A2. Table of Contents

SECTION A: PROJECT DESCRIPTION AND QUALITY OBJECTIVES

A3. Distribution List

Brian Keas
Director of Educational Development
Au Sable Institute of Environmental Studies
7526 Sunset Trail NE
Mancelona, MI 49659

Paul Wiemerslage
Environmental Education Coordinator
Au Sable Institute of Environmental Studies
7526 Sunset Trail NE
Mancelona, MI 49659

Renee Penny
Program Specialist
Kalkaska Conservation District
PO Box 2068
Kalkaska, MI 49646

Paul Steen
MiCorps Program Manager
Huron River Watershed Council
1100 N. Main Street
Ann Arbor, MI 48104

A4. Project/Task Organization

Project Manager & Quality Assurance Manager
Paul Wiemerslage
Au Sable Institute of Environmental Studies
7526 Sunset Trail NE
Mancelona, MI 49659
(231) 587-8686

Management Responsibilities
Project Manager will be responsible for overseeing all aspects of project implementation including but not limited to: event promotion, organizing MiCorps training, collection, and identification events, program outreach, equipment maintenance, record and sample keeping, and reporting. Additionally, the project manager will maintain the quality assurance project plan (QAPP).

Field Responsibilities
Oversight of all field activities will be the responsibility of the project manager. Individual field roles are as follows:

> **Stream Team Leaders –** Volunteers trained in MiCorps collection protocols and methods responsible for leading a volunteer group through monitoring procedures at one sampling site during each monitoring event.
>
> **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
Project Manager will assume all identification responsibilities. Au Sable Institute will provide laboratory space and equipment.

Corrective Action
Project Manager will assume the role of initiating, developing, approving, and implementing corrective actions. Reports to Executive Director.

A5. Problem Definition/Background

The Upper Manistee River faces a number of restoration challenges and future concerns that local volunteers throughout the watershed are motivated to address. Over the past century the watershed has experienced significant disturbance beginning with heavy logging that has permanently altered the stream corridor and substrate. Immediate and future watershed concerns include non-point source pollution and increased water withdrawals from gas and oil exploration associated with hydraulic fracturing. The Upper Manistee River Watershed Management Plan (UMRWMP) conducted by the Michigan Department of Environmental Quality (MDEQ) notes nutrients, sediment, temperature, and oils and greases as the main pollutants of concern that threaten the designated and desired uses of the Upper Manistee River. Additionally, the plan notes the need for increased awareness and education as necessary components of future restorative projects. An increased stream monitoring presence supported by local residents would provide a means to address on-going water quality concerns and educate the local public.

There are four primary goals for the project:

1. Educate watershed residents on monitoring, quality, and protection of our water resources.
2. Engage stakeholder groups and individuals through collaborative water monitoring projects and citizen science.
3. Monitor stream and tributary conditions within the Upper Manistee River

Watershed.
4. Identify or verify problem areas where degradation has occurred and remediation or best management practices can be implemented.

Today, the Upper Manistee River maintains relatively high water quality despite watershed wide threats including those listed above. As noted in the UMRWMP, "the key to protecting the watershed will be proactive measures." Au Sable's Manistee River Stream Team volunteer water quality monitoring program ensures that citizens and policy makers are taking proactive measures to be better informed and ready to respond to current and future water quality concerns.

A6. Program Description

Au Sable Institute volunteer stream monitoring program proposes to establish a volunteer based stream monitoring program on the Upper Manistee River between M-72 and West Sharon Road, a section of the stream that is popular for recreation, valued for its natural beauty, and could benefit from more frequent monitoring. Our sampling efforts within this portion of the watershed will be an extension of current monitoring efforts undertaken by the Upper Manistee River Association (UMRA) further upstream and will provide a more comprehensive longitudinal monitoring presence within the river system. Our volunteer water-monitoring program will provide Au Sable the opportunity to educate local citizens on water quality issues.

Au Sable's Upper Manistee River Stream Monitoring Project and members of its Stream Team engage the public through meaningful citizen science and aim to educate local residents about water quality issues affecting the Manistee River. Through engagement in our volunteer monitoring program, we hope to equip participants with the skills and knowledge needed to make informed decisions and take proactive measures to ensure watershed health. Monitoring efforts will result in water quality data that can be used by individuals, local associations, municipalities, and state and federal agencies to inform future watershed management decisions.

Critical to the success of this project is volunteer recruitment and engagement. Volunteers will be recruited from partner organizations and the local community. Au Sable's communications and marketing effort will solicit volunteers through quarterly Institute publications, direct emails, local newspapers and radio, and through the Institute website and online social media outlets. Publicity will target volunteer opportunities on the Manistee River. As project volunteers are recruited, their contact information will be gathered to build a mailing list and e-mail listserv for stream monitoring volunteer opportunities. Volunteers will become members of Au Sable's Manistee River Stream Team.

