Quality Assurance Project Plan

Michigan Sulfide Ore Mining Project,
Menominee County Component

A1. TITLE AND APPROVAL SHEET

Date: 31 August 2006
Version # 1.1

Organization: Sierra Club Foundation/Sierra Club Michigan Chapter

QAPP Prepared by: Rita Jack

Title: Sierra Club Water Sentinels Project Director

Signature: _____

Other responsible individual: Name
Title: Title

Signature: _____

(Other signatures may be added as necessary)

MiCorps Staff Use

Tracking Number:

MiCorps Reviewer: _____

☐ Approved ☐ Returned for modifications

Signature of reviewer Date

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A3. QAPP DISTRIBUTION LIST

Ric Lawson	MiCorps – Huron River Watershed Council
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Joan Martin	MiCorps – Huron River Watershed Council
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Jack Wuycheck	MDEQ MiCorps Program Officer
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A4. PROJECT ORGANIZATION

Name	Project Role	Responsible for	Affiliation & Contact information
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Rita Jack	Project Manager	Reporting to MiCorps	Same
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Notes: During the first year, primary responsibilities will stay with the Project Manager. During the second year, key volunteers will begin to take over particular tasks. The Project Manager will update the QAPP as these changes occur, with MiCorps approval.

A5. PROBLEM DEFINITION/BACKGROUND

Background: Physical Setting

The Shakey Lakes area in Menominee County is in parts or all of Lake, Holmes, and Stephenson Townships in Menominee County, Michigan. Lake and Holmes are on the border with Wisconsin; The Menominee River is the boundary line. Wetlands are a dominant feature of the landscape, with many small streams and ponds. The study area is mostly forested with very little development. The county has zoned the land "recreational", so there are some hunting camps. The tributary streams are natural and unchannelized, flowing through forests in the middle stretches, while some originate from farmland or fields. The Shakey Lakes Natural Area / Shakey Lakes Savanna is a managed Oak Barrens, and is scheduled to be burned soon by the Michigan Department of Natural Resources (MDNR). (At this time, none of our monitoring sites are located within the Savanna.) According to local residents, there are only 2 active farms in the area, but it's unverified if surface water in the target streams originates from these areas or not.

Expected Land Use Changes

Exploration for zinc and gold in sulfide ore deposits began several years ago around the Shakey Lakes Natural Area. Sulfide ores chemically react when brought into contact with water and air, and form sulfuric acid. Water quality impacts associated with sulfide mining include changes in pH and conductivity, thermal changes in cold-water streams from discharge of treated waste water, changes in dissolved oxygen, and leaching of heavy metals by acidified waters. These measurable changes can lead to changes in the makeup of the aquatic biological community of the receiving water, leading to **loss of diversity**. In many locations in the area, soils are sandy and easily erodible. This means that increases in residential, industrial, and commercial development, as well as heavy construction and mining truck traffic, may increase the **sediment load** at road/stream crossings.

This volunteer monitoring project will address two major questions.

1. What are the current (baseline) water quality conditions and trends in the small first-order Menominee River tributaries around the Shakey Lakes Natural Area, as measured by gauging benthic macroinvertebrate community diversity?

Currently, research on state and federal Websites yields little information about the current status of benthic macroinvertebrate and other aquatic communities and aquatic habitat at the Menominee River tributary sites in question. New information generated by volunteer water quality monitoring in these locations will support decisions about major land-use changes expected in the watershed over the next few years, and could aid the state's assessment of whether or not to grant water discharge or groundwater discharge permits around the Shakey Lakes Natural Area.

2. If mining or other development occurs in the small first-order streamsheds, what changes in the diversity of the benthic macroinvertebrate community and water quality will occur?

Continued assessment over time will track changes in the benthic community, representing water quality shifts, and should determine if any of those changes could be associated with mining activity or with any other change in land use, such as increased residential and commercial and road development, that would accompany mine development.

A6. PROJECT DESCRIPTION

Water Monitoring

The Shakey Water Sentinels will monitor water quality twice per year, following MiCorps protocols, by collecting, sorting, identifying and counting benthic macroinvertebrates in small Menominee River feeder streams around the area of the Shakey Lakes Natural Area. The benthic macroinvertebrates will be used as stream health "indicator" organisms, and a stream health index score will be assigned based on the diversity of, and the relative number and kind of organisms.

Data Management

We will submit our data to the MiCorps Program via the MiCorps website at www.micorps.net and directly to the Michigan Department of Environmental Quality in order to assist in filling data-gaps that currently exist about small tributaries to the Menominee River. As stated earlier, applications for mining permits, surface and groundwater discharge permits, and other related permits will be forthcoming in the next 2-4 years. If a mine is developed near the Shakey Lakes Natural Area, many other related developments will accompany it, and our water quality information will be useful in any water-related decision-making that will need to take place.

Project Goals and Measurable Objectives

Note: See Scheduled Task List in Appendix A.

Goal 1. Assess the current status of water quality in several small, unnamed tributaries in the middle reaches of the Menominee River Watershed. Track subsequent trends in water quality.

Measurable Objective(s):

- Perform bi-annual inventory of the benthic macroinvertebrate community, using established methods provided by MiCorps and an approved quality assurance plan.
- Perform once-yearly habitat assessment of all monitoring sites.
- Walk the length of the streams at least once per year to assess any upstream changes in land use that may impact water quality downstream. Keep a log for all data, both hard-copy, and a computerized database.

Goal 2. Develop Project Data Quality Goals, write and adhere to Quality Assurance Project Plan to meet those goals, produce scientifically valid unbiased data and results.

Measurable Objective(s):

- Work with MiCorps staff to develop an approved Quality Assurance Project Plan (QAPP) to assure that all data are gathered using methods that are scientifically rigorous and repeatable.
- Train all new volunteers to use and follow the QAPP in their monitoring, provide opportunities for retraining and for side-by-side data collection to compare their data collection.

