A1. Title and Approval Sheet

Quality Assurance Project Plan for
Hatlem Creek Benthic Macroinvertebrate Monitoring Program

Date: 1/14/2008
Version # 2
Organization: Glen Lake Association

QAPP Prepared by: John Hayes
Title: Project Manager

Signature: _____ Date:_____

MiCorps Staff Use

Tracking Number:

MiCorps Reviewer: _____

☐ Approved ☐ Returned for modifications

Signature of reviewer Date

A3. Distribution List

Ric Lawson
Huron River Watershed Council
1100 N. Main, Suite 210
Ann Arbor, MI 48104

Rob Karner
Glen Lake Association

Mike Litch
Glen Lake Association

Sarah Litch
Glen Lake Association

John Hayes
Glen Lake Association

A4. Project Organization

A) Management responsibilities

John Hayes, Program Manager (PM) – Mr. Hayes is responsible for all administrative and QA oversight (QA manager) of the entire project and will be a team leader. Mr. Hayes will create and maintain the program database and manage the equipment needs of the project. Mr. Hayes will train new volunteers only if Mr. Karner is not available.

Mike Litch – Mr. Litch will assist with communication with the Glen Lake Association. Mr. Litch servers as the water quality chairperson of the Glen Lake Association and will be a team leader.

Sarah Litch – Ms. Litch is the serving Glen Lake Association President. She will facilitate communications between Mr. Hayes and the members of the Glen Lake Association and will be a team leader.

Rob Karner, Project Expert – Mr. Karner is the project biologist and a team leader. Mr. Karner will train volunteers.

B) Field responsibilities

Team leader – Team leaders are responsible for collecting and returning stream sampling kits, directing volunteers on site and returning 5 gallon bucket with samples to the Leelanau School lab for analysis.

Collectors- Collectors are responsible for in-stream macro collection as well as sorting of the samples back in the lab.

Project Manager – The PM is responsible for distributing the collection kits to team leaders.

Project Expert - Mr. Karner is the project biologist and a team leader. Mr. Karner will train volunteers in a 30 minute in-stream training session before each sampling at site #1.

C) Laboratory Responsibilities
Rob Karner – Mr. Karner will lead the macroinvertebrate identification. Mr. Karner will coordinate the sample storage and will provide samples if necessary to MiCorps. The PM will assist Rob Karner in the identification process and storage of samples and datasheet.

D) Corrective Action
John Hayes, Rob Karner, Mike Litch and Sarah Litch will form a committee that will meet twice a year to discuss and implement corrective action.

John Hayes
jmhayes@umich.edu
(W)734.615.0190
(H)248.821.8615

Mike and Sarah Litch
elitch05@centurytel.net

Rob Karner
rkarner@leelanau.org

A5. Problem/Definition

The Leelanau Peninsula is home to several natural treasures. The most popular attraction is the Sleeping Bear Dunes National Lakeshore, which has about 1.3 million visitors per year. Visitors to the area have been increasing steadily since 1984. Many of these park visitors also take time to enjoy Glen Lake and the Crystal River, engaging in a multitude of water activities. Though tourism has had a positive impact on the local economy, there are major environmental concerns that have arisen because of the growth.

Population growth and increased tourism within in the Leelanau Peninsula has accelerated the need for active involvement in the protection of the Glen Lake/Crystal River Watershed. The Glen Lake Association (GLA) has risen to the challenge and initiated several programs to protect the quality of its water resources, an outstanding resource within the watershed. A few of the programs include: conducting regular water quality monitoring activities as part of the Cooperative Lakes Monitoring Program (CLMP) administrated through the Michigan Lake & Stream Associations, Inc. (ML&SA), invasive species prevention and education activities, and best practice land use education for riparian owners. Though many great strides have been taken to protect this sensitive watershed, there is more that needs to be done.

In 2002 the GLA, in partnership with the Leelanau Conservancy, developed the Glen Lake/Crystal River Watershed Management Plan (GLCRWMP). The plan was approved by the Michigan Department of Environmental Quality (MDEQ) and published in 2003. An area of focus of the GLCRWMP was the Hatlem Creek Corridor. As stated in the plan GLCRWMP, the Hatlem Creek Corridor is considered an environmentally sensitive area.

“The ecologically rich Hatlem’s Creek region presently provides diverse habitat for many threatened endangered species, and biological communities including: the federal and state endangered Michigan monkey flower (Mimulus glabratus var. Michiganensis), state

threatened red-shouldered hawk (Buteo limeatus), a species of special concern, the eastern box turtle (Terrapene Carolina) and geographic features such as kettles."