Educational water quality training sessions will be offered to volunteers and the general public during the fall and spring of each year. The purpose of these trainings is to certify volunteers in MiCorps stream monitoring procedures thereby enabling them to lead volunteer groups in sampling events. Volunteers who have participated in water quality training will be called Stream Team Leaders. To ensure quality and consistency of our methods and data, Stream Team Leaders will be required to attend at least one water quality training every two years.

Stream Team's will monitor each of our 5 sampling sites twice a year over a two-week period during May and late September or early October. Stream Teams will consist of at least four people of which at least two members will be Stream Team Leaders.

Sampling sites were selected with safety and accessibility in mind. Sampling sites currently exist on Big Cannon Creek, Flowing Wells Creek, Maple Creek, Pierson Creek, and Big Devil Creek. A map of our sampling sites can be found in appendix 1. Stream Team Leaders will be responsible for ensuring group safety on site. Stream Team Leaders will also ensure sampling protocols are followed by team members. The project manager will work with Stream Team Leaders to ensure a habitat assessment is performed once a year during the fall season.

Each team will return their site's sample jar containing specimens to the Project Manager. Samples will be identified to order taxonomic level with volunteer help and later to family by the Project Manager. All data will be entered into the MiCorps database. Sampling summaries will be distributed to stakeholders during the winter and summer. A year-end report summarizing sampling efforts and data will be produced in August.

A7. Data Quality Objectives for Measurement Data

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. Human error in sampling techniques plays an important role in estimating precision (lack of precision between monitoring teams often comes from sampling bias and is addressed more in the bias section below).

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 Index (SQI) score or total diversity (D) measure across macroinvertebrate taxa will be noted as "preliminary" until three spring sampling events and three fall sampling events have been completed.

Volunteer team leaders and collectors will be 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 thorough in each one);
- picking style (must be able to pick thoroughly 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).

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 an indoor identification session. Volunteers can be designated as identification experts as determined by the judgment of the Project Manager. All field identifications and counts will be checked by an expert with access to a scope, keys, and field guides. The Project 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 Project Manager will review all the specimens processed by that expert and reassess if that person should be considered an expert for future sampling events.

MiCorps staff conducts a method validation review (the "side-by-side" visit) with the Project Manager to ensure their expertise, preferably prior to the first training session. This review consists of supervising the Project 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. (The side-by-side visit was held on 8/29/2014 with MiCorps Program Manager Paul Steen).

Bias

At every sample site, a different team will sample there 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 Project Manager needs to conduct a more thorough investigation to determine which team is likely at fault. The Project Manager will accompany teams to observe their collection techniques and note any divergence from protocols. The Project 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 Project Manager's duplicate sampling:

> Resulting diversity measures by teams are compared to Project 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 Project 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 Project Manager and Technician will re-evaluate 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 is 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 percent.

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 Project 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 Project 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 Project 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 Project Manager leaves the position and a new Project 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.

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 in the classroom discussing project background, goals, and procedures as well as aquatic macroinvertebrate identification practice. During the afternoon participants will practice collection methods in a nearby stream under the direction of the Project Manager and other "certified" Stream Team Leaders. To ensure quality and consistency of our methods and data, Stream Team Leaders will be required to attend at least one water quality training every two years.

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

B. PROGRAM DESIGN AND PROCEDURES

B1. Study Design and Methods

Au Sable Institute's volunteer stream monitoring program will monitor aquatic macroinvertebrate communities within the upper Manistee River watershed. Five sites have been chosen for immediate monitoring, an additional four sites will be monitored as volunteer capacity allows. Sites will be sampled twice a year, once in May and once again in late September or early October. Our study sites and locations are as follows *(watershed map showing all study site locations is included as appendix 1.)*:

1. Flowing Wells, Section 35, Excelsior Township
   44.689889, -85.007361
2. Big Cannon Creek, Section 8, Garfield C Township
   44.583333, -85.073056
3. Maple Creek, Section 1, Garfield W Township
   44.583611, -85.105028
4. Big Devil Creek, Section 4, Garfield C Township
   44.585722, -85.043833
5. Pierson Creek, Section 18, Oliver Township
   44.641070, -85.088029

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 Project 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 Project Manager will, if feasible, sample the site. Otherwise, the site will go unmonitored for that season.

Macroinvertebrate Sampling Procedure

The collection of macroinvertebrate specimens will occur for 30 minutes from within the identified 300' stretch of stream. During this time, multiple collections will be taken from each habitat type present at the site, including riffle, rocks or other large objects, leaf packs, submerged vegetation or roots, and depositional areas, while wading and using a D-frame kicknet. 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 7*). The trained Collector will transfer the material from the d-frame net into his or her 5-gallon bucket for later sorting, or if it is more convenient or requested, into a team member's sorting tray. The remaining volunteers (Pickers) will pick out samples of all different types of macroinvertebrates from the trays and place them into jars of

70% ethyl alcohol for later identification. A delineation Stream Team Roles and Duties is included in appendix 4.

During the collection, the Collector will provide information to the team's Streamside Leader in response to questions on the data sheet (*appendix 5*) that review all habitats to be sampled, the state of the creek, and any changes in methodology or unusual observations. The Streamside Leader will instruct and assist other team members in detecting and collecting macroinvertebrates in the sorting trays, including looking under bark and inside of constructions made of sticks or other substrates. 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. As we intend to identify all organisms to family taxonomic level, it is imperative that all observed specimen within the timeframe of the collection event be transferred to sampling jars regardless of abundance.