Goal 3. Communicate all data quarterly to MiCorps, and the Michigan Department of Environmental Quality (MDEQ).

Measurable Objective(s):

- Submit data to MiCorps through the MiCorps Data Exchange Web site and in an annual report, and also maintain the data in our own database. Data or information deemed important or time-sensitive will be communicated immediately.
- Submit data at least yearly to the MDEQ via a report with data tables, and with a copy of this QAPP.

Goal 4. Assure the long-term viability of our water monitoring by recruiting and keeping motivated volunteers.

Measurable Objective(s):

- Recruit 40 volunteers from our own Sierra Club membership and from the potentially impacted area.
- Encourage volunteer experts, such as university biology professors or high school biology teachers for all training, as is possible, to help develop knowledgeable, competent volunteers.
- Foster leadership, delegate important tasks, and encourage accountability.
- Give volunteers opportunities to learn by providing additional training and resources.

Goals for Data Use

Volunteers who live in or own property in the Menominee River Watershed will use the data they collect to make effective public comments on various mining permit applications (expected sometime over the next 24 – 48 months.) Informed public commentary regarding these permits is critical for protecting the natural resources and waters in the Menominee River Watershed. Likewise, the Sierra Club Water Sentinels Project will use the data for making public comments.

Goals for Geographic Locations to be Studied

Because the project will work to assess baseline conditions before land use and land cover changes from natural-cover to potential-mine-site, streams that would likely be affected will be monitored. The monitoring project will concentrate on sites upstream and downstream of high-activity mining exploration locations. In addition we will monitor in a similar site where mining is not likely to occur to use as our control or reference site.

The project will develop and use individual site maps to assure that volunteers are studying the appropriate sites along the small streams. Maps will incorporate sufficient details to assure that volunteers can find the correct sites to be monitored. In addition, bright yellow flagging tape will be used to denote each stream site, with both ends of the 300 foot stretch marked, as well as at the 150 foot mark (at the center) of each site.

More details are provided in Section B-1 of this QAPP. A Map of the study area is provided in **Appendix E**

Project Resource and Time Constraint Impacts

The project study area is located in Menominee County, in Michigan's Upper Peninsula. The project manager is located in Lansing, Michigan, 8 hours away from the study area. The long-distance adds difficulty and additional expense to tasks such as new site identification, meetings with volunteers, media outreach, and even keeping an eye on the weather to determine safety of a chosen monitoring date. The project manager will often need to pay for lodging, and certainly for travel expenses for several days. However – the benefits of gathering new data for an area of the

state where there is little far outweighs the costs. Volunteers are mostly local residents who are highly motivated. Close cooperation with those volunteers who live nearby is key to staying in touch with local conditions and in recruiting new volunteers. So are communication tools such as email and telephone. If properly managed and planned for, impacts from time and distance away can be kept to a minimum.

A7. DATA QUALITY OBJECTIVES (DQOs)

Data Collection Techniques and Training Schedule

To assure the project meets our goal for precision and that we avoid bias in volunteer collection methods, the following techniques will be reviewed during training and in retraining of team leaders at least every three years:

- Collecting style (must be thorough and vigorous)
- Habitat diversity (must include all habitats present and be thorough in each one), and
- Transfer of collected macroinvertebrates from the net to the sorting tray to the sample jars (thoroughness is critical)

Management of Inherent Variability

Since there is inherent variability in finding and collecting the less common taxa in any stream site, and program resources do not allow program managers to perform 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** (simply the number of unique taxa) across macroinvertebrate taxa will be noted as "preliminary" until three spring sampling events and three fall sampling events have been completed.

To avoid bias in sampling technique, different Volunteer Teams will sample a different site at least once every four sessions (one event among four sampling events.) A **Relative Percent Difference (RPD**, below) between the new measure and the mean of past measures should be less than 40%. The Program Manager will evaluate all Sites that do not meet this DQO.

The resulting measures of **D** and **SQI** for each site will be compared to the composite (median) results and each should have a relative percent difference (RPD) of less than 40%. This statistic will be measured using the following formula:
RPD = [(Xc - Xv) / (mean of Xc and Xv)] x 100, where Xc is the composite measurement and Xv is an individual measurement for each parameter.

This examination requires all stream data records to include the personnel of the monitoring team and the number of each type of habitat sampled.

The Project Manager will work with Volunteers to sort and to identify all macroinvertebrates, and verification of the identifications will be done by the Project Expert. An error rate will be calculated for each identified sample using the same **RPD** statistic as above. The goal for the RPD of identifications is for less than 5%.

Sampling results that exceed these standards will be noted as "outliers" and examined to

clarify if the results are due to sampling error or a true environmental variation. If sampling error is determined, then the data point will be removed from the data record. The Project Manager will retrain Volunteer teams that generate more than one outlier before the next monitoring session.

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

Data Representativeness
Our site selection methodology reflects the goals of the project to assess baseline benthic macroinvertebrate community diversity prior to any major changes in land use, such as sulfide mining and/or associated development. As such, and because we will depend on a relatively small number of volunteers, our work centers around streams at most imminent risk from those potential changes. At least one stream will also be sampled that is not at risk of development. As the program grows, more sites can be added.

Groundwater inflow comprises the majority of stream flow in the area, as well as outflow from upstream wetlands, including bogs and ponds. Study sites are selected that represent the full variety of stream habitat types available in the stream, 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. More details on site selection are included in Section B1.

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.

Data Comparability
Comparability is a measure of the confidence with which one data set or method can be compared to another. At the core of this measure is the degree to which sampling methods are identical across all sampling events.

Our primary goal is for the data from all parts of the Menominee Shakey Water Sentinels project to be comparable, despite being measured by different people at different times. To ensure data comparability, all volunteers in the program will follow the same sampling methods and use the same units of reporting. The Program Manager is familiar with standard MiCorps monitoring methods, and has participated in annual trainings both by MiCorps staff and by MDEQ staff, and will assure that Volunteers are trained to follow those methods, thus ensuring comparability of results among all MiCorps programs. To the extent possible, the monitoring of all study sites will be completed on a single day.