Hatlem Creek is a second order coldwater stream and is the largest source of surface water flowing into Glen Lake. It is especially important to Glen Lake as it is the primary spawning ground for the Emerald Shiner. The Emerald Shiner is critical for many species of game fish found in Glen Lake because it is the main species in the forage base. Additionally, the creek is home to resident steelhead, brook trout and Coho salmon populations.

Active involvement by the GLA and surrounding community is vital to preserving the Hatlem Creek corridor. The GLA, following the suggestions of the GLCRWMP, created a new subcommittee in its organization dedicated to evaluating, monitoring and protecting the sensitive Hatlem Creek Corridor. Some water quality testing was done in 1991 by the GLA that established baseline data for the lower reaches of the creek. However, no data have been collected on the upper portion of the creek that resides in a higher terrain and in the midst of new residential development nor has there been any comprehensive monitoring done since 1991.

The GLA, beginning in 2006, will implement the Hatlem Creek Monitoring Initiative (HCMI); A comprehensive plan to implement ongoing water quality monitoring, evaluate and repair bank erosion sites, educate riparian owners on best land use practices, protect threatened endangered species and create a community interest in the area and project. The Benthic Invertebrate Monitoring Program is one very important part of the HCMI. The purpose of the Hatlem Creek Benthic Invertebrate Monitoring Program is to train volunteers in benthic invertebrate sampling and identification and provide volunteers with the equipment and education needed to carry out the project. The program will be an invaluable tool used to evaluate needs and provide direction for improvements to the watershed. It is suspected that sand and sediment removal, habitat restoration and bank stabilization will have a positive impact on the creek. The data will let us know if the "work" is working. Without ongoing water quality and benthic invertebrate data, we will have no way of knowing if our efforts are having a positive impact nor will we know if there is a serious problem with the creek. With hard work and dedication, the Hatlem Creek Monitoring Initiative will result in a healthier watershed, with an improved fishery, higher quality water, and a community that is more informed and cares more about our environment.

A6. Project Description

The over-arching goal of the program is to improve Hatlem Creek. In order to do this, we need to establish baseline macroinvertebrate data and maintain it over a long period of time coupled with collecting water quality data. Once we have several years of data, we can better understand Hatlem Creek and how it responds to environmental stressors.

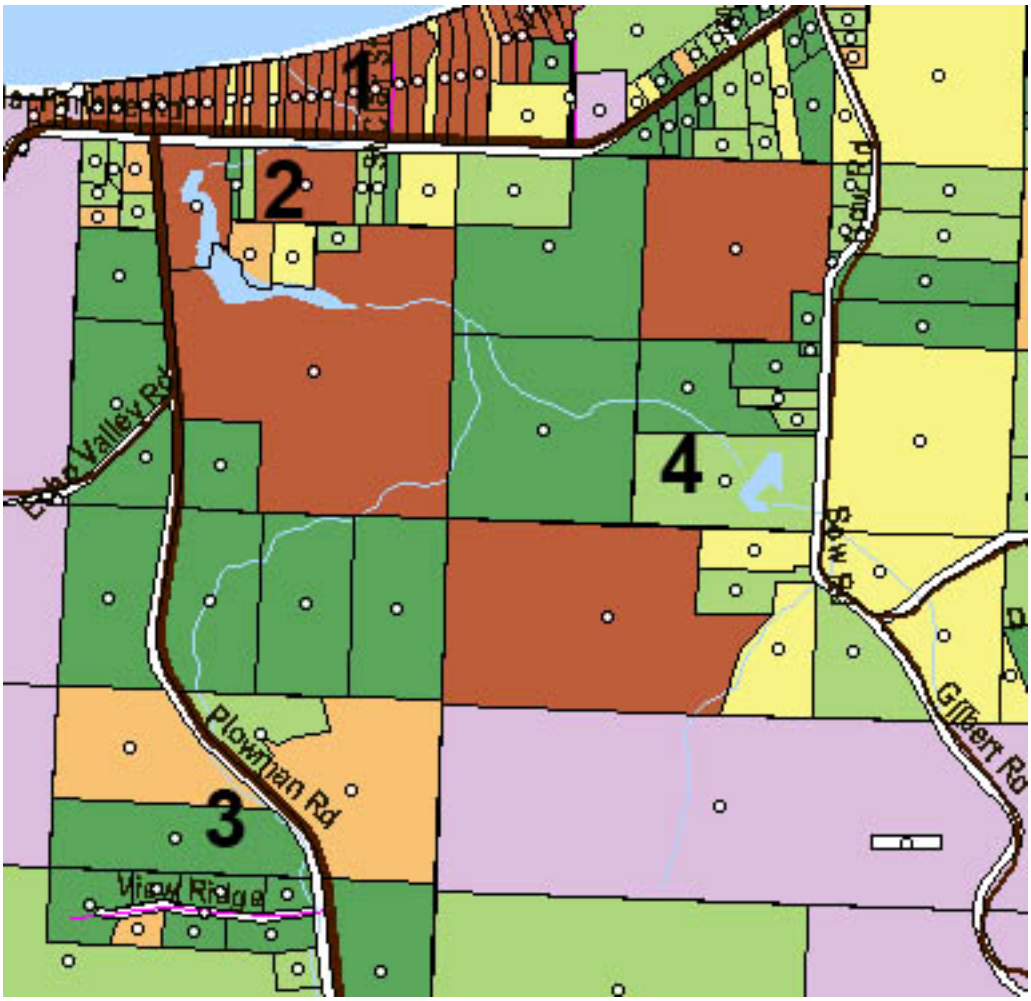
Testing locations are as follows:

1. Glen Lake/Crystal River Watershed, Leelanau County
    1) Water body name: Main branch (Hatlem Creek below CR675)
        1. Location: Leelanau County, Empire TWP. Latitude: N44º49.91', longitude: W85º57.79'
        2. Number of sample sites: 1
        3. Previous monitoring efforts: water quality testing for pH, DO, %DO temperature, depth and conductance
        4. Environment description: mostly residential, forest and small area wetland

2. Glen Lake/Crystal River Watershed, Leelanau County
    1) Water body name: Main branch (Hatlem Creek below CR675)
        1. Location: Leelanau County, Empire TWP. Latitude: N44º50.60', longitude: W85º57.79'
        2. Number of sample sites: 1
        3. Previous monitoring efforts: none
        4. Environment description: mostly residential, forest and small area wetland

3. Glen Lake/Crystal River Watershed, Leelanau County
    1) Water body name: West branch
        1. Location: Leelanau County, Empire TWP. Latitude: N44º49.92', longitude: W85º57.79'
        2. Number of sample sites: 1
        3. Previous monitoring efforts: none
        4. Environment description: mixed residential, wetland and forest with few road crossings

4. Glen Lake/Crystal River Watershed, Leelanau County
    1) Water body name: East branch
        1. Location: Leelanau County, Empire TWP. Latitude: N44º50.33', longitude: W85º57.08'
        2. Number of sample sites: 1
        3. Previous monitoring efforts: none
        4. Environment description: mixed residential, wetland and forest



A7. Data Quality Objectives

The following techniques will be reviewed during training and in retraining of team leaders every three years: [1] collecting style (must be thorough and vigorous), [2] habitat diversity (must include all habitats present and be thorough in each one), and [3] the transfer of collected macro invertebrates from the net to the sample jars (thoroughness is critical).

Since there is inherent variability in accessing the less common taxa in any stream site and program resources do not allow program managers to perform independent (duplicate) collections of the sampling sites, our goal for quality assurance is conservative. A given site's Stream Quality Index (SQI) score or total diversity (D) measure across macro invertebrate taxa will be noted as "preliminary" until three spring sampling events and three fall sampling events have been completed. At least two of these six measures will be collected by different volunteer teams. 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. Note that this examination requires that all stream data records must include the personnel of the monitoring team and the number of each type of habitat sampled.

Sample results that exceed these standards should be then noted as “outliers” and examined to determine if the results are likely due to sampling error or a true environmental variation. If sampling error is determined the data point should be removed from the data record. Volunteer teams that generate more than one outlier should be observed by the Project Expert at the next sampling event and be considered for retraining.

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. This will be conducted with each new Project Expert added to a MiCorps monitoring program. This review will consist of a joint sampling event, with MiCorps staff jointly collecting, sorting and identifying the macroinvertebrates with the project expert. Any monitoring issues will be addressed on site. If no major concerns remain, the Project Expert will be considered “certified” by MiCorps.

Sites will be sampled by different team leaders at least once every three years in each season (two events among six sampling events, if conducted twice per year) 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%. Sites not meeting this DQO will be evaluated as above by the Program Expert.

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 MiCorps staff to determine the main causes of data invalidation and develop a course of action to improve the completeness of future sampling events.

Study sites are selected to represent the full variety of stream habitat types available locally, emphasizing the inclusion of riffle habitat. All available habitats within the study site will be sampled and documented to ensure a thorough sampling of all of the organisms inhabiting the site. Resulting data from the monitoring program will be used to represent the ecological conditions of the contributing subwatershed.

Program directors and trainers will learn the standard MiCorps monitoring methods at annual trainings by MiCorps staff and will train their volunteers to follow those methods to ensure comparability of results among all MiCorps programs. To the extent possible, the monitoring of all study sites will be completed on a single day.

