Collector.

κκ. The only training required to be an Assistant is experience wading in moving water on slippery rocks.

Collector:

λλ. Collectors should attend training session in order to learn the techniques for sampling in the river.

μμ. The Collector is the only person that enters the water (unless there is an Assistant).

νν. They are responsible for sampling all of the habitats, and bring the samples to the rest of the team to sort through.

Streamside Leader:

οο. The Leader instructs the team, keeps the team together, locates the sampling site, is responsible for filling out the data sheets, labeling the jars, and reminding the Collector which habitats still need to be found.

ππ. Should require a training event.

Equipment Manager:

i. The Manager is a person who is willing to take responsibility for the equipment and will check the list to be sure everything leaves each site with the team
ii. This position should be a secondary job of one of the pickers.

When you get to the site- instructions for the streamside leader

1. Make sure you're at the right site!
2. Scout out a nice place for your team to sit on the bank and sort through samples.
3. Orient your team to what they are looking for. Explain that:
   - We want to collect samples of all the different macroinvertebrates.
   - Be patient when sorting; it may take a little time to see the tiny creatures that are there.
4. Make sure that each habitat gets sampled.
5. Let the team know about what you see in the creek, such as types of habitats that are missing and any evidence that the force of storm flow has affected the stream.

Collecting Hints- instructions for the collector

1. Always start downstream and work upstream to avoid disturbing where you're about to collect.
2. The most important thing is to get some of each type of creature.
3. Please note that some clams are endangered or threatened. Don't collect large clams, just make a note that you observed them.
4. You should spend approximately 45 minutes collecting at a small stream, and up to 1 hour collecting at a large river site (or 2 collectors spend 30 minutes in a river). Please collect as long as you need to thoroughly sample every different kind of habitat. The goal is to find as many types of macroinvertebrates as possible.
5. Sample a number of times in each habitat. Use three samples as a guideline but collect enough that you feel you got all of the different animals living in each habitat.
6. Remember - BE AGGRESIVE- the animals are holding on tight to rocks, branches, and leaves to avoid being carried downstream and you want to shake them loose!

Collecting Techniques

It is very important that you begin at the downstream end of your collecting site and work upstream, to minimize disturbance to the site. Collect from the various habitats in the order they come to you as you work your way upstream (and not necessarily in the order on the data sheet).

Riffle:

Note: When selecting a riffle, keep in mind that flow has a big impact on the types of animals that can live there. Two riffle samples, one in the fastest part (white water present, larger rocks) and one in the slowest part (no white water, smaller gravel sized rocks) will likely yield different animals.

1. Put net on bottom of stream, stand upstream, hold net handle upright.
2. Use kicking/shuffling motion with feet to dislodge rocks. You are trying to shake organisms off rocks as well as kick up organisms that are hiding under the rocks. Dig down with your toes an inch or two. Do a lil' dance. Some people use their hands to rub organisms off rocks, but beware of sharp objects on the stream bottom.

Quiet Place/pool:

1. Scoop some sediment up in your net. Some animals burrow into the muck.

Tip: When your net is full of muck, it is very heavy. To clean the excess muck out of your net: keep the top of the net out of the water to avoid losing animals, then sway the net back and forth, massaging the bottom of the net with your hand. When choosing a soft bottom area try to find one that contains silt since it is a far more productive habitat than just sand.

Undercut Bank/Overhanging Vegetation or Roots:

1. Jab the net into the undercut bank while pulling the net up. Move in a quick bottom to surface motion to scrape the macroinvertebrates from roots. Do this several times.
2. If you notice roots or overhanging vegetation, put the net under the bank at the base of the plants. Shake the vegetation using your net, trying to shake off the animals clinging to these plants. Feel free to use your hands if you are sure the plants are not poisonous.

Submerged or emergent vegetation:

1. Keeping the net opening pointed upstream, move the net through vegetation trying to shake the vegetation and catch any animals.
2. Use your hands to agitate the vegetation and dislodge the animals into the net.

Rocks/Logs:

1. Small logs and rocks can be pulled out of the water and given to the team to search for animals.

Hint for Logs: Be sure to check under bark.

Hint for Rocks: Caddisfly homes often look like small piles of sticks or clumps of small gravel attached to rocks.

Leaf Packs:

1. Look for a decomposing leaf pack. A “good” leaf pack has dark brown-black skeletonized leaves. Slimy leaves are an indication that they are decaying. Scoop a few into your net and let the team pull then apart and look for animals.
2. Tip: Sometimes a little water in the pan with the leaves will help dislodge the animals.

Finishing up

1. Remember to rinse the net and pans before leaving the site to avoid transporting animals or plants between sampling sites.
2. Have the Streamside Leader double check that the data sheet is completely filled out and that all habitats have been sampled.

Appendix 3

MiCorps Macroinvertebrate Data Sheet

MiCorps Site ID#:________________

Michigan Clean Water Corps

Stream Macroinvertebrate Datasheet

Stream Name: ____

Location:____(Circle one: *Upstream* or *Downstream* of road?)

Date:______________________________ Collection Start Time:________________(AM/PM)

Major Watershed:_____________________ HUC Code (if known):______________________

Latitude:_____________________________ Longitude:______________________________

Monitoring Team:

Name of Person Completing Datasheet:____

Collector:____

Other Team Members:____

Stream Conditions: Average Water Depth:____________________feet

Is the substrate covered with excessive silt?______No _____Yes (describe:___________________)

Substrate Embeddedness in Riffles:_______0-25% _____25-50% ______> 50% _____Unsure

Did you observe any fish or wildlife? ( ) Yes ( ) No If so, please describe:______________________

Macroinvertebrate Collection: Check the habitats that were sampled. Include as many as possible.

_____Riffles
_____Cobbles
_____Aquatic Plants
_____Runs
_____Stream Margins
_____Leaf Packs
_____Pools
_____Undercut banks/Overhanging Vegetation
_____Submerged Wood
_____Other (describe:_________ _____________________)

Did you see, but not collect, any **live crayfish**? (____Yes____No), or **large clams**? (____Yes____No)
remember to include them in the assessment on the other side!

Collection Finish Time:_____________(AM/PM)

Datasheet checked for completeness by:____Datasheet version 10/08/05
Data entered into MiCorps database by:____Date:_______________

MiCorps Site ID#:________________

Michigan Clean Water Corps

IDENTIFICATION AND ASSESSMENT

Use letter codes [**R** (rare) = 1-10, **C** (common) = 11 or more] to record the approximate numbers of organisms in each taxa found in the stream reach.

*** Do NOT count empty shells, pupae, or terrestrial macroinvertebrates***

Group 1: Sensitive

_____Caddisfly larvae (Trichoptera)
EXCEPT Net-spinning caddis
_____Hellgrammites (Megaloptera)
_____Mayfly nymphs (Ephemeroptera)
_____Gilled (right-handed) snails (Gastropoda)
_____Stonefly nymphs (Plecoptera)
_____Water penny (Coleoptera)
_____Water snipe fly (Diptera)

Group 2: Somewhat-Sensitive

_____Alderfly larvae (Megaloptera)
_____Beetle adults (Coleoptera)
_____Beetle larvae (Coleoptera)
_____Black fly larvae (Diptera)
_____Clams (Pelecypoda)
_____Crane fly larvae (Diptera)
_____Crayfish (Decapoda)
_____Damselfly nymphs (Odonata)
_____Dragonfly nymphs (Odonata)
_____Net-spinning caddisfly larvae
(Hydropsychidae; Trichoptera)
_____Scuds (Amphipoda)
_____Sowbugs (Isopoda)

Group 3: Tolerant

_____Aquatic worms (Oligochaeta)
_____Leeches (Hirudinea)
_____Midge larvae (Diptera)
_____Pouch snails (Gastropoda)
_____True bugs (Hemiptera)
_____Other true flies (Diptera)

STREAM QUALITY SCORE

Group 1:
____ # of R's * 5.0 = _____
____ # of C's * 5.3= _____
Group 1 Total= _______

Group 2:
_____# of R's * 3.0 = _____
_____# of C's * 3.2 = _____
Group 2 Total= _______

Group 3:
____ # of R's * 1.1 = _____
_____# of C's * 1.0 = _____
Group 3 Total= _______

Total Stream Quality Score = ________
(Sum of totals for groups 1-3; round to nearest whole number)

Check one:
____ Excellent (>48)
_____Good (34-48)
_____Fair (19-33)
_____Poor (<19)

Identifications made by:____

Rate your confidence in these identifications: Quite confident Not very confident
5 4 3 2 1

Datasheet checked for completeness by:____ Datasheet version 10/08/05
Data entered into MiCorps database by:____ Date:_______________

MiCorp Site ID#____________________

Identification verified by:_________________(optional)

Michigan Clean Water Corps

AQUATIC MACROINVERTEBRATE IDENTIFICATION WITH INSECT FAMILIES

Use letter code [**R** (rare) = 1-10, **C** (common) = 11 or more] to record the approximate numbers of organisms in each taxa found in the stream reach. Only use the blank by the main taxa heading (i.e. ANNELIDA, COLEOPTERA) when there are organisms that cannot be identified to the lower taxonomic levels. Enter both the family level data as well as the order level data into the Michigan Data Exchange.