Sampling Methodology

The Menominee Shakey Water Sentinels will attempt to always monitor all sites on one day per spring or fall season, as a planned "event". In the rare event a site is not sampled on a scheduled monitoring day, then monitoring by volunteers will be completed within two weeks. If a site is temporarily inaccessible, such as due to prolonged high water, then monitoring time may be extended for two additional weeks. If the site continues to be inaccessible beyond the extended dates, then no monitoring data will be collected during that time and there will be a gap in the data.

Monitoring event dates will be scheduled within the same 2-week period as the previous year's monitoring event dates. For example, the first fall monitoring event day will be October 7, 2006. In 2007, we will schedule the monitoring date for within the same two-week period of Sept. 29 to October 13, so that data are comparable between years. Spring monitoring dates will be likewise scheduled.

If a team is unable to monitor their site during the specified time, the 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.

A8. TRAINING AND SPECIAL TRAINING/CERTIFICATIONS

Using MiCorps training methods, forms, and protocols, the Project Manager will lead training events for all volunteers prior to their participating on Monitoring Days. Each will demonstrate understanding of monitoring methods by passing a short quiz, and will receive a certificate of achievement. We will also hold re-training and project re-orientation sessions the morning of every monitoring event day. Team Leaders will need to pass a more rigorous test prior to leading a team. It is acknowledged that prior to and during the first "real" monitoring session, most volunteers are likely be hesitant about rigorousness, and will have many questions, so data quality will be less than ideal. We will use that opportunity to evaluate and critique each other's work so that we can each improve our techniques.

SECTION B: PROJECT DESIGN AND PROCEDURES

B1. Study Design and Methods

The project manager consulted with MDEQ staff to determine if the agency had reports from previous studies of the project area. Benthic macroinvertebrate studies were done both in other parts of the Menominee River watershed, and in the area around the Sentinels' study area near the Sixty Islands. The most relevant was a July 2002 study of physical habitat, macroinvertebrate community, and water chemistry, by MDEQ Water Bureau staff using the Great Lakes Environmental Assessment Section Procedure #51 (http://www.deq.state.mi.us/documents/deq-swq-gleas-proc51.pdf). The MDEQ sites 8, 10, 11, and possibly 12 are within the area under study. We'll ascertain the exact locations of these sites using their latitude and longitude coordinates, and assess if they fit our criteria described in the section "Site Selection Details." If so, we may add them to our list of sites for monitoring.

Site Selection Details:

Depending on the season or month, streams can be very small, and some are intermittent, most are for the most part groundwater fed. An early September 2006 Stream Walk enabled us to identify

six (6) appropriate monitoring sections for the first fall monitoring event scheduled for October 7, 2006.

Using the Resort Lake, WI USGS 7.5 Minute Topographic Quadrangle map as the working base map, we identified the mine exploration drilling area using GPS and interviews with local land owners, and knowledge gained from a meeting and a tour with staff and consultants from Minerals Processing Corporation. In addition, we're using the National Geographic Topo Quad CD for the Upper Peninsula to exactly locate the latitude and longitude coordinates of all GPS points. We will also map the subwatersheds of the streams, or streamsheds, on the CD.

Using these tools, we located nearby streams that might be impacted, either due to proximity, or because they are down-gradient or downstream from the exploration area. We utilized a land-based stream survey method, whereby we walked the streams from their confluence with the Menominee River, located along River Road in Menominee County, to upstream as far as possible. We noted stream and aquatic habitat conditions as we walked the stream, focusing on stream stretches that, based on available habitat and quick informal searches, should provide the highest diversity of aquatic organisms.

In spring 2007, the Project Manager will lead a post-snow melt survey for an additional 4 monitoring locations, following the above procedures. At least one of these will be a site located far enough way so that it is not expected to be impacted, to use as a control site.

Study Design and Study Methods: Benthic Macroinvertebrates

The Menominee Shakey Water Sentinels will monitor water quality at a total of 10 sites located on several small Menominee River feeder streams twice per year. The project began with 5 sites in the fall of 2006, and in spring of 2007, will add 5 more sites. The project will follow MiCorps protocols to collect, sort, identify, and count benthic macroinvertebrates from the small streams around the area of the Shakey Lakes Natural Area. The benthic macroinvertebrates will be used as stream health "indicator" organisms, and the Stream Quality Index will be calculated according to MiCorps protocols, that is based on the number of and relative abundance of each kind of organism. **Stream Total Diversity** will be measured by simply counting the number of unique taxa collected.

Volunteer Training will be done by the Project Manager in a one-day session divided into 2-parts, with the morning spent in a classroom setting, and the afternoon focusing on field demonstration. See Typical Training Agenda in Appendix B. This more intensive Volunteer Training will be held at least once every 12 to 18 months, as new groups of volunteers are identified.

The ***Stream Macroinvertebrates*** presentation from the MiCorps website will be used to introduce use of benthic macroinvertebrates for water quality monitoring. Basic Habitat Assessment will be explained in the classroom by reviewing the ***MiCorps Stream Monitoring Procedures***, using the MiCorps monitoring forms, and all procedures will be demonstrated in the field session.

The Project Manager will identify 2 specific volunteers to be the **Site Leader** and **Lead Collector** for each site, with the remaining volunteers identified as **Pickers**. One volunteer for each site will also be the **Equipment Manager**, and is responsible for assuring all equipment is collected, reorganized, and brought back for cleanup and storage.

Hand-held pH and conductivity meters are not expected to be used until spring of 2007, the QAPP will be updated when this occurs.

Monitoring Day

On the morning of Monitoring Day, the Project Manager will lead a 1-hour mini-retraining session and Project Orientation, for which all Volunteers are expected to be present. A quiz will be administered to test all Volunteer's understanding of forms, the data to be gathered, all materials and their field-application. See Appendix C for the Monitoring Morning Quiz.

