A1. Title and Approval Sheet

Quality Assurance Project Plan for
Tip of the Mitt Volunteer Stream Monitoring Program

Date: 9-6-2005
Version # 1
Organization: Tip of the Mitt Watershed Council

QAPP Prepared by: Kevin L. Cronk
Title: Monitoring and Research Coordinator

Signature: ____

Other responsible individual: Ann Baughman
Title: Watershed Protection Director

Signature: ____

(Other signatures may be added as necessary)

MiCorps Staff Use

Tracking Number:

Funding Source:

MiCorps Reviewer: ____

☐ Approved ☐ Returned for modifications

____
Signature of reviewer Date

A2. Table of Contents

A3. Distribution List

Ralph Bednarz, Michigan Department of Environmental Quality - Water Bureau
Ric Lawson, Great Lakes Commission
Joan Martin, Huron River Watershed Council
Gail Gruenwald, Tip of the Mitt Watershed Council
Ann Baughman, Tip of the Mitt Watershed Council
Kevin L. Cronk, Tip of the Mitt Watershed Council

A4. Project Organization

1. Management Responsibilities –
    1) Kevin L. Cronk, Monitoring and Research Coordinator, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181, kevin@watershedcouncil.org. Kevin is the primary manager and liaison for the volunteer stream monitoring project. His responsibilities include:
        - Develop and implement a Quality Assurance Project Plan.
        - Attend 8-hour training session provided by MiCorps.
        - Promote volunteer stream monitoring activities and solicit volunteers and stream access permissions from local community.
        - Research and purchase necessary equipment for performing stream monitoring activities.
        - Coordinate and conduct volunteer stream monitoring training sessions.
        - Coordinate volunteer stream monitoring field data collection sessions.
        - Coordinate and implement macroinvertebrate identification sessions.
        - Database development, data entry, and data analysis.
        - Report generation for volunteers and lake/stream associations and web-page development for data dissemination.
        - Provision of products and deliverables. This should include all data collected, in both hard copy and electronic format.
        - Project evaluation.
        - He will also purchase necessary equipment, catalogue and store collected specimens, develop and maintain databases, and provide data to Michigan DEQ and the public. Finally, Kevin will ensure that the program adheres to the quality assurance protection plan.
    2) Ann Baughman, Watershed Protection Director, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181 ann@watershedcouncil.org. Ann's responsibilities include:
        - Promote volunteer stream monitoring activities and solicit volunteers and stream access permissions from local community.
        - Development and submission of a final report, following MiCorps guidance, at the end of the project.
        - Submission of a release of claims statement at the end of the project.
        - Project evaluation.
    3) Lynn D. Buffington, Business Manager, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181. Lynn's responsibilities include:
        - Development and submission of status reports following MiCorps guidance at a frequency included in the contract.
    4) Valerie Olinik-Damstra, Watershed Coordinator, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181. Valerie will assist Kevin in program management when necessary.
2. Field Responsibilities – Field sampling will be performed by volunteers. Team leaders and collectors will receive training in field data collection methods by Tip of the Mitt Watershed

Council staff or MiCorps staff. Trained leaders will provide instruction and guidance to other volunteers in the team.

3. Laboratory Responsibilities – Kevin Cronk, Monitoring and Research Coordinator, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181, kevin@watershedcouncil.org will be responsible for calibrating and maintaining the Watershed Council Hydrolab MiniSonde, which will be used to measure conductivity.
4. Corrective Action – Kevin Cronk, Monitoring and Research Coordinator, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181, kevin@watershedcouncil.org will be responsible for initiating, developing, approving, and implementing corrective actions.

A5. Problem Definition/Background

According to US Census Bureau statistics the number of inhabitants in the northern counties of the Lower Peninsula has doubled in the last forty years. Population pressure is expected to increase at even greater rates, resulting in urban area expansion and consequent negative impacts on surface water quality. Chloride data from the Comprehensive Water Quality Monitoring Program (coordinated by Tip of the Mitt Watershed Council) reveal the widespread human impacts as chloride levels have steadily increased in most of the 40-plus lakes monitored throughout Antrim, Charlevoix, Cheboygan and Emmet Counties.

Although volunteers have been monitoring lake water quality in the northern Lower Peninsula for up to 30 years, streams have been largely neglected. Recently, a number of lake associations have expressed interest in monitoring stream water quality to determine the affects of tributaries draining into their lakes. It is extremely important that a volunteer stream monitoring program be established as soon as possible to collect baseline water quality data, determine the current health of the streams and begin monitoring changes that may result from human influence. Three areas have been targeted for this project: the Lake Charlevoix Watershed; Cheboygan River Watershed (Mullett Lake Sub-watershed); and Elk River Watershed. These areas were selected because of development pressure, growth patterns, nonpoint source pollution concerns, and interest from lake associations in stream monitoring.

Tip of the Mitt Watershed Council has a long history of providing aquatic resource information and education to government officials and the local community. Having access to such information generates greater interest in the resource from the public and results in increased awareness and understanding of the environmental and economic values of aquatic ecosystems. Government officials, planners and others will be more effective at protecting aquatic resources when water quality data are available to aid in the decision-making process during activities such as master planning and zoning. The general public will have greater success promoting stewardship of aquatic resources by using stream water quality data during educational activities.