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.

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 jars containing the collection from this site. The data sheet also states the number of jars containing the collection from this 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 Project Manager. Upon return to Au Sable Institute, 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 Au Sable until they are examined and counted on the day of identification (within two weeks of sampling). The data sheets are used on the identification day, after which they remain on file for a period of at least five years. Before leaving site, Stream Team Leaders will make sure that all sampling equipment is clean and free of plant or 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 Project Manager.

Macroinvertebrate Identification Procedure
At the time of identifying the sample, the sample identifier checks the data sheet and jars to ensure that all the jars, and only the jars, from that collection are present prior to emptying them into a white tray for sorting. If any specimens are separated from the tray during identification, a site label accompanies them. For identification,

volunteers sort all individuals from a single jar into look-alike groups, and then are joined by an identification expert who confirms the sorting and provides identification of the taxa present. The Project Manager then verifies theses identifications. 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 the Au Sable indefinitely. The alcohol is carefully changed (to avoid losing small specimens) in the jars every few years. Data is recorded on the corresponding site-specific MiCorps macroinvertebrate data sheet (*appendix 5*). An SQI is computed and checked for correctness by Project Manager. A signature of the person(s) completing the data sheet is required along with a personal confidence interval.

Habitat Assessment Procedure (fall only)
Stream Team Leaders and/or the Project Manager will complete a Habitat Assessment (*appendix 6*) 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 7*) 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 8*), 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 Project Manager to do so. All final Habitat Assessment data sheets will be reviewed by the Project 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 Project Manager and appropriate action will be taken to resolve and/or address noted concerns including informing appropriate authorities.

Collection Parameters

- Macroinvertebrate community will be monitored and identified to family level. Literature references used for identification are included in appendix 2.
- Trained Stream Team Leaders will monitor habitat once a year in the fall.

Timing

- The benthic population is sampled within a 2-week period in May and late September or early October.
- The physical characteristics of the sites are measured once every year in the fall.

Equipment Quality Control

- Check to make sure equipment is in working order and not damaged
- Clean equipment before and after taking it into the field
- Maintain a detailed inventory of equipment including dates of purchase and dates of last usage
- Check the batteries of all equipment that requires them

Field Procedures Quality Control

- Review sampling procedures with Stream Team Leaders prior to all collection events.
- Collect replicate samples
- Conduct repeat and/or side by side tests performed by separate field crews
- At least once every 3 years in each season: change the composition of the field crews to maintain objectivity and minimize individual bias
- Review field records before submitting for analysis to minimize errors

Data Analysis Quality Control (Macroinvertebrate Identification)

- Field datasheets and labels will be verified by volunteers in the laboratory
- Specimen identification will be completed by trained volunteers using referenced identification guides (*appendix 2*)
- Taxa identification will be verified by an identification expert and/or the Project Manager
- Counts will be verified by at least two volunteers
- Calculations will be completed by at least two volunteers and verified by the Project Manager
- Hard copies of all computer entered data will be reviewed for errors by comparing to field data sheets

Since 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. All lab sorting is rechecked by an expert before completing identification.

B2. Instrument/Equipment Testing, Inspection, and Maintenance

All equipment will be maintained and deemed acceptable for use in sampling by the Project Manager. In the case that the Project Manager should find equipment insufficient for sampling, it is his/her responsibility to repair or replace the equipment prior to use in the field.

A detailed list of each Stream Team's field macroinvertebrate sampling kit follows:

- Clipboard case
- Field data collection packet
- Laminated sampling tip sheets
- Laminated emergency contact list including site GPS coordinates
- 2 Pencils
- 2 Pens
- D-Net
- 5-Gallon bucket
- Rinse jar
- 2 Light colored sorting trays
- Tweezers (enough for group)
- 2 Eye droppers
- 2 Collection jars filled ¾ with 70% ethanol with site label including location, date, and group leader names
- 2 Magnifying glasses
- Waders (as needed)
- First aid kit
- Equipment sanitization kit

A Habitat Assessment of each site will occur during the fall season. Only trained Stream Team Leaders are authorized to perform the Habitat Assessment. The following materials are required:

- Habitat Assessment data sheets
- Clipboard case
- Pen or pencil
- Waders (as needed)
- Tape measure (or D-net with delineated measurements on shaft)

Identification of each team's sample will occur post collection at Au Sable Institute. Materials necessary to sort and identify each teams sample include:

- Macroinvertebrate data sheet
- Site collection sample
- 70% ethanol
- Laminated identification sheets (quick ID)
- Detailed identification resource (appendix 2)
- 1 Light colored sorting tray

- Dissecting Microscope
- Tweezers
- Eye droppers
- Petri dish

Problems encountered during field collection or laboratory analysis will be documented on the data sheets and resolved accordingly. Spare equipment will be kept on hand in case of damage or improper operation during field or laboratory work. When not in use, all equipment will be stored at Au Sable Institute.