A large-format Topo map will be used to orient all Volunteers to the area, and to display where each team will be working relative to the other teams. Individual maps and directions to each site will be given to each team.

Each Monitor Team will be assigned a Site Leader, a Lead Collector, and at least 2 Pickers. One Picker will also be the Equipment Manager. Bias will be avoided by assuring that all sites are monitored by different Monitor Teams every monitoring session.

Sampling the Benthic Community

The monitoring sites are each to be 300 feet long, and measured using a surveyors measuring tape. The center and each end of each stretch is to be flagged with bright yellow flagging tape. We took numerous photos upstream and downstream and along the stretch, and the latitude/longitude locations using GPS. We also noted the directions to get to each listed site from River Road. We'll measure and flag each new site in the same manner.

On monitoring day, each team will go to their site, and will set up their work-area as near to the center as possible of the 300 feet stretch. The team will locate all available aquatic habitats, especially noting the location of riffles, and identify them to the Site Leader and Collector. These are to include: Riffles, Runs, Pools, Leaf Packs, Woody Debris, Overhanging Vegetated Margins, Aquatic Vegetation, Rocks, Gravel, Sandy Areas, Sedimented Areas, and any human-made objects that may be an artificial substrate. The Site Leader will note the Collection beginning time on the monitoring form, and the Collector will begin to collect macroinvertebrates. The Site Leader will track collecting time for the Collector.

Multiple collections will be taken from all available habitats in 30 to 40 minutes (not including time spent walking in the stream), including riffles, rocks or other large objects, leaf packs, submerged vegetation or roots, and depositional areas, while wading and using a D-frame kick net. The Collector will hand large rocks, chunks of woody debris, and leaf packs to the Pickers. The trained Site Leader will record the number of locations sampled within the monitored reach in each habitat type and note the locations sampled on the site map sketch. The trained Collector will transfer the material from the net into white pans. The Pickers will pick out samples of all different types of macroinvertebrates from the pans and place them into jars of 70% ethanol for later identification.

During the collection, the Collector will provide information to the team Site Leader in response to questions on the data sheet that review all habitats to be sampled, the state of the creek, and any changes in methodology or unusual observations. The Site Leader will instruct and assist other

team members in detecting and collecting macroinvertebrates in the sorting pans, including looking under bark and inside of constructions made of sticks or other substrates.

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. The Collector and the Site Leader will decide together whether a site needs to have an extended collection time or other variations in procedure. If such actions are taken, they will be described on the data sheet and reported to the project manager.

Labeling the Macroinvertebrate Collection, Correlation with Data Sheet for Each Site
At each collecting site, all invertebrate sample jars receive a label that is written in pencil, stating the date, location, name of Collector, and the number of jars containing the collection from that site (example: #1 of 2 jars, Camp Carl Site) . Label(s) will be placed inside the jar(s).

The data sheet is to correlate with the label, so will also state the number of jars containing the collection from a particular site. The Site Leader is responsible for labeling and securely closing the jars. The Equipment Manager is responsible for returning all jars and all equipment. Upon return to the Project Meeting Location, the Project Manager will check all collections 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.

Transport of Macroinvertebrate Collection
The jars and all monitor forms will be transported to East Lansing where they will be examined, identified to the level of "Order", and counted by either: Trained East Lansing-based Volunteer Team overseen and verified by the Project Manager, or just by the Project Manager. The Project Expert will verify the identifications, and will sign-off on the data form.

Macroinvertebrate Identification
The data sheets are used on identification day, after which they remain on file indefinitely at the East Lansing Project office. 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 pan for sorting. If any specimens are separated from the pan during identification, a site label accompanies them. For final identification, all individual organisms from a single jar will be sorted into look-alike groups, and the Project Expert will confirm the sorting and verify identification of the taxa present. When identification of a sample is complete, the entire collection is placed in a single jar of fresh ethanol with a poly-seal cap and a printed label inside the jar and stored at the East Lansing Project office indefinitely. The ethanol is carefully changed in the jars every two years.

Potential Sources of Variability
Variability could be introduced in several of these areas, and will be managed as follows:

1. Volunteers could go to the wrong site. This could happen because the sites are not accessed by simply going to a particular road-intersection – several of the sites are accessed from walking paths or from ORV trails, or by walking upstream from the road crossing. This will be managed by

providing clear directions, and by marking each site at the center and at each end of the 300 feet stretch, and by marking the latitude and longitude of each location with a GPS. If locating a particular site proves problematic, then additional steps such as signs with arrows may be used. Monitor teams will debrief with the Project Manager after each monitoring session to assure they went to the correct location.

2. Volunteers may not understand methods. This will be managed by quizzing volunteers about methods and interpretation, and about macroinvertebrate identification, and by observing rigorousness of sampling. For the first year, only volunteers who attain at least 65% on a quiz will be allowed to be Site Leaders. In year 2 and beyond, Site Leaders will need to attain at least 75% correct. A Monitor Team will ideally have a mix of strengths, and will complement each other's work. The Project Manager will work with Volunteers who score lower than ideal, since these represent teaching opportunities.

3. Volunteers may concentrate on collecting a particular type of organism, or may not be able to see some organisms due to small size. This will be managed by stressing the need for completeness during the survey, having Pickers pick out everything that moves, and encouraging the use of magnifying lenses and reading glasses. If a sample is altogether missing small or tiny organisms, then the Project Manager will work with those volunteers to show them what the organisms look like and how they may be found.

4. Macroinvertebrate identification may be incorrect. This will be managed by the Project Expert verifying and signing off on all identifications. See Data Collection Techniques section above for more information.