A6. Project Description

The over-arching goal of the proposed monitoring program is to protect and improve the water quality of the streams of the northern Lower Peninsula of Michigan. Specific objectives of the program include: collect baseline data, characterize stream ecosystems, identify specific water quality problems, determine water quality trends, and, most importantly, inform and educate the public regarding water quality issues and aquatic ecology. As with the Volunteer Lake Monitoring Program, which has been sponsored and coordinated by the Tip of the Mitt Watershed Council for the last 20 years, volunteer stream monitoring activities will continue to be supported by the Watershed Council into the future.

The key to accomplishing the stated goal is fostering stewardship of aquatic resources through community involvement and education. As more people become involved in monitoring activities and receive water quality education, particularly concerning information regarding the health of local streams, the more likely they are to take care of their streams and become involved in community decision making that could impact water quality. Once base-line data is collected, then streams will be characterized, specific problems identified, trends determined, and information will be utilized and shared with local governments and citizens for educational and resource management purposes.

Data to be collected by volunteers includes: 1) aquatic macroinvertebrate diversity, 2) conductivity and 3) water temperature. Aquatic macroinvertebrates are the primary focus of this monitoring program. Aquatic macroinvertebrates will be collected, identified and tallied to determine diversity in the benthic community and thus, gauge the health of the stream reach. Conductivity will be measured in water samples collected by volunteers to determine ionic content, the results of which could expose abnormalities in the stream system caused by contamination from human activity. Stream water temperature will be measured by volunteers to note variation within a stream system and view any changes over time.

The service area for the Tip of the Mitt Watershed Council includes the counties of Antrim, Charlevoix, Cheboygan, and Emmet as well as portions of major watersheds that extend into five other counties. Based upon interest from lake/stream associations and ongoing monitoring activities, streams from three major watersheds have been selected for the proposed monitoring. Information regarding the streams where monitoring is being proposed are presented by watershed:

I. Lake Charlevoix Watershed, Charlevoix County
   1) Water body name: Stover Creek
      1. Location: Charlevoix County, longitude: -85.28, latitude: 45.27
      2. Number of sample sites: 3
      3. Previous monitoring efforts: macroinvertebrates sampled on 11-6-4 with total taxa numbers ranging from 7 to 18.
      4. Environment description: largely agricultural and wetland in the headwaters and more urbanized towards the outlet.
   2) Water body name: Horton Creek
      1. Location: Charlevoix County, longitude: -85.09, latitude: 45.29
      2. Number of sample sites: 2
      3. Previous monitoring efforts: physical and chemical water quality data collected from 2001 to 2004, results typical for high-quality streams of northern Michigan.
      4. Environment description: forested, agricultural and wetland.
   3) Water body name: Boyne River
      1. Location: Charlevoix County, longitude: -84.95, latitude: 45.19
      2. Number of sample sites: 4
      3. Previous monitoring efforts: Larry Maltby of Friends of the Boyne River coordinates water quality monitoring with high school groups, results are unknown.
      4. Environment description: forested, wetland and agricultural upstream with urbanized area at outlet. Proposing to discharge Boyne City Waste Water Treatment Plant effluent into wetlands adjacent to river.

II. Cheboygan River Watershed, Cheboygan County
   1) Water body name: Mullett Creek
      1. Location: Cheboygan County, longitude: -84.59, latitude: 45.53
      2. Number of sample sites: 2
      3. Previous monitoring efforts: water sample collected for analysis by lake association member and showed high nutrients.
      4. Environment description: large agricultural operations in headwaters and rest is forested and wetland.
   2) Water body name: Little Sturgeon River
      1. Location: Cheboygan County, longitude: -84.44, latitude: 45.54

2. Number of sample sites: 1
3. Previous monitoring efforts: none
4. Environment description: agricultural and forest upstream, forest and wetland downstream.

3) Water body name: Pigeon River
   1. Location: Cheboygan County, longitude: -84.55, latitude: 45.43
   2. Number of sample sites: 2
   3. Previous monitoring efforts: none.
   4. Environment description: largely natural ecosystem types (i.e. forested, wetland, shrub, etc). More agriculture and developed land in lower sections.

III. Elk River Watershed, Antrim County

1) Water body name: Spencer Creek
   1. Location: Antrim County, longitude: -85.26, latitude: 44.86
   2. Number of sample sites: 2
   3. Previous monitoring efforts: phosphorus and discharge monitored by Three Lakes Association.
   4. Environment description: agriculture scattered throughout, wetlands in headwaters, forested in mid-section, mix of natural and developed in lower section.
2) Water body name: Eastport Creek
   1. Location: Antrim County, longitude: -85.34, latitude: 45.12
   2. Number of sample sites: 2
   3. Previous monitoring efforts: fecal coliforms and phosphorus monitored by Three Lakes Association.
   4. Environment description: mix of agricultural, developed and natural.