B3. Inspection/Acceptance for Supplies and Consumables

The Program Manager will maintain detailed records of all equipment including purchase date and approve supplies for use in the field or laboratory setting.

B4. Non-direct Measurements

Not applicable.

B5. Data Management

After each sampling event data from the Habitat Assessment and Macroinvertebrate Sampling will be entered into Microsoft Excel by the Project Manager. Raw data will be entered from data sheets directly into the online MiCorps database by the Project Manager for storage within the MiCorps data exchange system. Original data sheets will be scanned and saved in digital format on Au Sable's cloud drive and on a backup drive and stored off site. All originals will be filed on premises and saved for a period of at least 5 years.

Macroinvertebrate data is summarized for reporting into four metrics: all taxa, insects, EPT (Ephemeroptera + Plecoptera + Trichoptera), and sensitive taxa. Units of measure are families counted in each metric. A Stream Quality Index (SQI) is also computed. The method for calculating that metric is included in the MiCorps macroinvertebrate data sheet (*appendix 5*).

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

SECTION C: SYSTEM ASSESSMENT, CORRECTION, AND REPORTING

C1. System Audits and Response Actions

Volunteer Team Leaders trained by the Project Managers ensure that quality assurance protocols are followed and report any issues possibly affecting data quality. When significant issues are reported, the Project 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, including on-site reviews of field sites and facilities where data is processed and analyzed.

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 Project 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 Project 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.

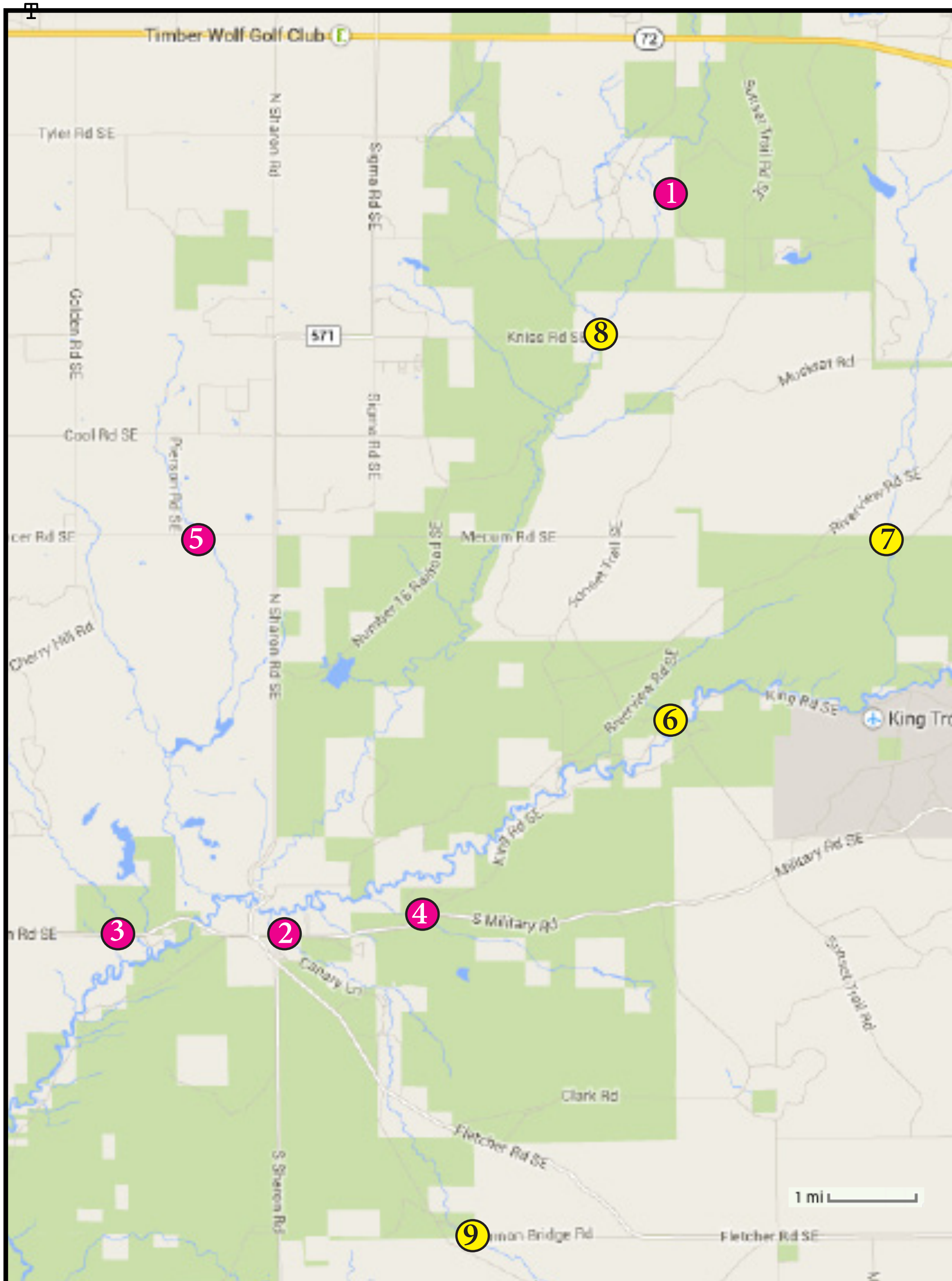
C3. Reconciliation with Data Quality Objectives