ANNELIDA— Segmented Worm______
Hirudinea ___________________
Oligochaeta ___________________

COLEOPTERA — Beetles____________
Chrysomelidae ___________________
Curculionidae ___________________
Dryopidae ___________________
Dytiscidae ___________________
Elmidae ___________________
Gyrinidae ___________________
Haliplidae ___________________
Caenidae _________________ Hydrophilidae
Ephemerellidae Lampyridae
Ephemeridae Lutrochidae
Heptageniidae Noteridae
Isonychiidae Psephenidae
Ptilodactylidae
Scirtidae
Staphylinidae

COLLEMBOLA — Springtail__________

CRUSTACEA—Crustaceans_________

Amphipoda ___________________
Decapoda ___________________
Isopoda ___________________

DIPTERA — True Flies_______________

Athericidae ___________________
Blephariceridae__
Ceratopogonidae_
Chaoboridae ___________________
Chironomidae___
Culicidae ___________________
Dixidae ___________________
Dolichopodidae__
Empididae ___________________
Ephydridae ___________________
Muscidae ___________________
Phoridae ___________________
Naucoridae Ptychopteridae
Sarcophagidae
Pleidae Simuliidae
Stratiomyidae

DIPTERA— continued
Syrphidae _________________
Tabanidae _________________
Tipulidae _________________

EPHEMEROPTERA — Mayflies_____
Acanthametropodidae______________
Ameletidae _________________
Ametropodidae _________________
Arthropleidae _________________
Baetidae _________________
Baetiscidae Hydraenidae
Leptohyphidae
Leptophlebiidae
Metretopodidae
Neoephemeridae _________________
Oligoneuridae _________________
Polymitarcyidae____________________
Potamanthidae_____________________
Pseudironidae _________________

Siphlonuridae______________________
Tricorythidae_______________________

GASTROPODA — Snails, Limpets___
Ancylidae _________________

Physidae _________________
Planorbidae _________________
Right-handed snail_________________

HEMIPTERA — True Bugs__________
Belostomatidae___________________
Corixidae _________________
Gelastocoridae___________________
Gerridae _________________
Hebridae _________________
Hydrometridae____________________
Mesoveliidae Psychodidae
Nepidae
Notonectidae Sciomyzidae
Saldidae
Veliidae _________________

MiCorp Site ID#____________________

Michigan Clean Water Corps

AQUATIC MACROINVERTEBRATE IDENTIFICATION WITH INSECT FAMILIES (PAGE 2)

HYDRACARINA — Water mites_______

LEPIDOPTERA — Moths and Butterflies______

Cosmopterigidiae____________________
____
____
____

MEGALOPTERA — Alderflies,Dobsonflies____
Corydalidae ____________________
Sialidae ____________________

ODONATA — Damselflies, Dragonflies_____
Aeshnidae ____________________
____
____
____
____

Macromiidae_____ Petaluridae
____

TRICHOPTERA — Caddisflies________
Apataniidae __________________
Brachycentridae __________________
Dipseudopsidae__ Nepticulidae______
Glossosomatidae___________ Noctuidae
Goeridae ________________ Pyralidae
Helicopsychidae____________ Tortricidae
Hydropsychidae ___________
Hydroptilidae __________________
Lepidostomatidae __________________
Leptoceridae __________________
Limnephilidae __________________
Molannidae __________________
Odontoceridae __________________
Philopotamidae___ Calopterygidae____
Phryganeidae______________ Coenagrionidae___
Polycentropodidae__________ Cordulegastridae__
Psychomyiidae_____________ Corduliidae
Rhyacophilidae_____________ Gomphidae
Sericostomatidae___________ Lestidae
Uenoidae ________________ Libellulidae

PELECYPODA — Bivalves____________
Corbiculidae_____ Dreissenidae________
Sphaeriidae ____________________
Unionidae ____________________

PLATYHELMINTHES— Flatworms
Turbellaria ____________________

PLECOPTERA— Stoneflies___________
Capniidae ____________________
Chloroperlidae___ Leuctridae
________________ Nemouridae________
Perlidae ____________________
Perlodidae ____________________
Pteronarcyidae___ Taeniopterygidae ____

Datasheet checked for completeness by:__________________________Datasheet version 6/6/08
Data entered into MiCorps database by:___________________________Date:_________________

Appendix 4

MiCorps Habitat Assessment Data Sheet

STREAM HABITAT ASSESSMENT

Michigan Clean Water Corps

I. Stream, Team, Location Information

Site ID:___________________ Date:_____________________ Time:______________________

Location:____

Name(s):____

II. Stream and Riparian Habitat

A. General Information *Circle one or more answers as appropriate*							Notes and Observations: Give further explanation when needed.
1	Average Stream Width (ft)	< 10	10-25	25-50	>50		
2	Average Stream Depth (ft)	<1	1-3	>3	>5		
3	Has this stream been channelized? (Stream shape constrained through human activity- look for signs of dredging, armored banks, straightened channels)	Yes, currently	Yes, sometime in the past	No	Don't know		
4	Estimate of current stream flow	Dry or Intermittent	Stagnant	Low	Medium	High	
5	Highest water mark (in feet above the current level)	<1	1-3	3-5	5-10	>10	
6	Which of these habitat types are present?	Riffles	Deep Pools	Large woody debris	Large rocks	Undercut bank	
		Overhanging vegetation	Rooted Aquatic Plants	Other:	Other:	Other:	
7	Estimate of turbidity	Clear	Slightly Turbid (can partially see to bottom)		Turbid (cannot see to bottom)		
8	Is there a sheen or oil slick visible on the surface of the water?	No	Yes				
9	If yes to #8, does the sheen break up when poked with a stick?	Yes (sheen is most likely natural)		No (sheen could be artifical)			
10	Is there foam present on the surface of the water?	No	Yes				
11	Is yes to #10, does the foam feel gritty or soapy?	Gritty (foam is most likely natural)		Soapy (foam could be artifical)			

The following are optional measurements not currently funded by MiCorps
– Water Temperature, Dissolved Oxygen, pH, and Water Velocity

MiCorps Site ID#:___________ Date:________________

II. Stream and Riparian Habitat (continued)

B. Streambed Substrate

Estimate percent of stream bed composed of the following substrate.

If group will take transects and pebble counts (in Section IV), check this box and record the measured percentages. ☐

Substrate type	*Size*	*Percentage*
Boulder	>10" diameter	
Cobble	2.5 - 10" diameter	
Gravel	0.1 - 2.5" diameter	
Sand	coarse grain	
Fines: Silt/Detritus/Muck	fine grain/organic matter	
Hardpan/Bedrock	solid clay/rock surface	
Artificial	man-made	
Other (specify)		

C. Bank stability and erosion.

Summarize the extent of erosion along each bank separately on a scale of 1 through 10, by circling a value below. Left/right banks are identified by looking downstream.