A7. Data Quality Objectives

Precision/Accuracy: The primary goal of this project is to gauge stream health by measuring the total diversity of macroinvertebrate taxa. To guarantee precision and accuracy, a designated Project Expert (usually the Program Manager) will accompany teams to observe their collection techniques and note any divergence from protocols. The Project Expert will also perform an independent collection (duplicate sample) no less than a week after the team's original collection and no more than two weeks later. As there are only be two project experts available and seven teams of volunteers, it will take four field collection days (2 years) to achieve this goal. Subsequently, as the program expands, Project Experts will accompany new teams during their first macroinvertebrate sampling event and collect duplicate samples.

Techniques under review shall include [1] collecting style (must be thorough and vigorous), [2] habitat diversity (must include all habitats and be thorough in each one), [3] variety and quantity of organisms (must ensure that diversity and abundance at site is represented in sample), and [4] the transfer of collected macroinvertebrates from the net to the sample jars (specimens must be properly handled and jars correctly labeled). Resulting diversity measures by teams will be compared to expert results and each should have a relative percent difference (RPD) of less than 40%. This statistic will be measured using the following formula:

RPD = [(Xe - Xv) / (mean of Xe and Xv)] x 100,

where Xe is the expert measurement and Xv is the volunteer measurement for each parameter.

Volunteer teams that meet quality standards will be allowed to conduct future field collection without expert oversight, though they will be "recertified" after about every five sampling events. Teams that do not meet quality standards will be retrained in the relevant methods and the Project Expert will re-evaluate their collection during the subsequent sampling event.

The accuracy of specimen identification is dependent upon the abilities of the experts aiding in the indoor identification session. Identifications made by experts that have not received course work or training in family level aquatic macroinvertebrate identification or better, will be reviewed by qualified Watershed Council staff. At least 10% of the samples processed by experts in question will be reviewed to verify results. If more than 10% of specimens were misidentified, then Watershed Council staff will review all the samples processed by that expert.

Additionally, MiCorps staff will conduct a method validation review with the designated Project Expert to ensure his or her expertise, preferably prior to the first training session held by the Project Expert (note that this must be conducted with each new Project Expert added to a MiCorps monitoring program). This review will consist of a joint duplicate sampling event, with MiCorps sorting and identification. RPD statistics will be calculated as above. All cases of collecting deficiencies will be 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. MiCorps staff will also verify the volunteer's identification of all of the collected macroinvertebrates before the subsequent monitoring season.

Regarding physical water quality data collection, accuracy and precision will be accounted for by following procedures similar to those established for macroinvertebrate data. The Project Expert accompanying the team will collect a separate water sample to measure conductivity and measure stream water temperature at the site. Results by teams will be compared to expert results. Conductivity measurements between team and expert should not vary by more than 50 microSiemens (when properly calibrated the accuracy of the Hydrolab MiniSonde® 4a Multiprobe, as reported by Hach Company is: Accuracy: +/- 0.5% of reading +/- 0.001 mS/cm, Resolution: 0.001) and temperature should not vary by more than 5 degrees Celsius. If results are outside limits of comparability, data collection techniques will be reviewed with leader and a Project Expert will accompany team during the next sampling event. Furthermore, measuring equipment will be checked to ensure that it is functioning correctly. Thermometers of team and expert will be used simultaneously, side by side, to verify accuracy and comparability. During the next sampling event the expert will measure conductivity in the field with the calibrated Hydrolab MiniSonde. Water samples will be collected by both team and expert and measured for conductivity at the Watershed Council office. This protocol will help determine the source of error if unacceptable disparity in readings occurs again.

Bias: Sites will be sampled by different teams at least once every two years to examine the effects of bias in individual collection styles. An RPD between the new measure and the mean of past measures should be less than 40% for all parameters. Sites not meeting this DQO will be evaluated as above by the Program Expert.

Completeness: Following a QA/QC 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 95%. If the program does not meet this standard, the Program Manager will consult with MiCorps staff to determine the main causes of data invalidation and develop a course of action to improve the completeness of future sampling events.

Representativeness: Study sites for the program are selected following the methodology described in section B1. As indicated, all available habitats will be sampled and documented to assure that the site is representative of other stream segments in the subwatershed. Resulting data from the monitoring program will be used to summarize the biological conditions of the contributing subwatershed, as an initial screening mechanism. 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.

Comparability: To ensure comparability, all volunteers participating in the program will follow the same sampling methods and use the same units of reporting. The methods are based on MiCorps standards, which will increase comparability with other MiCorps programs. Periodic reviews of sampling events by the Program Expert will ensure adherence to these standard methods.

A8. Special Training/Certifications

Kevin Cronk received Volunteer Stream Monitoring Grantee Training was held on Saturday, June 4, 2005. This training provided information about basic stream monitoring methods established by MiCorps. Topics covered included stream macroinvertebrate sampling and identification (to the order level), habitat assessment, data management and entry into the MiCorps database, attracting and retaining volunteers, and program evaluation. The training included both indoor and field components, and was conducted by Jo Latimore and Joan Martin of the Huron River Watershed Council and Anne Sturm of the Great Lakes Commission, with cooperation from the Tip of the Mitt Watershed Council.

A9. Documentation and Records

Raw data collected by volunteers will be entered and managed in Microsoft Excel workbooks. Conductivity measurements will be stored in the Hydrolab Surveyor and recorded manually on paper. Data in Surveyor will be exported into a spreadsheet format and copied into a Microsoft Excel workbook. If electronic data is used, manually recorded data sheet will be used as a backup. Diversity indices are also calculated in Microsoft Excel. All data is backed up daily and a back-up tape is stored off premises. Computer passwords provide data security.