5. Macroinvertebrate Collections may become separated from the monitoring forms. This will be managed by having pencil-written labels inside all jars before the jars are released by a Site Monitoring Team. All jars and all monitoring forms will be labeled with the number of jars for the particular site (example: #1 of 2), the site number, date, and team member's names. The Equipment Manager and the Site Leader will verify that all jars and forms are labeled correctly. The Project Manager will sign the form to indicate they have taken custody of the jars and forms, and that all are labeled appropriately, and will place them into their own box for transport to East Lansing for final identification by the Project Expert and then long-term storage.

Sampling Equipment Description and Procedures

All equipment is stored in the cool dry basement at the home of the Project Manager. Waders are hung from pegs to avoid mildew, and are hosed down after every monitor session. All equipment is transported to and from monitoring sites by the Project Manager, and is cleaned and inspected after every use, and re-sorted to make up monitoring kits.

Each Monitor Team will have a Monitor Kit with the following Equipment:

- 1 white 5-gallon bucket, useful for transporting items in or for transporting stream water
- 1 Aquatic D-Frame Kick Net – to be vigorously r inse and scrubbed between uses in different sites. If a team is to monitor at 2 sites on one stream, they will work upstream first, to avoid potentially transporting any aquatic nuisance species. All nets are inspected before use for rips or tears, and won't be used if in need of repair.

- 1 or 2 white sorting trays – ideally with a lip for pouring; will be cleaned after every session
- 1 water wash bottle to spray down sides of net, and to blast organisms from rocks and wood
- 3 featherweight (flexible) forceps with narrow tip
- 2 or more pipettes for catching small invertebrates
- Preservative - 70% ethanol, #86-1263 $20.95/4 L, from Carolina Biological Supply
- Killing alcohol – 70% isopropyl alcohol (less expensive for killing and initial transport of organisms until they are prepared for storage, when 70% ethanol preservative will be used.)
- 3 – 4 Jars - either 4 oz. Plastic Jars or heavy widemouth glass jars, from Ward's
- 3 - 4 Lids with Polyseal Liner to prevent evaporation of alcohol
- 1 Thermometer with attached fishing bobber to float
- 1 (one) 100-foot measuring tape, for measuring stream width, and for use in flow velocity
- 1 medium sized apple for use in measuring flow velocity, following instructions on the monitoring form. Alternatively, teams may use a brightly colored film canister partly filled with water so that it still floats.
- 2-3 magnifying lenses
- Pens, pencils
- Monitoring forms
- First-aid kit: all Monitor Teams will have a first aid kit in their possession while monitoring

B2. Sample Handling and Custody

This project will not take samples of water for any analysis at any time. If it is determined in the future that water sample analysis is necessary, then this QAPP will be updated to reflect appropriate procedures and reporting.

Macroinvertebrate collection handling, transport, and storage are described in section B1.

B3. Analytical Methods

Frequency and Time Frame for Monitoring

Monitoring will be done twice per year, within 2 weeks of middle of May, and within 2 weeks at end of September and/or beginning of October. This project is located in Michigan's Upper Peninsula, and seasonal changes can occur differently than in the Lower Peninsula. Snow melt comes slightly later in the UP, so spring monitoring will be done in May instead of April. Habitat will be monitored at least every five years in the summer or fall. See Section B1 for monitoring procedures. (Note: Stream Habitat will be monitored in spring 2007.)

Taxonomic Level of Macroinvertebrate Identification

Organisms will be identified at least to the level of Order, utilizing either a hand-held magnifying lens, or a Celestron stereo dissecting microscope or other dissecting microscope to aid in seeing small features.

Literature and Equipment to be Consulted for Identifying Macroinvertebrates

1. *Key to Macroinvertebrate Life in the River*, 11-17 inch poster-style, developed by the University of Wisconsin Extension in cooperation with the Wisconsin Department of Natural Resources. http://clean-water.uwex.edu/wav/otherwav/riverkey.pdf

2. *A Guide to Common Freshwater Invertebrates of North America*, by J. Reese Voshell, Jr., October 2002, The McDonald & Woodward Publishing Company, Blacksburg, Virginia.

3. *An Introduction to the Aquatic Insects of North America, Third Edition,* edited by R. W. Merritt and K. W. Cummins, 1996, by Kendall/Hunt Publishing Company.

B4. Quality Control

Equipment Quality Control:
• Check to make sure equipment is in working order and not damaged after and before every monitoring session
• Clean equipment before and after taking it into the field
• After use in a stream and before storage or before use in another stream, vigorously rinse and scrub aquatic D-frame kick net to dislodge any clinging organisms
• Sorting Trays should be cleaned and free of any organisms prior to use.
• Label equipment with the date of purchase and date of last usage
• Check the expiration date of chemical reagents prior to each use
• Check the batteries of all equipment that requires them
• Make sure equipment is calibrated appropriately before conducting each test

Field Procedures Quality Control:
• At least once every three years: 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
• Check all calculations twice
• Hard copies of all computer entered data will be reviewed for errors by comparing to field data sheets
• Have qualified professionals review data analysis methods and results periodically.

Since our evaluation is based on the diversity, relative number and kind of the aquatic benthic 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. Each site score(s) will be compared with other locations in the same river system that have been sampled in the same way.

Volunteer Training
All Collectors attend an in-stream training session, and sites will be sampled by different Volunteer Teams and 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 ideally re-sampled by a new team within two weeks. If a change is confirmed, the site will be reported to the MDEQ, and will be a high priority for the next scheduled collection.

Field Checks
The Site Leader will check all data sheets to assure each habitat type available was sampled, and will examine picking trays to ensure all present families have been collected.

Lab Checks
The Project Expert will check all macroinvertebrate identification before data are entered to the MiCorps database. The Project Expert will sign off on all data sheets once identification is complete.

B5. Instrument/Equipment Testing, Inspection, and Maintenance

Critical Instruments and Equipment
At this time, critical instruments only include stream sampling equipment listed on page 14 in section B1

Study Design and Methods.
The critical equipment to maintain includes nets (check to assure nets are firmly attached to poles and free of holes), collection jars (clean, with poly seal tops), forceps (with tips that meet), and waders that are clean and dry and do not leak.