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 Project 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 that 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 T



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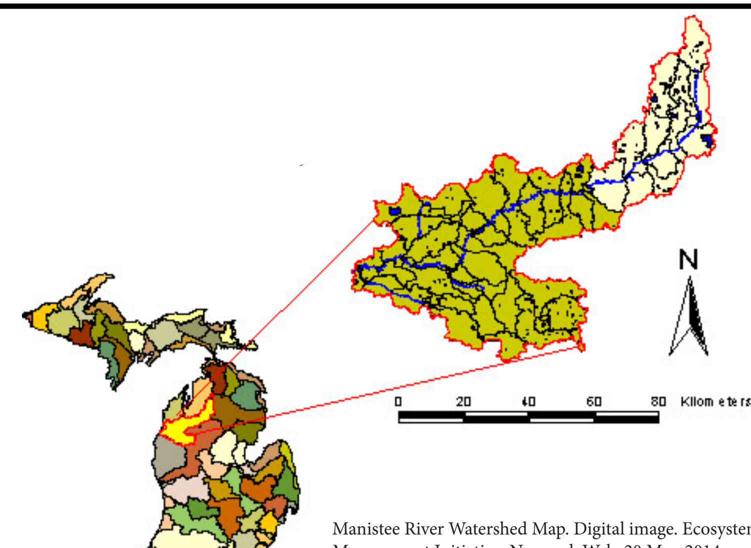
MiCorps Volunteer Stream Monitoring Site Locations
- Upper Manistee River -

Key

- Current Monitoring Site
- Proposed Future Monitoring Site

Sites

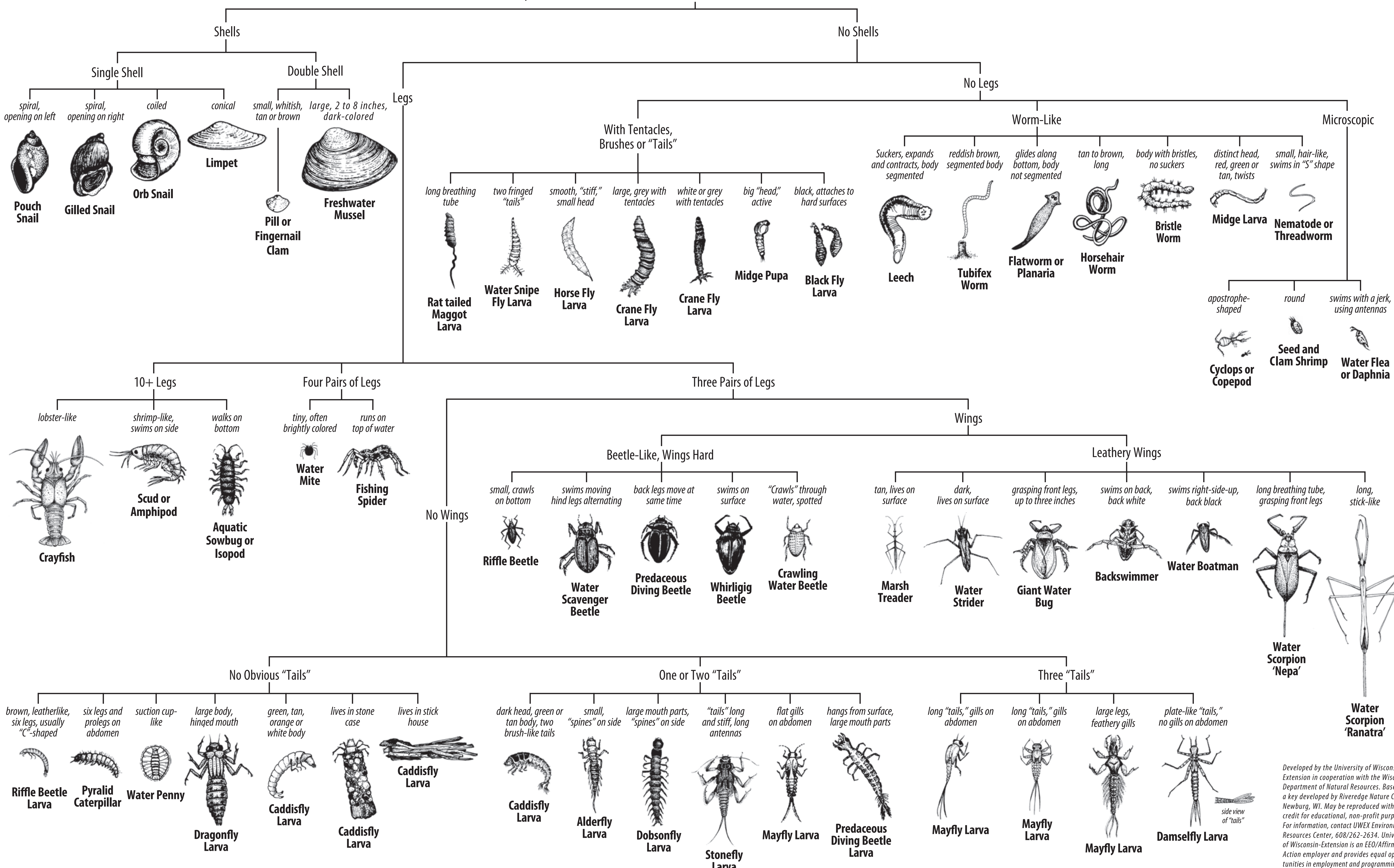
1 - Flowing Wells
2 - Big Cannon Creek and Military Rd.
3 - Maple Creek and Sharon Rd SE
4 - Big Devil Creek and Military Rd.
5 - Pierson Creek and Spencer Rd.
6 - Manistee River and Sunset Trail
7 - Black Creek and Riverview Rd.
8 - N. Branch and Kniss Rd.
9 - Big Cannon Creek and Cannon Bridge Rd.