B1. Study Design (Experimental Design) & Methods

Sample Sites:
Sample sites were chosen to assess water quality in areas of concerns and to monitor longitudinal variation in stream systems. Each potential site on the target streams was visited by Watershed Council staff. Sites were photographed, recorded on GPS, subjectively scored/ranked (based largely on habitat diversity), and pertinent notes were taken, all of which were inputted to a database for future reference. Three maps depicting stream channels, sample sites and watershed boundaries were also developed and are included in Appendix A.

Mullett Creek, a tributary of Mullett Lake, stretches 11 miles through a 10400 acre watershed in Cheboygan County. Two sites have been chosen on Mullett Creek, one near the mouth on M27 and the other at the Crump Road stream crossing. Both sites are presently being monitored for several physical and chemical parameters as well as bacteria in a project funded by the Mullet Lake Area Preservation Society and conducted by Tip of the Mitt Watershed Council. There are concerns by watershed and Mullett Lake residents regarding impacts of agricultural operations in the watershed. The Crump Road site was chosen because it is located just downstream of one of the agricultural operations in question. The mouth of the stream was chosen as the second site to gauge the cumulative impact of activity in the watershed and to monitor the quality of water flowing from the stream into the lake.

The Pigeon River is the second largest tributary to Mullett Lake, flowing 48 miles through a 96,000 acre watershed. Although large portions of the Pigeon River Watershed are located on undeveloped state land, human activity in the mid-section may be responsible for high phosphorus inputs observed during water quality monitoring conducted by the Watershed Council. Two sample sites have been selected, one upstream in Pigeon River Country, a State Wilderness Area, and the other downstream at the Highway M68 road-stream crossing.

Stover Creek flows 6.9 miles into Lake Charlevoix just south of the City of Charlevoix. The Stover Creek watershed encompasses 4242 acres, dominated by agricultural lands upstream and largely urbanized towards the mouth. Both of these land uses potentially contribute to water quality degradation from non-point source pollution. Stover Creek was formerly placed on the State's list of streams with impaired water quality and has been targeted for improvement by Tip of the Mitt Watershed Council. Funds donated by the Charlevoix Community Foundation were used by the Watershed Council to coordinate volunteer monitoring activities in 2004 and as well as a volunteer stream clean-up. Three sites were monitored during the 2004 season and will continue to be monitored in this program. In the headwaters, Stover Creek will be monitored at the Ferry Road crossing and in the lower reaches; the creek will be monitored at the City Cemetery on highway M66 and at the mouth, adjacent to Irish Boat Shop.

The headwaters of Horton Creek are located less than a mile from Little Traverse Bay, but the creek winds 6.2 miles through a 8850 acre watershed before emptying into the north side of Lake Charlevoix. The watershed is under threat of development due to proximity to the growing urban areas of Petoskey and Charlevoix. Horton Bay Club, a private association with land holdings at the mouth of the creek, is concerned about the health of the creek and potential impacts on the quality of receiving waters at Horton Bay. The Club has contracted the Tip of the Mitt Watershed Council to monitor physical and chemical water quality parameters, including bacteria, since 2001. Water quality data collected by volunteers will supplement this data set and help monitor the impacts of development in the watershed. Two sites have been chosen on Horton Creek, one near the mouth on Boyne City Rd and the other towards the headwaters on Church Road. Although greater habitat diversity at the Boyne City Road stream crossing may limit comparisons with data collected at the Church Road crossing, an upstream monitoring station is needed to gauge the cumulative impacts of development in the watershed.

The Boyne River flows into the east end of Lake Charlevoix from a 45,900 acre watershed. The main channel extends 6 miles inland before splitting into the North Branch (6.2 miles) and the South Branch (11.2 miles). The Boyne River contains portions that are considered to have very high water quality, such that it has been classified as a "blue-ribbon" trout stream. However, the Boyne River is not without problems. The river contains many impoundments that likely have thermal impacts on cold water fisheries. Although much of the watershed is forested, development pressure is increasing, particularly around the urban areas of Boyne City and Boyne Falls, and poses a threat to water quality. Furthermore, a new waste water treatment plant in Boyne City has proposed to discharge treated waste water into the lower reaches of the Boyne River. If this happens, water quality in the lower section of the Boyne River would be in jeopardy. There would be a distinct possibility of untreated effluent being discharged into the river due to system malfunction or due to system overload during large storm events. There would also probably be thermal impacts from daily treated discharge flowing into the river. Due to the fact that the Boyne River has two major branches, four sample sites have been chosen. Volunteers will monitor water quality in the headwaters of the North Branch on Thumb Lake Road and on the South Branch at Dobleski Road. Monitoring will be conducted mid-way through the river at Dam Road and toward the mouth of the river at Old City Park on East Street in Boyne City.

Eastport is a small tributary on the north end of Torch Lake that flows 2.3 miles through a 2153 acre watershed. The Three Lakes Association is concerned about water quality of the creek due to testing that has revealed high bacteria counts and moderately high phosphorous levels. Sites selected for this tributary include the Farrell Road stream crossing in the headwaters and the Highway M88 stream crossing towards the mouth. Both sites have been visited and have a good array of habitats.