The Project Manager stores all monitoring equipment in the dry clean basement of her home. If post or pre-monitoring inspection yields problems with any piece of monitoring equipment, it will be replaced.

B6. Instrument/Equipment Calibration and Frequency
(Water Chemistry Projects only)
At this time, the only equipment that requires calibration are the Vee Gee Pocket Thermometers, their range is 0-50 deg C.

All project thermometers will be calibrated together at least once per monitoring season by placing first into a jar of room-temperature water for 10 minutes and then all compared, and then into a jar of ice water. Those not within one degree Celsius of the others will be discarded.

Calibration results, any deficiencies, and resolution will be noted on a pre-monitoring checklist to be filed electronically and stored in hard-copy with that monitoring session's data sheets in the Sierra Club office in Lansing, Michigan.

B7. Inspection/Acceptance for Supplies and Consumables
At this time, this project has no supplies that are consumable, other than 70% ethanol. This QAPP will be updated if additional calibration solutions or other consumables are to be utilized.
The Project Manager is responsible for maintaining supplies of consumables that are not past their expiration dates.

B8. Non-direct Measurements
Not applicable to this project.

B9. Data Management

MiCorps-supplied monitoring forms will be used to collect all field data. Each monitoring team's Site Leader will inspect the form to assure all sections are completed correctly. The monitoring form will accompany the macroinvertebrate collection. Once monitoring is complete and organisms are identified and counted, then the Project Manager will enter raw data into Microsoft Excel spreadsheets stored electronically on the Sierra Club office server. All data is backed up to a CD whenever it is updated, the CD is kept off premises. Computer passwords provide data security.

The Project Manager, and/or later, a trained Volunteer Data Manager, will enter Data from data sheets directly into the online MiCorps database for storage within the MiCorps data exchange system. Data entry error will be managed by careful comparison against the original data sheets.

Data sheets will be filed at the central Sierra Club office for a period of at least five years.

SECTION C: System Assessment, Correction and Reporting

C1. System Audits and Response Actions

The Project Manager, in consultation with the Project Expert and MiCorps, will perform all audits of capabilities and program performance.

Data Quality Assessment Process

This data quality assessment process will assess the scientific and statistical quality of the data collected.

Total Diversity Data Quality Assessment:

The total diversity reported by each team must equal at least 70 % of the diversity previously found at the site. Sites with results less than 70 % will be re-sampled by Project Manager (if feasible) to verify or discard such unusual results, which could be the result of less-than-thorough sampling.

Corrective Actions:

If deviation from this QAPP is noted at any point in the sampling or data management process, the affected samples may be deleted from the data set. Re-sampling will be conducted if warranted and feasible, given that the deviation is noted soon after occurrence and volunteers are available. Otherwise, a gap may be left in the monitoring record.

All corrective actions, such as above, will be documented and communicated to MiCorps.

C2. Data Review, Verification, and Validation

Validating refers to either accepting, rejecting or qualifying data (such as rejecting outliers) before using it for analysis and/or decision making.

All data collection forms are standardized, downloadable from the MiCorps website at www.micorps.net. This facilitates spot-checking for Data Completeness, and to make sure they are completed correctly.

The Project Manager will review all data forms, with Volunteers still present, on site on Monitoring Day while in Menominee County. Data will be reviewed again before they are entered to a spreadsheet, and before they are filed. The Schedule of Tasks specifies when data will be examined and entered to spread sheets.

A Voucher Collection of benthic organisms will be developed over the first 2 years to facilitate macroinvertebrate identification. The Voucher Collection will be stored at the East Lansing home of the Project Manager.

All macroinvertebrate identification results will be verified by viewing under enlargement by dissecting microscope by an Aquatic Biologist Project Expert using the three texts described above.

Rationale for Determining if Data are Acceptable.

The total diversity reported by each team must equal at least 70% of the diversity previously found at the site, as verified by the Program Manager. Sites with results less than 70% agreement will be re-sampled by the Project Manager if feasible to verify or discard such unusual results, which could be the result of less-than-thorough sampling.

C3. Reconciliation with Data Quality Objectives

All decisions on Data Quality, for example, whether to include a data set or not, will be made within 30 days of data collection. If sampling issues are identified on Monitoring Day, then the Project Manager will resample if feasible before departing Menominee County.

DQO	Described as:	Corrective Action to be taken
Data Variability statistics	Compare SQI, D, RPD scores to previous 3 spring monitoring sessions*	Examine need for retraining and retrain if necessary.
Data completeness	% of data elements filled in on the monitor form, DQO is 90%	Work with Site Leader to remember to fill in all the data elements.
Data representativeness	The degree to which data collected are representative of real conditions.	Work with Site Leader and Collector to assure understanding of different habitats to be sampled.
Data comparability	A measure of the confidence with which one data set or method can be compared to another.	Work with Site Leader and Collector to assure understanding of methods to be used.

*****Data Variability statistics cannot be performed until at least three spring sampling events have occurred (described in Section A-7.)

The Project Manager will submit Quarterly Progress Reports to MiCorps as required, with all quality issues noted as appropriate. Data reporting will include discussion of uncertainty and the

limits of data-use. All data are preliminary until at least three sampling years. See Appendix A for the Schedule of Tasks.

C4. Reporting

Quality Control reports will be included as part of quarterly project reports, as appropriate.