Excellent	Good	Marginal	Poor
Banks Stable. No evidence of erosion or bank failure. Little potential for problems during floods. < 5% of bank affected.	Moderately stable. Small areas of erosion. Slight potential for problems in extreme floods. 5-30% of bank in reach has areas of erosion.	Moderately unstable. Erosional areas occur frequently and are somewhat large. High erosion potential during floods. 30-60% of banks in reach are eroded.	Unstable. Many eroded areas. > 60% banks eroded. Raw areas frequent along straight sections and bends. Bank sloughing obvious.
LEFT BANK 10 - 9	LEFT BANK 8 - 7 - 6	LEFT BANK 5 - 4 - 3	LEFT BANK 2 - 1 - 0
RIGHT BANK 10 - 9	RIGHT BANK 8 - 7 - 6	RIGHT BANK 5 - 4 - 3	RIGHT BANK 2 - 1 - 0

You may wish to take photos of unstable or eroded banks for your records. Record date and location.

Comments:

MiCorps Site ID#:____________ Date:__________________

Michigan Clean Water Corps

II. Stream and Riparian Habitat (continued)

D. Plant Community

Estimate the percentage of the stream covered by overhanging vegetation ________%

Using the given scale, estimate the relative abundance of the following:

Plants in the stream:		*Plants on the bank/riparian zone:*	
Algae on Surfaces of Rocks or Plants	Filamentous Algae (Streamers)	Shrubs	Trees
Macrophytes (Standing, Floating Plants)	**0= Absent 1= Rare 2= Common 3= Abundant 4= Dominant**	Grasses	**0= Absent 1= Rare 2= Common 3= Abundant 4= Dominant**
Identified species (optional)		Identified species (optional)	

E. Riparian Zone

The riparian zone is the vegetated area that surrounds the stream. Right/Left banks are identified by looking downstream.

1. Left Bank

Circle those land-use types that you can see from this stream reach.

Wetlands Forest Residential Lawn Park Shrub, Old Field Agriculture

Construction Commercial Industrial Highways Golf Course Other____________

2. Right Bank

Circle those land-use types that you can see from this stream reach.

Wetlands Forest Residential Lawn Park Shrub, Old Field Agriculture

Construction Commercial Industrial Highways Golf Course Other____________

3. Summarize the size and quality of the riparian zone along each bank separately on a scale of 1 through 10, bycircling a value below.

Excellent	Good	Marginal	Poor
Width of riparian zone >150 feet, dominated by vegetation, including trees, understory shrubs, or non-woody macrophytes or wetlands; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	Width of riparian zone 75-150 feet; human activities have impacted zone only minimally.	Width of riparian zone 10-75 feet; human activities have impacted zone a great deal.	Width of riparian zone ,10 feet; little or no riparian vegetation due to human activities.
LEFT BANK 10 - 9	LEFT BANK 8 - 7 - 6	LEFT BANK 5 - 4 - 3	LEFT BANK 2 - 1 - 0
RIGHT BANK 10 - 9	RIGHT BANK 8 - 7 - 6	RIGHT BANK 5 - 4 - 3	RIGHT BANK 2 - 1 - 0

MiCorps Site ID#:____________ Date:__________________

Michigan Clean Water Corps

III. Sources of Degradation

1. In what ways is this stream degraded, if any?

2. Does a team need to come out and collect trash?

3. Based on what you can see from this location, what are the potential causes and level of severity of this degradation? Only judge what you can see from the site.

(Severity: S – slight; M – moderate; H – high) (Indicate all that apply)							
Crop Related Sources	**S**	**M**	**H**	Land Disposal	**S**	**M**	**H**
Grazing Related Sources	**S**	**M**	**H**	On-site Wastewater Systems	**S**	**M**	**H**
Intensive Animal Feeding Operations	**S**	**M**	**H**	Silviculture (Forestry)	**S**	**M**	**H**
Highway/Road/Bridge Maintenance and Runoff	**S**	**M**	**H**	Resource Extraction (Mining)	**S**	**M**	**H**
Channelization	**S**	**M**	**H**	Recreational/Tourism Activities (general)	**S**	**M**	**H**
Dredging	**S**	**M**	**H**	• Golf Courses	**S**	**M**	**H**
Removal of Riparian Vegetation	**S**	**M**	**H**	• Marinas/Recreational Boating (water releases)	**S**	**M**	**H**
Bank and Shoreline Erosion/ Modification/Destruction	**S**	**M**	**H**	• Marinas/Recreational Boating (bank or shoreline erosion)	**S**	**M**	**H**
Flow Regulation/ Modification (Hydrology)	**S**	**M**	**H**	Debris in Water	**S**	**M**	**H**
Invasive Species	**S**	**M**	**H**	Industrial Point Source	**S**	**M**	**H**
Construction: Highway, Road, Bridge, Culvert	**S**	**M**	**H**	Municipal Point Source	**S**	**M**	**H**
Construction: Land Development	**S**	**M**	**H**	Natural Sources	**S**	**M**	**H**
Urban Runoff	**S**	**M**	**H**	Source(s) Unknown	**S**	**M**	**H**

Additional comments:

MiCorps Site ID#:____________ Date:__________________

IV. Optional quantitative measurements

A. Transects and Pebble Counts

To take quantitative stream habitat measurements, conduct 5-10 transects of your stream reach. Required equipment: tape measure long enough to stretch across the stream, and graduated rod or stick to measure water depth. Data sheet is on the next page.

Directions:
1) Determine stream width.
2) Use the rod to measure depth (D) and substrate (S) at more than 10 but less than 20 regular intervals along the entire transect. (For streams less than 10 feet wide, measure every ½ foot, for streams about 10 feet wide, measure every foot, etc.)
3) At every depth measurement, identify the single piece of substrate that the rod lands on (can be arbitrary).
4). For every measurement, enter the reading on the tape measure, the depth, and the substrate on the data sheet on the next page.

Data use: The depth and tape measure reading can be used to produce stream cross-section profiles. The pebble count can be used to give a more accurate percentage breakdown of the stream substrate than simply making an eyeball estimate (see Section II-B).

B. Bank Height

Vertical banks higher than 3 feet are usually unstable, while banks less than 1 foot, especially with overhang, provide good habitat for fish. While doing the transects, measure the bank heights and record the angle of the bank (right, acute, or obtuse) as indicated on the data sheet. Left/right banks are identified by looking downstream.

Data use: Calculate the percentage of banks with right, obtuse, and acute angles. Right angles indicate higher erosive potential, while acute angles improve the habitat structure of a stream.

V. Final Check

This data sheet was checked for completeness by: ___________________________________

Name of person who entered data into data exchange: ________________________________

Date of data entry:____

VI. Credits

This habitat assessment was created for the MiCorps Volunteer Stream Monitoring Program from a combination of habitat assessments from the Huron River Watershed Council, the Friends of the Rouge River, and the Michigan Department of Environmental Quality. Version 1.0, June 2009.

MiCorps Site ID#:___________ Date:_________________

STREAM TRANSECT DATASHEET

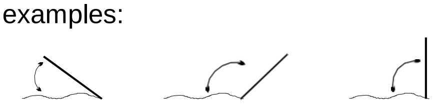
B: Boulder -- more than 10”
C: Cobble -- 2.5 - 10”
G: Gravel – 0.1 – 2.5”
S: Sand -- fine particles, gritty

F: Fines: Silt/Detritus/Muck
H: Hardpan/Bedrock
A: Artificial
O: Other (specify)

T= Reading on tape
D = Depth
S = Substrate

	EXAMPLE			Transect #			Transect #			Transect#		
Stream Width	13.3 feet											
	T	**D**	**S**	**T**	**D**	**S**	**T**	**D**	**S**	**T**	**D**	**S**
Beginning Water's Edge:	1.5											
1	2.5	0.4	G									
2	3.5	0.4	G									
3	4.5	0.4	G									
4	5.5	0.2	C									
5	6.5	0	S									
6	7.5	0.6	S									
7	8.5	0.7	G									
8	9.5	0.7	G									
9	10.5	0.6	C									
10	11.5	0.7	B									
11	12.5	0.4	G									
12	13.5	0.3	F									
13	14.5	0.2	F									
14												
15												
16												
17												
18												
19												
Ending Water's Edge	14.8											
Bank Side	**L**	**R**		**L**	**R**		**L**	**R**		**L**	**R**	
Bank Height	1.7 feet	0.5 feet										
Does the bank have an undercut?	N	Y										
If so, how wide is it?		1 ft										
Bank Angles: Sketch												

Sketch examples:



Undercut (Acute) Obtuse Right

MiCorps Site ID#:________________

Michigan Clean Water Corps

Site Sketch

Stream Name:____________________________Location:______________________

Date:__________________ Drawn by:__________________________________

Draw a bird's-eye view of the study site. Include enough detail that you can easily find the site again! Include the following items in the sketch:

- Direction of water flow
- Which way is north
- Large wood in the water
- Vegetation
- Bank features
- Areas of erosion
- Riffles
- Pools
- Location of road
- Trees
- Fences
- Parking lots
- Buildings
- Any other notable features

0 feet

150 ft

300 ft

Appendix 5

MiCorps Volunteer Stream Monitoring Standard Operating Procedures

MiCorps Volunteer Stream Monitoring Procedures

August 2006

Prepared by:

Jo Latimore, Huron River Watershed Council

Adapted from:
"Stream Crossing Watershed Survey Procedure, April 27, 2000"

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Surface Water Quality Division Michigan
Department of Environmental Quality

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MiCorps Volunteer Stream Monitoring Procedures

A. OBJECTIVES

This set of stream monitoring forms is intended to be used as a quick screening tool to increase the amount of information available on the ecological quality of Michigan's streams and rivers, and the sources of degradation to the rivers. This document is designed to provide standardized assessment and data recording procedures that can be used by trained volunteers participating in the Michigan Clean Water Corps (MiCorps) Volunteer Stream Monitoring Program.

This stream monitoring procedure is designed to address several general objectives:

- Increase the information available on the ecological quality of Michigan rivers and the sources of pollutants, for use by DEQ staff, local communities and monitoring groups.

- Provide consistent data collection and management statewide.

- Serve as a screening tool to identify issues and the need for more thorough investigations.

B. TRAINING

All MiCorps Volunteer Stream Monitoring Program leaders must have received basic training in the stream assessment methods described below from MiCorps staff. Trained program leaders are then qualified to train their program volunteers in these procedures.

C. GENERAL CONCEPTS

The procedures and data forms provided below include two types of assessment: Stream Habitat Assessment and Macroinvertebrate Sampling.

The Stream Habitat Assessment is a visual assessment of stream conditions and watershed characteristics. The assessment should include approximately 300 feet of stream length. Only observations that are actually seen are to be recorded. No "educated guesses" are to be made about what should be there or is probably there. If something cannot be seen, it should not be recorded. The one exception is if a significant pollutant source or stream impact is known to be upstream of a particular site, a comment about its presence can be made in the comment section of the form.

The Macroinvertebrate Sampling procedure should be used in conjunction with the Stream Habitat Assessment because each approach provides a different piece of the stream condition puzzle. Because of their varying tolerances to physical and chemical conditions, macroinvertebrates indicate the ecological condition of the stream, while thehabitat assessment provides clues to the causes of stream degradation.. Macroinvertebrate data used to calculate the MiCorps Stream Quality Index, which provides a straightforward summary of stream conditions and can be used to compare conditions between study sites.

D. SURVEY DESIGN

1. Selecting Monitoring Sites

One of the basic questions in planning stream monitoring is the location of study sites: how many stream sites should be surveyed within a watershed to adequately characterize it, and where should they be located? That depends on a variety of factors including the heterogeneity of land use, soils, topography, hydrology, and other characteristics within the watershed. Consequently, this question can only be answered on a watershed-by-watershed basis.

A general DEQ guideline is to try to survey a minimum of 30% of the stream road-crossing sites within a watershed, with the sites distributed such that each subwatershed (and in turn their subwatersheds) are assessed to provide a representative depiction of conditions found throughout the watershed. At least one site should be surveyed in each tributary, with the location of this site being near the mouth of the tributary. The distribution of sampling stations within the watershed should also achieve adequate geographic coverage. Consider establishing stations upstream and downstream of suspected pollutant source areas, or major changes in land use, topography, soil types, water quality, and stream hydrology (flow volume, velocity or sinuosity). If the intent of monitoring is to meet additional, watershed-specific objectives, then additional data may be needed.

In all cases, the site should be representative of the area of stream surveyed, it should contain a diverse range of the available in-stream cover, and it should contain some gravel/cobble bottom substrates if possible. Remember that each study site should allow for the assessment of 300 feet of stream length.

2. Time of Year

The time of year in which monitoring is conducted is important. For comparisons of monitoring data from year to year, data should be collected during the same season(s) each year. Ideally, macroinvertebrate sampling should take place in spring and again in early fall. Different macroinvertebrate communities are likely to be encountered during these different seasons, and sampling twice a year will provide a more complete picture of the total stream community. Habitat Assessment should be done in early spring before leaf-out, or in the fall after streamside vegetation dies back, allowing visual assessments of stream characteristics. Stream habitat assessments should not be conducted when there is snow on the ground or ice on the water because important features may be hidden from view. Surveys conducted during or shortly after storm runoff events may help to identify sources of pollutants, but high water obscures bank conditions and increased stream turbidity may make assessment of instream conditions difficult. Furthermore, all sites within a single watershed should be surveyed as closely together in time as possible to facilitate relative data comparisons among stations surveyed under similar stream flow and seasonal conditions.

E. INSTRUCTIONS FOR COMPLETING DATA SHEETS

1. Stream Habitat Assessment

a. Photographs

Taking Pictures

Always take photos. Photographs are useful for interpretation of Stream Habitat Assessment data and for later comparisons among different sites. Site photos should show the bank conditions and some of the riparian corridor. Additional photos may be taken to highlight a particular item of concern in the stream or upland landscape. Be sure to document photos as they are taken, to simplify identification later.

b. Site Identification Information

MiCorps Site ID#: A site ID# for each of your study sites will be assigned to you by MiCorps. If you do not know the MiCorps Site ID#, leave this space blank.

Stream Name: Use the stream or river name found on the U.S. Geological Survey (USGS) topographic map for the area and note also the local name if it is different. For tributary streams to major rivers, record the tributary stream name here, ***not*** the major river name. If the tributary is an unnamed tributary, record as "Unnamed Tributary to" followed by the name of the next named stream downstream. For example, a station on an unnamed tributary of Hogg Creek would be recorded as "Unnamed Tributary to Hogg Creek".

Location: This is often the name of the road from which you access the study site. It is very important to indicate whether the site is upstream or downstream of the road. If the same road crosses a single stream two or more times, it is sometimes desirable to record the road name relative to the nearest crossroads (e.g. "Green Road between Brown Road and Hill Road").

Date: Record the month, day and year.

Start Time: Record the time when the monitoring activity began. Use 24-hr time (e.g. 1:00 PM should be recorded as 1300).

Monitoring Team: Record the name and the phone number of the person completing the datasheet, as well as the names of other team members participating in the assessment.

Location Information:

- *Major Watershed*: Record the name of the major watershed where the study site is located (e.g., Grand River Watershed, St. Mary's River Watershed), and the corresponding HUC Code, if known.

- *County*: Record county name.
- *Township*: Record the township name.
- *Sec*: Record the township section number, town number, range number, and section ¼ ¼ designations (e.g. SW ¼ of the NW ¼).
- *Latitude and Longitude:* Record the latitude and longitude coordinates of the study site. Ideally, these coordinates will correspond to the midpoint of the stream study reach.
- *Coordinate Determination Method*: Check the method used to determine the latitude/longitude location coordinates. This could include a GPS unit, a topographic map, or a mapping website, like www.topozone.com.
- *Map Scale*: If a map is used to determine latitude/longitude coordinates, record the scale of measurement (e.g. 1:25,000) if known.
- Indicate whether the standard 300 feet of stream were assessed, or explain any deviation from this standard.

c. Background Information

Storm Event Conditions Noted at Site: A stream "event" occurs when water runoff from a significant weather event, such as a major rainstorm or fast snowmelt, causes an increase in river flow. Note that high water flow conditions that are not related to storm events can exist (particularly in the spring). Also, rainstorms can occur that result in no increase in stream flow and therefore there is no stream event.