Spencer Creek flows 5.7 miles through a 6505 acre watershed into the southeast end of Torch Lake. The Three Lakes Association has an ongoing project to model phosphorus inputs into Torch Lake and have recorded levels above the EPA recommended threshold of 50 parts per billion in Spencer Creek. The cause/source of phosphorus is unknown, but may be due to agriculture activities scattered throughout the watershed or urban impacts in the lower section.

Due to TLA interest and concern for the health of this creek, volunteers will monitor stream water quality at two sites; upstream at McPherson Road and downstream at Coy St. in the village of Alden.

Methods:
Volunteers will monitor stream water quality by collecting physical and biological data two times per year, during the months of May and September. Physical data to be collected includes water temperature and conductivity. Biological data will consist of a representative sample of the benthic community.

Water temperature will be measured by volunteers using hand-held thermometers to note longitudinal variations in the stream system and impacts on the macroinvertebrate community. Temperature data is predicted to provide valuable insight into stream systems that contain impoundments. Water samples collected by volunteers will be used by Tip of the Mitt Watershed Council staff to measure conductivity. Conductivity measurements have been demonstrated to be a good surrogate indicator of human activity in a watershed and therefore, should provide valuable information in streams that flow through or near urban areas.

Our biological evaluation of stream water quality is based upon community diversity, such that 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. During field data collection efforts, volunteers will collect specimens from the benthic community from all habitats present at the site. Macroinvertebrates collected from the benthic community will be identified to the family level and tallied to provide data for the calculation of diversity indices. Diversity scores will be used to rate the health of the stream ecosystem and provide a basis for trend analyses. Our results will be compared with other data sets available through DEQ and other agencies/organizations for the site in question and compared with locations in the same river system included in this program.

B2. Study Methods

For each sampling event, monitoring by volunteers will be completed within the same two week period each year. If a site is temporarily inaccessible, due to factors such as 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 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 be responsible to see that the site is monitored unless sufficient redundancy has been included in the monitoring schedule that additional data is not needed."

Field macroinvertebrate data collection: A trained volunteer stream Collector will collect multiple samples at each site with the goal of sampling all habitats in the stream reach (i.e. riffles, runs, pools, woody debris, etc.). D-frame nets will be used to sample all habitat types, the contents of the net will be emptied into shallow white trays, and volunteers will pick aquatic organisms from the tray and store them in containers filled with 70% ethanol for later identification. An emphasis will be placed upon collecting a variety of aquatic organisms as opposed to quantity. A site sketch depicting the locations and types of habitats sampled will be completed by the group Leader during field data collection activities (see Appendix B). The Collector will provide information to the team Leader in response to questions on the data sheet that review all habitats to be sampled, stream conditions, and any changes in methodology or unusual observations. The Leader will instruct and assist other team members in finding and collecting macroinvertebrates in the sorting pans. Potential sources of variability such as weather, stream flow, turbidity, and erosion will be noted during each sampling event and discussed in study results. The field data sheet will include sections to record unusual procedures or accidents, such as losing part of the collection by spilling. The Leader and Collector will decide together whether a site needs to have an extended collection time or other variations in procedure.

Field physical parameter data collection: The team Leader will be provided with containers, which will be used to collect water samples at each site. Water will be collected from the middle of the stream at mid-depth, rinsing container and lid 3 times with stream water before collecting water sample. Water samples will be delivered to the Watershed Council office and tested for conductivity by Watershed Council staff. A handheld thermometer will be used by the Leader to measure water temperature at mid-depth in the middle of the stream and recorded to the nearest degree Celsius.

Indoor identification: Following the field data collection session an indoor identification session is held, bringing volunteers and aquatic scientists together to sort, identify, and tally specimens collected in the field. Volunteers separate preserved aquatic organisms into groups based on physical similarities. Aquatic scientists with macroinvertebrate taxonomic identification skills will then assist volunteers with the identification of specimens to the family level. All samples will be reviewed by qualified experts. Volunteers will record the family names and tally the number of specimens belonging to each family.

Equipment: Field sampling gear includes D-frame nets, sorting trays, containers and lids, forceps, eye-droppers, ethanol, and waders. All equipment will be stored in the Tip of the Mitt Watershed Council office and made available for pick-up by volunteers prior to sampling events. Equipment will be returned to the Watershed Council office on indoor identification days. Equipment will be maintained by Watershed Council staff.

B3. Sample Handling and Custody

At the sample site, a label written in pencil stating date, location, name of collector, and number of containers used to collect specimens is placed inside every container used at the site. The field data sheet includes a section to record the number of containers used at the site. Containers used for collecting water samples will have label tape affixed, which the Leader will use to record the site number and date with a permanent marker. The team leader is responsible for putting labels in containers, securely closing the containers, and returning all containers and equipment to the Tip of the Mitt Watershed Council office. Upon delivery to the Watershed Council office, all containers are checked for labels, secured together with a rubber band and site label, and placed together in one box. In addition, data sheets are checked for completeness and to verify that the correct number of containers from the sample site is indicated on the data sheet. Samples will be stored in the Watershed Council office until the indoor identification session (one or two weeks later). Water samples that can not be tested immediately due to distance constraints will be frozen and delivered/tested during the indoor identification session. The field data sheets are used on the identification day, after which they remain on file indefinitely. During the indoor identification session, 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.