APPENDICES

Appendix A: Schedule of Tasks

When due	Task or Subtasks or Deliverable	Responsible Person	check when done:
Target training & monitoring dates:	Note: Target training during week of August 14 - 19 and first monitoring date for Sept. 23	PD	X
June, July, August 2006			
June – July	**Announce project, recruit new volunteers** Detail: work with local organizations, Front Forty, and others who are interested in water monitoring; advertise in their publications if possible. Contact local angling organizations. Work with local community media, use media to notify residents of the monitoring. Announce training and monitoring sessions in Community Events of local newspaper. Send announcement postcards to area Sierra Club members.	PD	X, & ongoing
June-July	Meet with local MDEQ and MDNR staff to discuss monitoring plans & data quality objectives for QAPP. (Meeting may occur by phone.)	PD	X
June-July	Meet with local residents, Sierra Club members to discuss project component and expected outcomes.	PD	X
June-July	**Work with MiCorps staff, develop draft QAPP**	PD	
August 1-3	Locate at least 6 monitoring sites for fall 2006	PD & Vols	X
	Finalize QAPP		
August 5	**Attend 1-day training session with by MiCorps**	PD	X
mid-August	**Hold monitoring training sessions with new Vols.**	PD	X
	Evaluate		
September 2006	Finalize Menominee River Watershed Sentinel fall monitor plans. Inform MDEQ and MDNR.	PD & Vols	
By August 30	**Evaluate project component to date, report to MiCorps on project first quarter activities and expenditures.**	PD	X
September, October, November, December 2006			
August	**Attend side-by-side joint sampling evaluation w/ MiCorps**	PD	X
Fall- ongoing	Work with statewide media to educate about importance of project, invite them up north, arrange interviews with Vols.	PD & Vols	
October 7	**Hold first sampling date; check all forms with Vols present, check methods and bug i.d. for QA**	PD	
by October 30	**Submit bugs to Project Expert for verification**	PD	
	Evaluate data sheets for completeness and spot check results;	PD	
By November 30	**submit data to MiCorps database and report to MDEQ.**	PD	
October-November	Write first annual Menominee River newsletter, send to Vols, anglers, community.	PD & Vols	

By November 30	**Evaluate project component to date, report to MiCorps on project 2nd quarter activities and expenditures.**	PD	
October 7, 2006	Celebrate year's accomplishments with fall pizza party with Vols, thank and **share data.**	PD & Vols	
November	Plan activities for 2007, set target dates, work with volunteers.	PD	
December	Write update article for February 2007 Mackinac newsletter.	PD	
December	**Prepare annual report, submit to Sierra Club and MiCorps, clean up data.**	PD	
1st Quarter 2007: Jan., Feb., March			
January	Use annual report and companion materials for Vols and media; use it to develop materials and to recruit new volunteers	PD	
January & February	Work by phone and email with local volunteers and community media, get local coverage for spring outreach, use media to announce 2007 activities, training, monitoring.	PD	
March	Continue to recruit, identify organizations, offer to speak or present data to date at community or other organization(s).	PD & Vols	
March	Meet with local MDEQ staff to discuss monitoring plans for 2007 (Meeting may occur by phone.)	PD & Vols	
March & April	Finalize spring plans for component. Inform MDEQ and community news.	PD & Vols	
2nd Quarter 2007: April, May, June			
Early April	Notify media again re: training and monitoring day	PD & Vols	
By April 30	**Evaluate component project to date, report to MiCorps on first quarter activities and expenditures.**	PD	
Early to mid-May 2007	**Hold spring Monitoring date; check all forms with Vols present, check methods and bug i.d. for QA**	PD	
by May 31	**Submit bugs to Project Expert for verification**	PD	
	Evaluate data sheets for completeness and spot check results;	PD	
by June 30	**Submit data to MiCorps database and report to MDEQ.**	PD	
June	Schedule fall dates for training and monitoring: target mid- to late September, before snow fall.	PD & Vols	
June	2nd Annual Menominee River Newsletter for Vols	PD & Vols	
3rd Quarter 2007: July, Aug., Sept.			
By July 31	**Evaluate component project to date, report to MiCorps on 2nd quarter activities and expenses.**	PD	
August	Work with statewide media to educate about importance of project, invite them up north, arrange interviews with Vols.	PD & Vols	
Late August to Early-September	**Hold 2 evening or 1-day Saturday training session; evaluate.**	PD	
Late-September to early October 2007	**Hold Fall Monitoring date; check all forms with Vols present, check methods and bug i.d. for QA**	PD	
By Oct. 31	**Submit bugs to Project Expert for verification**	PD	October 7
	Evaluate data sheets for completeness and spot check results;	PD	
By Nov. 30	**Submit data to MiCorps database and report to MDEQ.**	PD	
4th Quarter 2007: Oct., Nov., Dec.			
Sept./October	**Celebrate year's accomplishments with pizza party with Vols,**	PD & Vols	

	thank and share data.		
By October 31	**Evaluate component project to date, enter data to database, report to MiCorps on 3rd quarter activities and expenses.**	PD	
November	Plan activities for 2008, set target dates with Vols.	PD & Vols	
December-January	Write update article for February 2008 Mackinac newsletter.	PD	
December	**Prepare 2nd annual report, submit to Sierra Club & MiCorps, assess and finalize data to date.**	PD	
1st Quarter 2008: January, February, March			
January	Use annual report and companion materials for Vols and media; use it to recruit new volunteers	PD	
January & February	Work with local volunteers and community media, get local coverage for spring outreach, use media to announce 2007 activities, training, monitoring.	PD	
February	**Identify tasks that volunteers can take over, such as media outreach to public.** **Identify key volunteers to begin turning over some project tasks.**	PD & Vols	
March	Continue to recruit, identify organizations, offer to speak or present data to date	PD & Vols	
March	Meet with local MDEQ and/or MDNR staff to discuss monitoring plans for 2008 (Meeting may occur by phone.), and to discuss project to date, and ongoing support.	PD & Vols	
March & April	Finalize spring plans for component. Inform MDEQ and community news.	PD & Vols	
2nd Quarter 2008: April, May, June			
Early April	Remind Volunteer Leaders to notify media again re: training and monitoring day	PD & Vols	
By April 30	**Evaluate component project to date, report to MiCorps on first quarter activities and expenditures.**	PD	
Early May	**Hold spring training and monitoring days, evaluate and check methods and bug identification for QA by Project Expert.**	PD & Vols	
Mid-May	**Study data sheets, evaluate completeness and check results; evaluate.**	PD	
By May 31	**Submit data to MiCorps database, report to MDEQ.**	PD	