Manistee River Watershed Map. Digital image. Ecosystem Management Initiative. N.p., n.d. Web. 20 Mar. 2014.

Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)



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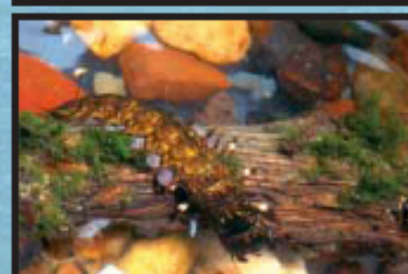
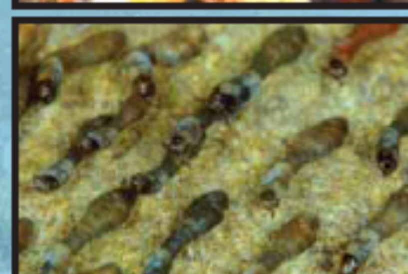
Appendix

Guide to Aquatic Invertebrates of the Upper Midwest

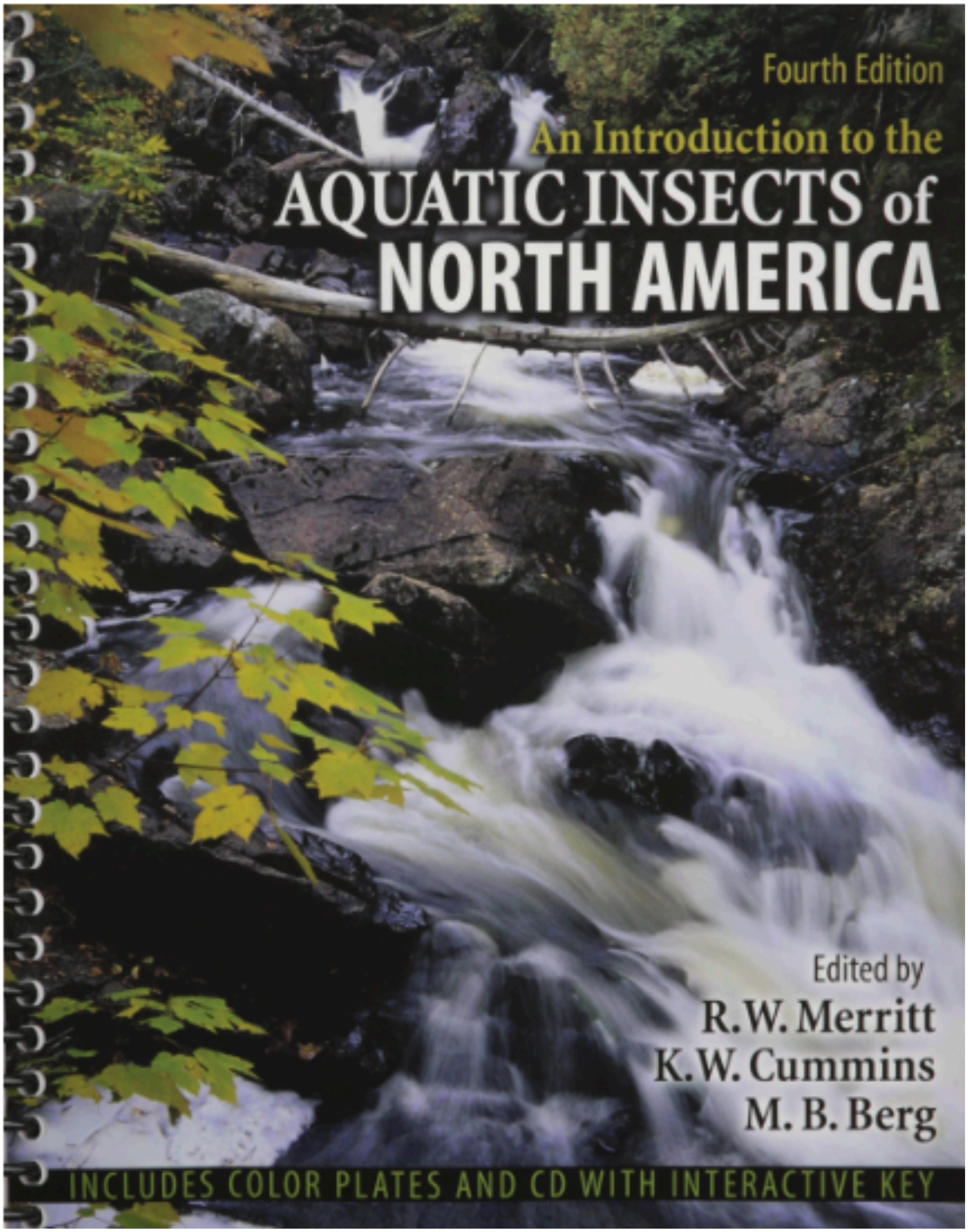
Identification Manual for Students, Citizen Monitors, and Aquatic Resource Professionals