After identification, ethanol used in the field will be discarded and specimens will be stored in fresh 70% ethanol. Samples will be stored in glass containers with Polyseal lining and contents will be reviewed periodically to guarantee long-term storage. Labels made of heavy-gauge paper will be inserted into containers to provide relevant information such as sample ID (corresponding to database), sample site location, and date collected. Preserved samples will be securely stored at the Tip of the Mitt Watershed Council office for future reference.

B4. Analytical Methods

Aquatic macroinvertebrates collected in the field during the months of May and September will be identified to the family level. Although reference literature for taxonomic identification is dependent upon the preference of the expert, copies of *Aquatic Insects of North America* by R. W. Merritt and K. W. Cummins, *Aquatic Insects of Wisonsin* by W. L. Hilsenhoff, and *A Guide to Common Freshwater Invertebrates of North America* by J. R. Voshell, Jr. will be available during indoor identification sessions. Stereo microscopes with up to 65x magnification will also be available during indoor identification sessions to aid the experts. If there are not enough experts to process all samples during the identification sessions, Tip of the Mitt Watershed Council staff will complete the identification process.

Several biotic diversity indices will be used to rate the water quality of each stream, make comparisons between streams and perform trend analyses within the same stream over time. Diversity indices to be used include: Total Taxa, EPT, and a Hilsenhoff Sensitivity Index. The Total Taxa index is the total number of families found at a sample site during one sample event. The EPT index is the total number of families belonging to the Ephemeroptera, Plecoptera, and Trichoptera orders found at a sample site during one sample event. A system developed by William L. Hilsenhoff to rate the sensitivity of aquatic macroinvertebrates will be used to total the number of sensitive families (those receiving ratings of 0, 1, & 2 by Hilsenhoff). All biotic diversity index scores will be calculated in Microsoft Excel.

Statistical analysis of data will be performed to examine variation between sample sites and trends within sites over time. Due to the fact that the program is just beginning and baseline data has not been collected, statistical procedures for data analysis have not yet been determined. Before conducting statistical analysis, Tip of the Mitt Watershed Council staff will consult with professional statisticians for guidance in choosing the correct statistical procedure and performing statistical analyses.

B5. Quality Control

<u>Equipment Quality Control:</u>

1. Hydrolab Surveyor unit must be checked and charged if necessary before each event.
2. Calibration solution standards must be checked to ensure that they are not expired and that there is sufficient volume to perform calibrations.
3. Hydrolab MiniSonde must be calibrated with standard solutions before each field event using the Hach Company standard calibration procedure from the Hydrolab manual. If the Hydrolab will not calibrate correctly or if experiencing any other technical problems, the unit must be sent into the Hach Company for service. If the Hydrolab is not ready for use during the sampling event, the Watershed Council will use a backup YSI conductivity meter. Hydrolab and calibration solutions will be securely stored in the laboratory of the Watershed Council office.
4. Thermometers must be inspected physically for damage and compared to other thermometers and/or the Hydrolab to verify that they are functioning correctly, prior to the sampling event. If the thermometer is damage or not working correctly, it will be disposed of properly and replaced with a new unit.
5. D-frame nets must be inspected for damage and replaced if necessary.
6. Containers for water sample collection must be checked for damage and cleanliness and replaced/substituted if necessary.
7. All equipment must be cleaned, dried and stored securely after sampling event.

Field Procedures Quality Control:

1. Replicate water samples must be collected during side-by-side field data collection when a new volunteer team starts monitoring and then every 3-5 years thereafter. A program manager or qualified expert will accompany the team and collect a replicate water sample to verify accuracy of conductivity measurements.
2. Replicate water temperature data must be collected during side-by-side field data collection when a new volunteer team starts monitoring and then every 3-5 years thereafter. A program manager or qualified expert will accompany the team and collect replicate water temperature data to verify accuracy.
3. Replicate benthic macroinvertebrate sampling must be performed during side-by-side field data collection when a new volunteer team starts monitoring and then every 3-5 years thereafter. A program manager or qualified expert will accompany the team and collect benthic macroinvertebrate data to compare diversity indices with those of the team and thus, verify quality control in collection techniques and thoroughness.
4. Volunteer monitoring teams must alternate streams and/or sample sites on a 2-3 year basis to maintain objectivity and minimize individual bias.

Indoor Identification Quality Control

1. All containers with macroinvertebrate specimens must be checked by a program manager upon receipt from volunteer team to assure that they contain labels and are secured together with a rubber band and site label, and placed together in one box.
2. Field data sheets used by volunteers must be checked for completeness and to verify that the correct number of containers from the sample site is indicated on the form.
3. Prior to identification, data sheets and jars must be checked to ensure that all jars, and only jars from that collection are present prior to emptying them into a white pan for sorting.
4. During the identification session, if any specimens are separated from the pan during identification, a site label must accompany them.
5. All samples must be checked/verified by a qualified expert.
6. Following identification, all specimens from the sample site in question must be stored in 70% ethanol in an air-tight container and a label included in the container that includes all relevant information (i.e. sample event date, sample site location, taxonomic family name, number of specimens per family).