Appendix B: Typical Training Agenda

Typical Monitoring Training Day Agenda:

8:45AM	Welcome, Gather, Greet, Ground rules, coffee & donuts provided
9:00AM	What is this project about? What are the Volunteer roles and jobs?
9:15AM	Water Basics 101: the Water Cycle, groundwater, soil water, surface water; what influences quality of the water; what does water monitoring tell us; how we use the information; why this project; and more
10:00AM	Bugs 101: Introduction to Benthic Macroinvertebrates, or spineless water critters visible without a microscope; why they're important
10:30AM	break
10:40AM	More Bugs 101, followed by Hands-on bugs identification practice (You'll like this part, really!)
11:40AM	Introduction to Aquatic Habitat identification: how to find those bugs, where to look
12:00N	Lunch break – remember to pack a lunch and bring a lawn chair!
12:40PM	Walk to our first monitoring site for a first field practice session
2:00PM	Walk back to cabin for quick break, and then to vehicles for next site visit
3:00PM	Finish up 2nd site visit – then to vehicles for tour of remaining sites, then back inside for wrap-up
4:00PM	Adjourn

Appendix C - Volunteer Monitoring Quiz for Site Team Leaders **Date _____**

Name _____

Phone _____

This quiz will determine if you are ready to either A) Lead a Team of Volunteers in monitoring a site, or B) Be the team's official Collector.

1. To avoid kicking up sediment that would hamper Collecting, Monitor Teams will always begin _downstream__ and work their way _upstream___.

2. Vigorousness in collecting methods is extremely important, but knowing where to look is equally important! Benthic Macroinvertebrates often can be found in the following habitat types:

1. Riffles	2. Runs	3. Pools	4. Leaf Packs
5. Submerged Logs & Woody Debris	6. Overhanging Vegetation/Undercut banks	7. Aquatic Vegetation	8. Under/on Rocks & Cobbles
9. Gravel	10. Sandy Areas	11. Sedimented Areas	12. Artificial Substrate

3. Describe how and where to use an Aquatic D-Frame Kick-Net, both for kicking and for vegetated margins:
For Kicking: In Riffle Areas, and in Sedimented and Sandy Areas; Hold the net against the substrate (bottom), exactly downstream of the Collector, so that water is flowing into and through the net. Kick vigorously at the substrate directly in front of the net, so that all loosened objects will be carried into the net. Work across the stream, in all available habitats in the 300 foot stretch.
In Vegetated Margins, under the water, vigorously push and work the net against the vegetation and bring the net up out of the water in a scooping fashion to capture any benthic macroinvertebrates clinging there.

4. **What kind of critters build their own protective cases?** _____caddisfly larvae_____
5. **To know one when you see one, what will it look like?**
   _will see leaf bits, stick bits, tiny gravel or sand, other similar bits, built into a tubular case, usually with a caddisfly poking out of one end
6. **Do all the critters of this type do this?** ___No -- Net-spinning caddis flies do not build cases_____
7. **What kind of critter has 2 tarsal claws** (the claws on the ends of their legs?) __stonefly larvae_____
8. **Name three Sensitive Benthic Macroinvertebrates:**

1. Caddisfly larvae, except Net-spinning	2. Hellgrammites	3. Mayfly nymphs
4. Gilled snails (right-handed)	5. Stonefly nymphs	6. Water penny
7. Water Snipe Fly		

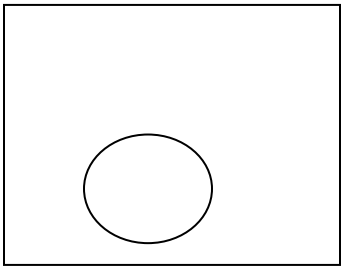
9. **Name three Semi-Tolerant Benthic Macroinvertebrates:**

1. Alderfly larvae	2. Beetle adults	3. Beetle larvae
4. Black fly larvae	5. Clams	6. Crane fly larvae
7. Crayfish	8. Damselfly nymphs	9. Dragonfly nymphs
10. Net-spinning caddisfly larvae	11. Scuds / Sideswimmers	12. Sowbugs

10. Name three Tolerant Benthic Macroinvertebrates:

1. Aquatic worms	2. Leeches	3. Midge larvae
4. Pouch snails	5. True bugs	6. Other true flies

11. The oval represents a Rock on the substrate – Add <u>50% embeddedness</u> to the drawing:



12. Circle one: True False When sampling a riffle, it's only necessary to sample in the "fastest" water.

Why did you choose this answer? ___<u>Different Bugs are found in the fast part and in the slow part, so both fast and slow-moving riffles are important sampling locations.</u>

13. Describe a Pool: <u>Large, slow moving deeper area of water, often found behind (just downstream from) large rocks, it's a hole in the stream, fish tend to hide there to eat.</u>

14. Describe a Riffle: <u>Faster-flowing area of the stream, it's bumpy water flowing over gravel or rocks, it's important because there's more aeration. Tend to find stonefly larvae, mayfly larvae, other sensitive bugs.</u>

15. Describe what to look for in a leaf pack, and how to collect bugs from them:
<u>The best leaf packs are those that are turning dark and getting slimy, though still-bright leaves are important, too. Collect them by the handful for Pickers to go through at stream-side. Caddisfly larvae, such as Net-spinning caddisflies, are often found in them, as are shredders.</u>

16. Define Riparian Vegetation Corridor: <u>It's the vegetation land-cover from the stream edges to 100 feet away, it may be forested, or it may be a farm field, it may be grass, it may be bare dirt, and in urban settings it may be a cement sidewalk.</u>

Appendix D – Volunteer Monitoring Certificate of Achievement

Appendix E Monitoring Base Map