Circle the appropriate description of event conditions exhibited ***in the stream***. Event conditions are increased river flow above what would be considered typical or normal for the stream for the time of year. The surveyor needs to determine this based on the following:

- Their knowledge of recent weather conditions (e.g. how much it has rained recently).
- Visual stream observations (look for event related conditions such as a rising or recently elevated water level, water running off the land into the stream, fast stream water velocity, increased water turbidity, an increase in the amount of debris being carried by the stream, etc.).
- The surveyor's knowledge (or best guess) of what is typical flow for that (or a similar) stream, in that geographic area, for that season of the year.

None	-	No event conditions are evident. Stream flow conditions exist that are typical for the season of the year. Note that it is possible to have "high" flow conditions that are not due to a recent storm event.
Light	-	Stream exhibits increased turbidity from normal and/or the water level of the stream (stage height) is somewhat elevated above what would be considered typical for the season of the year.
Moderate	-	Stream stage height is elevated substantially above typical flow conditions for the stream, for that time of year.

Heavy - Bank full or flooding conditions exist.

Days Since Rain: Circle the appropriate number of days that have passed since the last significant rain ended. This information is based on what you know about recent weather in the vicinity of the site. If you do not know, circle “unknown”.

Water Temp: This is an optional data item. The person coordinating a particular watershed survey will determine if temperature measurements will be made. If measured, record the water temperature to the nearest degree fahrenheit or centigrade, making sure to include the scale units.

Water D.O.: This is an optional data item. The person coordinating a particular watershed survey will determine if dissolved oxygen (DO) measurements will be made. If measured, record the DO level in the river. If DO is measured, it is important that the water temperature be measured also.

Water pH: This is an optional data item. The person coordinating a particular watershed survey will determine if pH measurements will be made. If measured, record the pH of the stream to the nearest tenth.

Water Color: Circle the choice that best represents the color of the water.

Waterbody Type-upstream: Characterize the waterbody upstream of the study site and circle the appropriate category. The answer usually will be “stream”, but not always. Impound=impoundment (dammed stream section/reservoir).

Waterbody Type-downstream: Characterize the waterbody downstream of the road crossing and circle the appropriate category.

Stream Width (ft): Circle the range that represents the average stream width in feet. Take width measurements of the stream at several points along the 300-foot assessment area, and indicate the average width here. These measurements are also useful in creating the Stream Site Sketch.

Avg. Stream Depth (ft): Circle the appropriate depth range in feet. Take depth measurements at several points within the 300-foot assessment area, and indicate the average depth here. This observation is for the average depth of the stream that is consistently observed. For example, if the stream is generally shallow (<1ft), but has a pool that is 3ft deep, circle the <1ft category since a pool is not representative of the average depth of <1ft observed over most of the stream.

Water Velocity (ft/sec): This is an optional data item. The person coordinating a particular watershed survey will determine if water velocity measurements will be made. If measured, record the approximate surface water velocity in feet per second, observedat the surface in the area of fastest river flow that is not impacted by a road crossing. One method is to observe how far downstream a floating object travels in one second (observe for 10 seconds and divide the distance by 10).

Stream Flow Type: Circle the category that best represents general flow volume in the stream. Describe the flow during the assessment in relation to the annual average flow. If a river flow is reduced in the summer, due to dry and hot conditions, circle "L" because it is below average, even though low flow may be typical for that stream in the summer.

Dry	=	No standing or flowing water, sediments may be wet.
Stagnant	=	Water present but not flowing, can be shallow or deep.
L (low)	=	Flowing water present, but flow volume would be considered to be below average for the stream.
M (medium)	=	Water flow is in average range for the stream.
H (high)	=	Water flow is above average for the stream.

d. Physical Appearance

The following categories should be observed throughout the 300-foot assessment reach. If a category type (e.g. aquatic plants) is not present in the stream, circle "None". If a category type can be seen, in any amount, circle "present". If a category type is present in a large portion of the stream, circle "abundant".

Aquatic Plants: This category refers to aquatic macrophytes only, not terrestrial species. By definition, macrophytes are any plant species that can be readily seen without the use of optical magnification. However, the usage here is directed primarily toward aquatic vascular plants—plants with a vascular system that typically includes roots, stems and/or leaves. This includes duckweed, as it is a floating vascular plant. Certain large algae species that superficially look like vascular plants, such as Chara, can be recorded here as well. If the person conducting the survey is knowledgeable about aquatic plants, the particular type or species of plant(s) can be noted in the comment section at the end of the form. Floating, suspended, or filamentous algae species should be recorded in one of the algae categories and not here.

Floating Algae: The presence of suspended algae (single celled organisms that may or may not form colonies) or floating algae mats/bundles should be recorded here. This includes bluegreen algae mats/bundles, whether floating on the surface, suspended in the water column, or present at the bottom.

Filamentous Algae: Algae that appear in stringy or ropy strands, such as Cladophora. The strands may or may not be attached to other objects in the waterbody.

Bacterial Sheen/Slimes:
-Bacterial sheens occur as oily appearing sheens on the water surface, often with a silverish cast to them. The sheens are produced from bacterial decomposition activity, and occur most often in still water areas of lake edges and coves, as well as wetland areas. The sheen can be distinguished from petroleum products by breaking into distinct platelets when poked with a stick or otherwise physically disturbed, whereas petroleum products remain viscous.
-Bacterial slimes are bacterial growths that are visible as a slimy-appearing coating of stream or lake substrates. They can be various colors, including black and orange.

Turbidity: Water appears cloudy—it is not transparent. Turbidity is caused by suspended particulates such as silt, sand, algae, or fine organic matter. Turbid water is opaque to varying degrees, preventing the observer from seeing very far into it. Note that water can have a color to it that is not turbidity, such as the brown transparent water often associated with swampy areas. If the water is slightly turbid, circle “present”. If it is moderately turbid to very turbid, circle “abundant”.

Oil Sheen: An oily appearing sheen on the water surface caused by petroleum products. A thin sheen will often have a rainbow of hues visible. The sheen can be distinguished from bacterial sheens by remaining viscous when poked with a stick or otherwise physically disturbed, whereas bacterial sheens break into distinct platelets.

Foam: Naturally occurring foam often looks like soap suds on the water surface and can be white, grayish or brownish. Foam is produced when water with dissolved organic material is aerated and can range in extent from individual bubbles to mats several feet high. Foam is typically produced in streams when water flows through rapids or past surface obstructions such as logs, sticks and rocks. Simple wave action can produce foam in lakes. This naturally occurring foam is quite common. Natural foam can be distinguished from soap suds by rubbing it between the fingers. If the suds disintegrate and leave only wet fingers or a gritty residue, the foam is natural. If the suds feel slippery and soapy, or smell perfumed, it is not natural foam.

Trash: Use this category to record the presence of general litter, such as paper, bottles, cans, etc., either in the waterbody or along the riparian banks. Use some reasonable discretion when completing this category. A single piece of gum wrapper on one bank would not be sufficient cause for checking “present”.

e. Substrate

Substrate is the material that makes up the bottom of the stream. In general, good quality substrates (from an aquatic habitat perspective) contain a large amount of course aggregate material—such as gravels and cobbles—with a minimal amount of fine particles surrounding or covering the interstitial pore spaces. These stable materials provide the solid surfaces necessary for the colonization of attached algae and the development of diverse macroinvertebrate communities.

Using the particle size and composition guidance provided below, identify the percent areal extent of each substrate type present. The composition estimate should include the entire area of the stream bottom in the study site (typically, 300 feet of stream).. Sometimes it is not possible to determine the substrate type all the way across a river because it is too deep or the water is turbid. In these cases, assign the appropriate percentage amount to the “unknown” category.

Substrate Type		Composition and Size
Boulder	-	Rocks 10 inches in diameter or larger.
Gravel-Cobble	-	Rocks 1/12 inch to 10 inches in diameter.
Sand	-	Rocks 0.06 to 2 millimeters in diameter.