Data Analysis Quality Control

1. Field records must be reviewed for errors upon receipt by a program manager to minimize errors before entry into a database and subsequent analysis.
2. Calculations for diversity and other variables must be repeated, preferably by another program manager, to reduce error.
3. Data entered into computer must be reviewed by comparing hard copy print outs of database with field data sheets.
4. Data analysis methods must be reviewed on a five year basis by qualified professionals.

A quality control check list for use by project managers has been developed and is included in Appendix C.

B6. Instrument/Equipment Testing, Inspection, and Maintenance

D-frame nets will be inspected before each sampling event to ensure that they are intact. If holes are found in the netting, nets will be replaced prior to use. Containers for collecting water samples will also be inspected before each event and replaced if necessary.

The Hydrolab MiniSonde® 4a Multiprobe and YSI Model 33 Conductivity Meter are used regularly by Watershed Council staff for a variety of projects and thus, are tested, inspected, and maintained on a continual basis. Watershed Council staff will return equipment to respective companies of origin if service is required.

Thermometers will be inspected physically for damage and compared to other thermometers and/or the Hydrolab to verify that they are functioning correctly, prior to the sampling event. If equipment has been damaged or is malfunctioning, replacement thermometers will be provided by Tip of the Mitt Watershed Council staff. All equipment will be stored in the Tip of the Mitt Watershed Council office.

B7. Instrument/Equipment Calibration and Frequency

Conductivity will be measured using a Hydrolab MiniSonde® 4a Multiprobe. Prior to use, the MiniSonde® will receive two-point calibration based upon procedures provided in the manual, using a standard potassium chloride solution of 447 µS at 25° Celsius. The following are specs provided by Hach Company for the Hydrolab MiniSonde® 4a Multiprobe: Range: 0-100 mS/cm, Accuracy: +/- 0.5% of reading +/- 0.001 mS/cm, Resolution: 0.001.

If calibration fails, the procedure will be repeated until calibration is successful. If unable to calibrate successfully, conductivity will be measured with a back-up unit (YSI Model 33 Conductivity meter). The back-up unit will be properly calibrated prior to use.

B8. Inspection/Acceptance for Supplies and Consumables

A list of monitoring supplies and consumables, including dates of purchase and projected replacement, has been developed in a Microsoft Excel workbook, a sample of which is included in Appendix D. Supplies will be maintained by program managers and stored at the Watershed Council office.

B9. Non-direct Measurements

Data from the Michigan Department of Environmental Quality (DEQ) streams database may or may not be used to make comparisons between sites, with the same site, or for trend analysis. Information about stream data collected by DEQ can be found at the following website: http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728---,00.html. Data from other agencies or organizations, such as the Little Traverse Bay Band of Odawa Indians, may be used for the same purposes.

B10. Data Management

Tip of the Mitt Watershed Council staff will ensure that field data sheets are turned in with collected specimens when brought in by volunteers from the field. Following the indoor identification session information from both field data sheets and specimen identification data sheets will be inputted into a comprehensive stream water quality Microsoft Access database, designed and created by Watershed Council staff. Either Watershed Council staff involved with the Volunteer Stream Monitoring Program or a single trained volunteer will input the data into the database. Approximately 10% of records in the database will be reviewed on an annual basis to assure quality control. Once a year, all new data will be exported to a MiCorps compatible format and sent to MiCorps for inclusion in their data exchange. Hard-copy data sheets will then be stored at the Watershed Council office for a period of at least five years, before being moved into archive storage where they will be stored indefinitely.

C1. Assessments and Response Actions

Volunteer team leaders trained by Tip of the Mitt Watershed Council or MiCorps will monitor to ensure that quality assurance protocols are followed and report any issues possibly affecting data quality. Program managers will accompany groups in the field to perform side-by-side sampling and verify the quality of work by the volunteer team. Details of this process and assessment of data quality are outline in section A7. Response to quality control problems is also included in section A7.

If deviation from the QAPP is noted at any point in the sampling or data management process, the affected samples will be deleted from the data set. Re-sampling will be conducted if feasible, given that the deviation is noted soon after occurrence and volunteers are available. Otherwise, a gap must be left in the monitoring record and the cause noted. All corrective actions will be documented and communicated to MiCorps.

C2. Reporting

Throughout the duration of this project funded by DEQ (next two years), quality control reports will be included with quarterly project reports that are submitted to the Great Lakes Commission and DEQ. After, quality control reports will be generated as quality control issues occur and shared internally with staff members involved in the project as well as the executive director of the Watershed Council and will be sent to MiCorps. Quality control reports will provide information regarding and 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.

Watershed Council staff will generate yearly reports to share results of the program with volunteers, lake and stream associations, and the general public. Data and reports will be made available over the Watershed Council web page (http://www.watershedcouncil.org).