R.W. Bouchard, Jr.





UNIVERSITY OF MINNESOTA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An Introduction to the
AQUATIC INSECTS of
NORTH AMERICA
Edited by
R.W. Merritt
K.W. Cummins
M.B. Berg
INCLUDES COLOR PLATES AND CD WITH INTERACTIVE KEY

Au Sable Institute - Stream Monitoring Program
Program Partners Receiving Reports

Paul Steen
MiCorps Program Manager
Michigan Clean Water Corps
Huron River Watershed Council
1100 N. Main St.
Ann Arbor, MI 48104
psteen@hrwc.org

Tamara Lispsey
MI DEQ – Water Bureau
lipseyt@michigan.gov

Renee Penny
Program Specialist
Kalkaska Conservation District
PO Box 2068
Kalkaska, MI 49646

Dean McCulloch
Township Supervisor
Blue Lake Township
10599 Twin Lake Rd NE
Mancelona, MI 49659
blsuper@torchlake.com

Jean Stiehl
Environmental Council Member
Garfield Township
0466 W. Sharon Rd
Fife Lake, MI 49633
Garfieldplanningsec@yahoo.com

Bob Thorsen
Volunteer Coordinator
Upper Manistee River Association
PO Box 282
Grayling, MI 49738
sockeyebob@att.net

Au Sable Institute - Stream Team Roles

A **Stream Team** consists of a Collector, Stream Side Leader, and generally 2 – 3 Pickers.

Collector: Trained volunteer responsible for collecting samples from within the stream during a sampling event.

Stream Side Leader: Trained volunteer responsible for managing Pickers during the collection event and ensuring Collector samples the full diversity of habitat types.

Pickers: Trained or untrained volunteers responsible for picking macroinvertebrates from the Collectors collection and placing them in jars of alcohol for later identification.

Collector:

- Must attend a day-long Stream Leader Training
- Trained to identify the presence of different habitat types
- Familiar with good sampling techniques
- Uses a D-Frame kick net to aggressively and thoroughly sample the stream for macroinvertebrates
- Secondary data sheet recorder

How to be successful:

- Transfer net contents into a 5 gallon bucket after sampling different habitats
- Listen to the Stream Side Leader to update you on remaining sampling time
- Use your net aggressively, it is sturdy!
- Use a runner to transfer bucket contents to Pickers (if group size allows)
- Avoid looking into your net to scout critters; this can consume a lot of time!
- Know your start and end spots.
- Never venture into a portion of stream that you suspect deep, unstable, or otherwise dangerous

Stream Side Leader:

- Must attend a day-long Stream Leader Training
- Time keeper for the collection event
- Reviews safety protocols with team
- Reviews collection protocols with team including site stretch parameters
- Maintains custody of data sheets and sample jars
- Ensures all equipment is present prior to sampling and returns to Au Sable post sampling
- Primary data sheet recorded

How to be successful:

- Keep your group on task, and on time, and make sure everyone knows their role
- Assist pickers in locating and picking specimen from collection
- May assist collector in sampiling habitat types that are close and easily accessible for sorting (ex. leaf litter packs, large rocks, woody debris)
- Remind collector of habitats options from data sheet available to sample

Picker:

- New volunteers, role does not require Stream Leader Training
- Responsible for sorting through collection and placing macroinvertebrates into sample jars

How to be successful:

- Listen to the instruction given by the Stream Team Leader in advance of the collection event.
- Ask questions if you do not understand something
- Use tweezers for larger critters and eye droppers for smaller ones
- Be prepared to be amazed!