Silt-Muck-Detritus	-	Silt is usually clay, very fine sands, or organic soils, 0.004 to 0.06 millimeters in diameter. Muck is decomposing organic material of very fine diameter. Detritus is small particles of organic material such as pieces of leaves, sticks, and plants.
Hardpan-Bedrock	-	Solid surface. Hardpan is usually packed clay, <0.004 millimeters in diameter. Bedrock is a solid rock surface (the tops of buried boulders are not bedrock).
Artificial	-	Human made, such as concrete piers, sheet piling or rock riprap (that portion of shoreline erosion protection structures that extends below the water surface is considered substrate).
Unknown	-	The portion of the stream bottom for which a substrate type determination can not be made because the bottom can not be seen due to water depth or turbidity.

f. In-stream Cover

In-stream cover generally refers to habitat cover that is available to fish to: (1) protect them from predators, or (2) avoid certain stream conditions such as fast flow velocities or direct sunlight. Check all the instream cover types on the data form that are present in the stream reach for as far as can be seen—except, only check those cover types that are in areas of sufficient water depth (usually greater than 6 inches). Types of cover include the following:

Undercut Banks	-	Stream banks that overhang the stream because water has eroded some of the material beneath them.
Overhanging Veg	-	Terrestrial vegetation that extends out from shore over the surface of the stream within a foot or two of the water surface (includes trees, shrubs, grasses, etc.). This category also includes sweeping vegetation, which is terrestrial shoreline vegetation that extends into the water itself (such as low hanging branches on shrubs) and is therefore often “swept” in a downstream direction by the current .
Deep Pools	-	A depression or “hole” in the bottom of the stream where the water is substantially deeper than the average water depth of the stream.
Boulders	-	Rocks 10 inches in diameter or larger.
Aquatic Plants	-	Aquatic macrophytes.
Logs/woody Debris	-	Logs, branches and roots.

g. Stream Morphology

Riffle

Riffles are areas of naturally occurring, short, relatively shallow, zones of fast moving water, typically followed by a pool. The water surface is visibly broken (often by small standing waves) and the river bottom is normally made up of gravel, rubble and/or boulders. Riffles are not normally visible at high water and may be difficult to identify in large rivers. The size of, and distance between, riffles is related to stream size. In large mainstream reaches, such as the Manistee or Muskegon rivers, riffles may be present in the form of rapids.

Present	-	A riffle can be positively identified.
Abundant	-	A series of riffles and pools are visible.

Pool

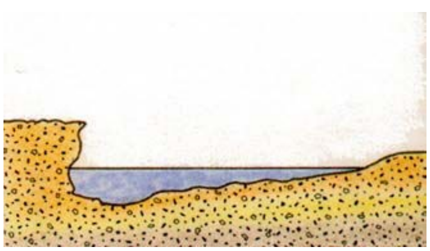
Pools are areas of relatively deep, slow moving water. The key word here is “relatively”. Water depth sufficient to classify an area as a pool can vary from around 8 inches in small streams, to several feet in wadable streams, to tens of feet in large rivers. Pools are often located on the outside bend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

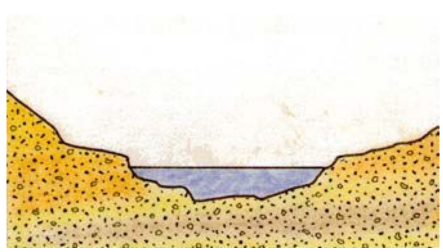
Present	-	At least one pool can be identified.
Abundant	-	A series of pools in a riffle pool sequence are visible.

Channel

The channel condition, for the purposes of this assessment, is classified as Natural, Recovering, or Maintained.

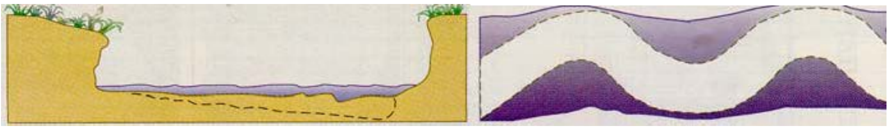
Natural Stream - A natural stream has not been altered from its defined pattern, dimension and profile by artificial means, which includes straightening and widening. It is not necessarily stable, however. The stream has a non-uniform cross section with distinct pool and riffle sequences, although in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





Recovering - A recovering stream is one that has been straightened or otherwise

controlled, and is evolving back to a stable pattern, dimension and profile. The stream channel is relatively straight, or is overly wide with a channel within the wider channel. Meanders may be beginning to form as evidenced by bank erosion and pool formation. Pools and riffles should be forming but may be sparse. Point bars may be forming. Vegetation may be sparse or very young.
Defined dikes or spoil piles along the stream bank can be identified.



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

Designated Drain

If the surveyor knows whether or not the stream segment being assessed is a legally designated drain under the Michigan Drain Code, circle "Y" (yes) or "N" (no). If the surveyor does not know, circle the "?".

Highest Water Mark

The highest water mark is the maximum height to which the stream water level rises at the site, as determined by the visible evidence present. This level is typically reached during floods or high flow conditions. The highest water mark is determined as the distance in feet **above the present water level** at the site. If the surveyor cannot visibly determine how far the stream rises at the site, circle the "?" on the form.

The highest water mark may be visible as discoloration on bridge pilings or abutments, stream debris (trash, leaves, weeds) left along the stream banks or in tree/shrub branches, ice scour marks on trees or streambanks, or muddy residues left in floodplains or on streamside vegetation.

Stream Cross Section

Draw a rough cross section of the stream profile. This should be just a general approximation. Do not spend more than a few seconds on this.

h. Stream Corridor

The questions in this section are used to characterize terrestrial land cover and land use in the vicinity of the stream, often referred to as the stream corridor.

Riparian Vegetative Width

The riparian vegetative width is the width of the streamside natural vegetation zone along the stream banks. The width is measured from the edge of the stream to the end of the contiguous block of natural vegetation. Natural vegetation is defined as including trees, shrubs, old fields, wetlands, or planted vegetative buffer strips (often used in agricultural areas and stormwater runoff control). Agricultural crop land and lawns are **not** considered natural vegetation for the purposes of this question. Circle the appropriate distance (in feet) that represents the **average, or most representative** (>50% of the lineal bank distance) width of the vegetation zone for each side of the river. Left and right banks are determined from the perspective of facing downstream.

Bank Erosion

Bank erosion may occur as a result of natural flow conditions, or may be caused by human activities. Determine the severity of erosion that has taken place and circle the appropriate category. Record the most severe magnitude of erosion observed on either bank.

0 - The banks appear stable and there is no evidence of erosion. These banks have stable toes and sidewalls, are most likely well vegetated or structurally stabilized, and have no evidence of exposed tree roots or leaning trees due to eroded soil. They are not being altered by water flows, livestock access, or recreational access.

L - Low evidence of erosion. Streambanks are stable but are being lightly altered. Less than 10% of the streambank is receiving any kind of stress. Stress that is noted is very light. Less than 10% of the bank is sloughing, broken down, or actively eroding.

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

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

Streamside Land Cover

Circle the letter of the dominant type of cover that exists at the streambank “edge” (within the first 20 feet or so of the stream edge) along the reach of river that can be seen from the road stream crossing.

Bare - Bare ground. No, or almost no, streamside vegetation. Grass - Grasses, wildflowers, ferns, sedges (non-woody vegetation).
Shrub - Shrubs and small trees. Woody vegetation less than 15 feet high.
Trees - Trees (15 feet tall or higher).

Stream Canopy

The stream canopy is the amount of leafy vegetation that extends out over a stream (at any height) and shades the water from direct sunlight. The average amount of stream canopy should be recorded as the amount of water shading that would be present *if the sun were directly over the stream.*

<25 - Less than 25% of the stream would be shaded.
25-50 - 25-50% of the stream is shaded.
>50 - Over 50% of the stream is shaded.

Adjacent Land Uses

Circle the appropriate left or right streambank (facing downstream) designation for all of the following land uses that are adjacent to the stream. Land use along the entire length of stream that can be seen from the road stream crossing should be evaluated. This might include land that is beyond the riparian corridor. “Adjacent” requires the use of some judgement on the part of the surveyor, but generally refers to any land that can be seen from the crossing and is reasonably close to the stream such that pollutants could run off it into the stream. For example, if a 20-acre corn field is near a stream but separated from it by a 10’ grass/shrub buffer strip, the “Rowcrop” category should be circled. If the same field were 100’ from the stream and the intervening distance was wooded, the “Forest” category should be circled.