D1. Data Review, Verification, and Validation

A standardized data-collection form will be used to facilitate spot-checking to ensure that forms are completely and correctly filled out. A program manager or a single trained volunteer will review data before it is stored in a computer or file cabinet. Raw data from field survey forms will be compared to computer entries on an annual basis. Biological monitoring results will be confirmed by identification from trained entomologists. Experts will conduct identification with the aid of dissecting microscopes (with a maximum enlargement of 65x), consultation with dichotomous keys (*Aquatic Insects of Wisconsin*, Hilsenhoff and *Aquatic Insects of North America*, Merritt and Cummins), and the use of a reference collection on-hand at the Watershed Council office.

Experts who will assist in macroinvertebrate identification quality control include:
Kevin Cronk, Tip of the Mitt Watershed Council
Valerie Olinik-Damstra, Tip of the Mitt Watershed Council
Ann Baughman, Tip of the Mitt Watershed Council
Rachel Schwarz, Little Traverse Bay Band of Odawa Indians
Kira Jensen, Little Traverse Bay Band of Odawa Indians
Mike Winnell, Freshwater Benthic Services, Inc.
Ric Olinik-Damstra, Graduate Student
Doug Fuller, SEE-North

D2. Reconciliation with Data Quality Objectives

Data quality objectives will be reviewed on an annual basis to ensure that objectives are met. Any data quality problems will be reported to program managers and MiCorps for assessment and corrective actions. Specific response to and reconciliation of problems that occur in data quality are outlined in section A7.

Appendix A. Maps of streams, watersheds and sample site locations.

Appendix B. Tip of the Mitt stream monitoring datasheet.

Appendix C. Quality control check list.

Tip of the Mitt Volunteer Stream Monitoring Program Quality Control Check List

Date: _________________ Name of program manager: __________________________

Prior to sampling event:

1. Charge Hydrolab Surveyor unit [ ]
2. Check calibration solutions (expiration and quantity) [ ]
3. Calibrate Hydrolab MiniSonde [ ]
4. Check thermometers for damage & accuracy [ ]
5. Check nets for damage and repair if necessary [ ]
6. Check water sample containers for damage & cleanliness [ ]

During sampling event:

7. Collect replicate water sample for conductivity analysis [ ]
8. Collect replicate water temperature measurements [ ]
9. Collect replicate macroinvertebrate sample [ ]

After sampling event:

10. Ensure that containers have labels inside [ ]
11. Secure containers with rubber band and label [ ]
12. Review field data sheet for errors for completeness [ ]
13. Review data sheet for correct number of containers [ ]
14. Clean, dry and store equipment [ ]

Indoor identification:

15. Ensure all (and only) jars from site are present [ ]
16. Ensure site labels accompany and specimens removed [ ]
17. Ensure that all samples are reviewed by expert [ ]
18. Store samples (with labels) in ethanol [ ]

Data review and analysis:

19. Review field records for errors prior to data entry [ ]
20. Repeat all calculations, preferably by other program manager [ ]
21. Compare database records with hard copies [ ]

Appendix D. Sample list of monitoring supplies and consumables.

Item	Quantity	Vendor	Purchase Date	Replacement Date
AQUATIC NET 12"D SHAPE.	10	BioQuip	9/1/2005	Dependent upon use/wear
AQUATIC NET BAG D-SHAPE, 12"	10	BioQuip	9/1/2005	Dependent upon use/wear
FEATHERWEIGHT FORCEPS, NARROW TIP	50	BioQuip	9/1/2005	Dependent upon use/wear
STEREO MICROSCOPE 1X,3X OBJ, 15X EYEPCS	1	BioQuip	9/1/2005	Dependent upon use/wear
STEREO MICROSCOPE 1X,3X OBJ, 20X EYEPCS	1	BioQuip	9/1/2005	Dependent upon use/wear
FIBEROPT LIGHT SOURCE 20W, BIFURC LIGHT GDE	2	BioQuip	9/1/2005	Dependent upon use/wear
SIEVE KIT, 4/KIT WIRE MESH #5,10,60,230	1	BioQuip	9/1/2005	Dependent upon use/wear
Medicine Dropper, Plastic, 1-mL Nipple, 3 1/2 in, Pk 12	4	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Ethanol, 95%, Lab Grade, 20 L	2	Carolina Biological Supply	9/1/2005	When supply is less than 10L
Bottle, Polyethylene, Widemouthed, 500 mL	20	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Write-On Label Tape, Bel-Art, 1 in x 40 yd	2	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Unitary Wash Bottle, Low-Density Polyethylene, Widemouthed, 250 mL	2	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Unitary Wash Bottle, Low-Density Polyethylene, Widemouthed, 500 mL	2	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Dissecting Needle, Plastic Handle, Straight Point	5	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Gratnell Storage Tray, Yellow, Small	5	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Gratnell Tray Insert, 8 Compartment	5	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Gratnell Clip-On Lid	5	Carolina Biological Supply	9/1/2005	Dependent upon use/wear
Thermometer Armors, 12″	10	WARD'S Natural Science	9/1/2005	Dependent upon use/wear
Celsius Red Alcohol Thermometers, -20° to +110°C, Total Immersion, Yellow	10	WARD'S Natural Science	9/1/2005	Dependent upon use/wear
Tray with Pour Lip	10	WARD'S Natural Science	9/1/2005	Dependent upon use/wear