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#:________________

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 5 4 3 2 1 Not very confident

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 ______________
Hydraenidae ______________
Hydrophilidae ______________
Lampyridae ______________
Lutrochidae ______________
Noteridae ______________
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 ______________
Psychodidae ______________
Ptychopteridae ______________
Sarcophagidae ______________
Sciomyzidae ______________
Simuliidae ______________
Stratiomyidae ______________

DIPTERA— continued
Syrphidae ______________
Tabanidae ______________
Tipulidae ______________

EPHEMEROPTERA — Mayflies____
Acanthametropodidae ______________
Ameletidae ______________
Ametropodidae ______________
Arthropleidae ______________
Baetidae ______________
Baetiscidae ______________
Caenidae ______________
Ephemerellidae ______________
Ephemeridae ______________
Heptageniidae ______________
Isonychiidae ______________
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 ______________
Naucoridae ______________
Nepidae ______________
Notonectidae ______________
Pleidae ______________
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 ________________
Nepticulidae ________________
Noctuidae ________________
Pyralidae ________________
Tortricidae ________________

MEGALOPTERA — Alderflies,Dobsonflies___
Corydalidae ________________
Sialidae ________________

ODONATA — Damselflies, Dragonflies____
Aeshnidae ________________
Calopterygidae ________________
Coenagrionidae ________________
Cordulegastridae ________________
Corduliidae ________________
Gomphidae ________________
Lestidae ________________
Libellulidae ________________
Macromiidae ________________
Petaluridae ________________

PELECYPODA — Bivalves___________
Corbiculidae ________________
Dreissenidae ________________
Sphaeriidae ________________
Unionidae ________________

PLATYHELMINTHES— Flatworms____
Turbellaria ________________

PLECOPTERA— Stoneflies__________
Capniidae ________________
Chloroperlidae ________________
Leuctridae ________________
Nemouridae ________________
Perlidae ________________
Perlodidae ________________
Pteronarcyidae ________________
Taeniopterygidae ________________

TRICHOPTERA — Caddisflies_______
Apataniidae ________________
Brachycentridae ________________
Dipseudopsidae ________________
Glossosomatidae ________________
Goeridae ________________
Helicopsychidae ________________
Hydropsychidae ________________
Hydroptilidae ________________
Lepidostomatidae ________________
Leptoceridae ________________
Limnephilidae ________________
Molannidae ________________
Odontoceridae ________________
Philopotamidae ________________
Phryganeidae ________________
Polycentropodidae ________________
Psychomyiidae ________________
Rhyacophilidae ________________
Sericostomatidae ________________
Uenoidae ________________

STREAM HABITAT ASSESSMENT

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							
8	Water Temperature						
9	Dissolved Oxygen						
10	pH						
11	Water Velocity						

MiCorps Site ID#:___________ Date:_________________

Michigan Clean Water Corps

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 <u>each bank separately</u> 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, by circling 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

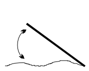
B: Boulder -- more than 10”
C: Cobble -- 2.5 - 10”
G: Gravel – 0.1 – 2.5”
S: Sand -- fine particles, gritty

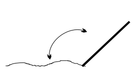
F: Fines: Silt/Detritus/Muck
H: Hardpan/Bedrock
A: Artificial
O: Other (specify)

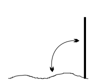
T= Reading on tape
D = Depth
S = Substrate

	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

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"

Prepared by:
Charlie Bauer, Saginaw Bay District
Greg Goudy, Cadillac District
Scott Hanshue, Great Lakes and Environmental Assessment Section
Gary Kohlhepp, Great Lakes and Environmental Assessment Section
Megan McMahon, Shiawassee District
Ralph Reznick, Nonpoint Source Unit

Surface Water Quality Division
Michigan Department of Environmental Quality

TABLE OF CONTENTS

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 the habitat 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, observed at 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

<u>Riffle</u>

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.

<u>Pool</u>

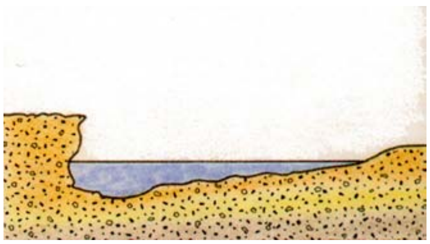
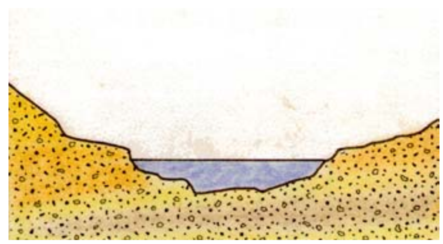
Pools are areas of relatively deep, slow moving water. The key word here is “relatively”. Water depth sufficient to classify an area as a pool can vary from around 8 inches in small streams, to several feet in wadable streams, to tens of feet in large rivers. Pools are often located on the outside bend 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.

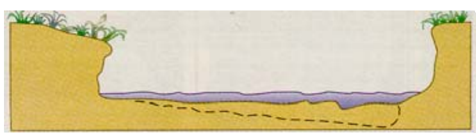
Channel

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.
<u>Construction:</u>Highway/Road /Bridge/Culvert	… there is clear evidence that on going or recent construction of transportation infrastructure is contributing pollutants to the waterbody.
<u>Construction:</u> 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.

Source Category	Use this Source Category if …
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.

<u>Macroinvertebrate Collection:</u>

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.