Wetlands - Wetland vegetation is present. May or may not include standing water. Could include shrubs and trees.
Shrub or Old Field - Meadow or field that has not been recently cultivated or grazed. Often represented by tall grasses and shrubs.
Forest - Trees present in forested setting (includes small woodlots). Trees may be cultivated or natural.
Pasture - Field showing signs of being recently or actively grazed by livestock (vegetation is cropped close to the ground).
Crop Residue - An agricultural crop residue remains, after harvest and/or tillage, which covers 30% or more of the field surface.

Row crop	-	Agricultural cropland planted in rows and cultivated.
Res. Lawns, Parks	-	An expanse of maintained grass, often found in residential lawns and parks.
Impervious	-	Impervious surfaces (water can not penetrate them) are present near the water. Includes paved surfaces and roofs.
Disturbed Ground	-	Soil has been disturbed (plowed, cleared, bulldozed, excavated) for construction or agriculture. Vegetation is not present on disturbed ground but may be present in adjacent areas.
No Vegetation	-	Bare ground. No vegetation is present on the soil, but it is not disturbed ground.

i. Potential Sources

The intent of this section is to evaluate the relative importance of potential sources in terms of pollutant contribution to the waterbody at a given site in the watershed. The evaluation assesses the potential for pollutant inputs at the site, **NOT pollutant impacts**, or the potential for pollutant impacts. Pollutant impacts, as indicated by visual manifestations, were evaluated previously on the first page of the data sheet.

Evaluating potential sources of pollutants to a waterbody is a three step process: identification of potential sources, evaluation of pathways for pollutants to get to the waterbody, and finally evaluation of the severity (magnitude) of this pollutant input or loading. The three steps of this process will result in scoring identified sources on the survey sheet as Slight, Moderate, or High Priority in terms of the severity or amount of their pollutant contribution to the waterbody at the site being surveyed.

(1) Source Identification

Visually evaluate the various land use/land change activities at the site for potential sources of pollution. Note all potential sources for the area that can be seen (choosing from among the list of sources on the data sheet). For example, is there evidence of soil disturbance at the site, or land uses such as residential lawns, agricultural fields, parking lots, urban areas, etc., near the waterbody? Use the source definitions provided to help identify what potential sources may exist. If it is known that a significant source exists upstream of the study site, such as a wastewater treatment plant, it may be important to note the presence of that source, but it should be recorded in the comments section since it was not visible at the site.

(2) Pollutant Pathway

Next, for each potential source that has been identified, evaluate how pollutants could get from the source to the water. An evaluation of likely pathways for pollutants to enter the waterbody provides information regarding the potential for the identified sources to contribute pollutants. The following provides a quick outline of some visual observations to consider in evaluating pollutant pathways. Pay particular attention to likely water runoff patterns at the site that may occur during rainfall or snowmelt events.

- Gully/rill erosion provides a direct pathway for pollutants to enter the stream in a concentrated flow when the land slopes toward the stream. Pollutants associated with eroding soils will vary depending on the type of land use activity.
- Tile/pipe discharges are potential direct pathways for pollutants.
- Bare soils near the edge of a waterbody provide a likely pathway for sediment to get to the waterbody.
- Maintained lawns to the edge of a waterbody provide a likely pathway for nutrients and pesticides to the waterbody.
- Land disturbance/use activities to the edge of a waterbody provide a likely pathway for various pollutants to the waterbody.
- Open areas of disturbed soils and/or bare soils devoid of vegetation provide a potential pathway for pollutants via wind erosion.
- Steep streambanks (steeper than a 2:1 slope) devoid of vegetation are likely pathways for sediment.
- No canopy over the waterbody is a pathway for dramatic thermal increase in water temperature during the day.
- Impervious surfaces (parking lots, roads, roof tops, etc.) provide a likely pathway for various pollutants, and may increase flows in the watershed causing flashiness.
- Culverts/bridges may not be aligned with the stream, or may be undersized, and could provide a likely pathway for flow to create streambank erosion both upstream and downstream of the culvert or bridge.

(3) Severity Ranking

Finally, for each source for which a pathway has been identified, evaluate how severe the <u>pollutant loading</u> is. Rank each source identified as Slight, Moderate or High severity for the contribution of pollutants, based on the magnitude or quantity of pollutants likely to be delivered to the stream. The surveyor must use their judgement on assigning a slight, moderate or high rating.

The severity ranking is based only on *pollutant inputs* from the specific source *at the site*, <u>not</u> on visible stream impacts or impacts the pollutant may cause downstream. The pollutant loads from the identified source(s) may or may not have an impact at the site.

Evaluation of the source, location and pathways can provide a reasonable assessment of the severity of the pollutant loading. The following provides a quick outline of some visual observations to consider in evaluating the severity of pollutant loading.

- Proximity to waterbody – generally the closer the use, or land disturbance activity, is to the waterbody, the greater the likelihood for pollutant delivery.
- Slope to waterbody – generally the steeper the slope/topography to the waterbody, the greater the likelihood of overland pollutant delivery.
- Conveyance to waterbody (ditch, pipe, etc.) – generally a conveyance from the use, or land disturbance activity, increases the likelihood of pollutant delivery.

- Imperviousness – impermeable surfaces reduce the amount of land area available for water infiltration and increase the potential for overland runoff. Additionally, if a watershed is greater than 10% impervious, it will start to show some systemic problems due to impacts from flow. If a watershed is greater than 25% impervious, the natural hydrology is generally heavily impaired.
- Intensity and type of use, or land disturbance activity – generally the more intensive the activity the greater the likelihood for the generation of pollutants. Certain activities may have specific types of pollutants associated with them.
- Size of erosion area – generally the larger the erosion area the greater the likelihood for sediment delivery.
- Soil type – clay is less permeable than sand, and therefore would create a greater potential for overland runoff of pollutants.
- Presence and type of vegetation – the greater the vegetative buffer around a waterbody, the better the filtration of pollutants from nearby land disturbance and use activities. Certain types of vegetative buffers work better than others and should be evaluated on a case-by-case basis.

Potential Source Category Definitions:

Source Category	Use this Source Category if …
Crop Related Sources	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the farmed area. Possible pathways: farming to the edge of the drain, gully/rill erosion off field, tile discharge, wind erosion off field.**
Grazing Related Sources	**… there is clear evidence that grazing of animals near or in the waterbody has resulted in the degradation of streambanks or stream beds, sedimentation, nutrient enrichment, and/or potential bacterial contamination.**
Intensive Animal Feeding Operations	**… there is a reasonably clear pathway for pollutants to enter the waterbody from either runoff from the operation or land application of animal manure. Possible pathways: overland flow, tile discharge.**
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	**… there is clear evidence that transportation infrastructure is creating increased flow, runoff of pollutants, or erosion areas in or adjacent to the waterbody.**
Channelization	**… there is clear evidence that the natural river channel has been straightened to facilitate drainage.**
Dredging	**… there is clear evidence that a waterbody has been recently dredged. Evidence might include: spoil piles on side of waterbody, disturbed bottom, disturbed banks.**
Removal of Riparian Vegetation	**… there is clear evidence that vegetation along the waterbody has been recently removed (within the last few years).**
Bank and Shoreline Erosion/ Modification/Destruction	**… there is clear evidence that the banks or shoreline of a waterbody have been modified through either through human activities or natural erosion processes.**

Flow Regulation/ Modification (Hydrology)	**… there is reasonably clear evidence that flow modifications in the watershed have created unstable flows resulting in streambank erosion.**
Upstream Impoundment	**… there is reasonably clear evidence that an upstream impoundment has contributed to impacts on downstream sites. Impacts may be: nuisance algae, increased temperatures, streambank erosion from unstable flows.**
Construction:Highway/Road /Bridge/Culvert	**… there is clear evidence that on going or recent construction of transportation infrastructure is contributing pollutants to the waterbody.**
Construction: Land Development	**… there is clear evidence that on going or recent land development is contributing pollutants to the waterbody.**
Urban Runoff (Residential/ Urban NPS)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from an urban/residential area. Possible pathways: gully/rill erosion, pipe/storm sewer discharge, wind erosion, runoff from lawns or impervious surfaces.**
Land Disposal	**… there is a reasonably clear pathway for pollutants to enter the waterbody from an area where waste materials (trash, septage, hazardous waste, etc.) have been either land applied or dumped. Possible pathways: gully/rill erosion, pipe discharge, wind erosion, or direct runoff.**
On-site Wastewater Systems (e.g. septic systems)	**… there is reasonably clear evidence of nutrient enrichment and/or sewage odor is present, and there is reason to believe the area is unsewered.**
Silviculture (Forestry NPS)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the forest management area. Possible pathways: logging to the edge of the waterbody, gully/rill erosion off site, pumped drainage, erosion from logging roads, wind erosion off site.**
Resource Extraction (Mining NPS)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the mined area. Possible pathways: gully/rill erosion off site, pumped drainage, runoff from mine tailings, wind erosion off site.**
Recreational/Tourism Activities (general)	**… you are unable to clearly identify the recreational source as related to a golf course, or recreational boating activity. Foot traffic causing erosion would fall into this category.**
Golf Courses	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the golf course area. Possible pathways: overland runoff, gully/rill erosion off course, tile discharge, wind erosion off course.**
Marinas/Recr. Boating (water releases)	**… if you can reasonably determine that releases of pollutants to a waterbody such as septage or oil/gasoline are due to recreational boating activities.**
Marinas/Recr. Boating (streambank erosion)	**… you can reasonably determine that streambank erosion is due to wake from recreational boating activities.**
Debris in Water	**… debris in the water either is discharging a potential pollutant, or is causing in stream impacts due to modifications of flow. Possible examples: Leaking barrel, Refrigerator, Tires, etc. This does not include general litter (e.g. paper products).**
Industrial Point Source	**… there is reasonably clear evidence that an upstream industrial point source has contributed pollutants.**

Municipal Point Source	**… there is reasonably clear evidence that an upstream municipal point source has contributed pollutants.**
Natural Sources	**… there is reasonably clear evidence that natural sources are contributing pollutants. Possible examples: streambank erosion, pollen, foam, etc.**
Source(s) Unknown	**… if you see an impact but are unable to clearly identify any likely sources.**

Additional Comments:

Any observations about the site that were not covered elsewhere on the survey form should be recorded in this section. If certain survey responses require clarification or elaboration, those should be described here as well. The comment section can also be used to add detail to the site characterization, such as listing the types of aquatic plants or algae present, if known.

In addition, any unique conditions or issues that arose or were observed during the assessment process should be noted here.

Finish Time: Record the time that the assessment was completed.

Completeness: A volunteer team member *other than the person who filled out the data sheets* must check the data sheet for completeness before the team leaves the site. This verification of completeness should be noted at the bottom of each page.

j. Site Sketch

A site sketch should be made of the 300-foot study site each time the stream habitat is assessed. Draw a bird's eye view of the study site. Include enough detail that someone unfamiliar with the site could easily find the site again. It is important to include a north arrow, the direction of water flow, and notable stream, upland, and location features in the sketch.

2. Stream Macroinvertebrate Monitoring

a. Streamside Procedures

Stream Location Information:

MiCorps Site ID#: A site ID# for each of your study sites will be assigned to you by MiCorps. If you do not know the MiCorps Site ID#, leave this space blank.

Stream Name: Use the stream or river name found on the U.S. Geological Survey (USGS) topographic map for the area. For tributary streams to major rivers, record the tributary stream name here, ***not*** the major river name. If the tributary is an unnamed tributary, record as "Unnamed Tributary to" followed by the name of the next named stream downstream. For example, a station on an unnamed tributary of Hogg Creek would be recorded as “Unnamed Tributary to Hogg Creek”.

Location: This is often the name of the road from which you access the study site. It is very important to indicate whether the site is upstream or downstream of the road. If the same road crosses a single stream two or more times, it is sometimes desirable to record the road name relative to the nearest crossroads (e.g. “Green Road between Brown Road and Hill Road”).

Date: Record the month, day and year.

Collection Start Time: Record the time when macroinvertebrate sampling begins. Use 24-hr time (e.g. 1:00 PM should be recorded as 1300).

- *Major Watershed*: Record the name of the major watershed where the study site is located (e.g., Grand River Watershed, St. Mary’s River Watershed), and the corresponding HUC Code, if known.
- *Latitude and Longitude:* Record the latitude and longitude coordinates of the study site. Ideally, these coordinates will correspond to the midpoint of the stream study reach. Sources for these coordinates include a GPS unit, a topographic map, or digital maps, such as www.topozone.com.

Monitoring Team: Record the name of the person completing the datasheet, the person doing the actual in-stream macroinvertebrate collecting, as well as other team members participating in the assessment.

Stream Conditions:

Average Water Depth : This value can be taken from the Stream Habitat Assessment datasheet, if completed at the same time. Otherwise, to measure average water depth (ft), three measurements should be made at random points along the representative reach length being surveyed, and these values averaged for a mean depth.

Siltation: Some siltation along stream margins is normal. However, silt that settles on gravel, cobble, and woody debris in the main stream channel can have a negative impact on the benthic invertebrates that colonize these substrates and also can affect fish reproduction. Note on the data form whether there is obvious siltation on the dominant substrate types in the main stream channel.

Embeddedness: Embeddedness refers to the extent to which gravel, cobble, or boulders are surrounded or covered by fine material (such as silt or sand). The more the substrate is embedded, the less its surface area is exposed to the water and available for colonization by invertebrates. Record the appropriate level of embeddedness observed in the stream reach. This is measured as the percentage of an **individual** substrate piece, such as a rock, that is covered on average.

Fish or Wildlife: During the macroinvertebrate survey, volunteers should take note of any fish or wildlife (frogs, turtles, ducks, etc.) that may be visible in or near the stream and document any observations on the survey form.

Note if any crayfish or large clams, that would not fit in the sample jar, were found at the site but not collected. Many freshwater clams are rare or endangered, and should not be disturbed. Remember, however, to include these organisms in the Stream Quality Score on the second page of the data sheet.

Macroinvertebrate Collection:

The sampling effort expended to collect benthic macroinvertebrates at each site should be sufficient to ensure that all types of benthic invertebrate habitats are sampled in the stream reach. This generally will be about 30 minutes of total sampling time per station. Macroinvertebrate samples should be collected from all available habitats within the stream reach using a dip net with a one millimeter (mm) mesh, a kick screen made from doweling and window screening, or by hand picking. Habitat types can include riffles, pools, cobbles, aquatic plants, runs, stream margins, leaf packs, undercut banks, overhanging vegetation, and submerged wood. Habitat and substrate types from which macroinvertebrates were collected (or collections were attempted) should be recorded on the form; include as many as possible.

Collecting should begin at the downstream end of the stream reach and work upstream.

All organisms collected should be placed into a bucket or tray. The composite sample should be rinsed and all large pieces of debris removed. The remaining sample contents should be emptied into enamel or plastic pan(s) with a light-colored bottom. The team of volunteers should then sort through the collection and place the macroinvertebrates into jar(s) of 70% ethanol preservative for later identification. Volunteers should be shown how to pick through the tray, and to inspect rocks and other debris, emphasizing hidden locations under bark and in caddisfly cases. Be sure that every jar has a label written in pencil and placed inside the jar. It is recommended that all individuals collected be placed in the sample jar. However, in cases where there are VERY large numbers of clearly identical organisms, no more than approximately 15 individuals need to be included in the collection.

** *While macroinvertebrates collected from the stream can be identified to order in the field by experienced collectors, the collected organisms must still be preserved in labeled sample jars and retained by the volunteer monitoring program for verification purposes. See "Macroinvertebrate Monitoring: Is It Good for the Stream?" in the MiCorps Monitor, Issue 2 (April 2006) for more information (www.micorps.net/newsletter.html)* **

b. Macroinvertebrate Identification and Stream Quality Assessment

The organisms in the collection should be identified to order or sub-order, as indicated, using taxonomic keys. The abundance of each taxon in the stream study site should be estimated and recorded on the survey form (R=Rare [1-10 organisms], C=Common [11 or more organisms]).

The total stream quality score should be calculated as indicated on the survey form. This score is then used to rank the site as excellent, good, fair, or poor.

Identification Confidence: The name(s) of those determining the identification of organisms in the sample should be recorded, as well as a numerical rating of confidence in the identifications.

For more information, or to view the latest version of this procedure and MiCorps data sheets, visit the MiCorps website at www.micorps.net.