For each sampling event that is not completed on a single day, monitoring by volunteers will be completed within the same two week period. If a site is temporarily inaccessible, such as due to prolonged high water, the monitoring time may be extended for two additional weeks. If the issue concerning inaccessibility is continued beyond the extended dates, then no monitoring data will be collected during that time and there will be a gap in the data. If a team is unable to monitor their site during the specified time, the 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. Special Training/Certifications

1) John Hayes, Mike and Sarah Litch and Rob Karner have all been trained by MiCorps for benthic macroinvertebrate and habitat assessment.

2) Rob Karner is a biologist with degrees from Michigan State University, B.S and the University of Michigan, M.S. Mr. Karner has developed several testing programs for the Glen Lake/Crystal River Watershed and has extensive experience in macroinvertebrate identification.

3) Side-by-side training has been completed by Rob Karner, John Hayes, Mike Litch and Sarah Litch.

B1. Study Design and Methods

The benthic macroinvertebrates will be sampled twice a year at four locations. Sampling will take place at each site in the spring (early May) and late summer (late September). Each sample site will be 300ft and will be sampled for 30 minutes.

Multiple collections will be taken from each habitat type present at the site, including riffle, rocks or other large objects, leaf packs, submerged vegetation or roots, and depositional areas, while wading and using a D-frame kick net and/or seine. The team leader will record the number of locations sampled within the monitored reach in each habitat type and note the locations sampled on a site map. The collector will transfer the material from the net into the 5 gallon bucket. During the collection, the collector will provide information to the team 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 team leader will instruct and assist collectors in detecting and collecting macroinvertebrates, 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 Leader will decide together whether a site needs to have an extended collection time or other variations in procedure.

B2. Sample Handling and Custody

The Project Manager labels each 5 gallon collection bucket and poly-seal jar sample containers before sampling starts and creates a collection kit for each team. The kits contains D-frame collection nets, seine, waders, poly-seal jar with 70% alcohol, collection pans and forceps, 24 well plate, data sheets and transfer pipettes. The labels for the poly-seal cap jars are marked with pencil and placed in poly-seal cap jars with 70% EtOH. The date, collection site name (GPS coordinates and common name) and collection team are marked. Kits are given to team leaders and sampling commences. Collection teams will return to the Leelanau School Laboratory with the collection kits and 5 gallon buckets containing the samples. The PM will collect all kits after sampling and verify that items are returned. The PM will clean, fix, or purchase replacement equipment and repack and store the equipment in personal storage unit on the creek.

Rob Karner coordinates the picking process in his lab at the Leelanau School immediately after the picking process. 4 stations are set up and samples are sorted from 5 gallon buckets by volunteers. One team leader is at each station. Immediately after the sorting, the samples will be analyzed.

Rob Karner will empty one station sample into a collection pan and will separate the samples, count them and fill in the appropriate datasheet. A 24 well plastic plate will be used in the separating process and each well will be labeled with a histology (EtOH resistant) marker. Once Rob identifies all the specimens in the sample jar, the specimens are all placed back in a new poly-seal jar with the original label made by the PM. Rob will add his initials and an analysis date to the label in pencil. Data sheets will be finalized. This will be repeated for all samples. Once analysis is complete, samples are placed in the Rubbermaid container and sealed with tape. The initials of the PM and date will be placed on box to verify it has been analyzed. The PM will house the samples in a personal storage unit near creek.

B3. Analytical Methods

The macroinvertebrate community will be monitored twice a year indefinitely and sampling will take place in the spring (early May) and late summer (late September). Habitat assessments will be done once a year in late summer (late September).

We will assess down to a family level using a Wolfe® StereoPro™ Zoom Trinocular Stereomicroscope and the Streamkeeper's Field Guide -- (Thomas Murdoch and Martha Cheo, 1996) as well as a key presented at the MiCorps macroinvertebrate and habitat training session.

There will be few used materials. The EtOH waste from the identification can be washed down a sink. Transfer pipettes can be discarded in the trash.

We will use a flow meter in the habitat assessment. If the instrument needs calibration as per the instructions, the recommended protocol will be followed.

B4. Quality Control

Equipment quality control

A) All equipment will be checked by the PM when it is purchased, prior to each sampling and immediately after each sampling. D-frame nets and seines will be inspected for tears, the flow meter will be checked for damaged impellers and lose connections.
B) Each piece of equipment will be labeled with a key that will track its purchase data, use and maintenance.

C) Equipment will be maintained by the PM. Before the first sample and after each subsequent sample, the PM will pack the sample kits and initial each one verifying that the kit is done and all equipment has been checked for integrity.

D) The EtOH solutions are to be made fresh for each sample.

Field quality control

A) The PM will collect replicate samples from one test site per sampling. The side-by-side sample will be analyzed for consistency. If the results vary one level (from the MiCorps assessment ranking), Rob Karner will sample the site. This preliminary check will occur for three years until enough data has been collected and the RPD can be calculated.

Once an RPD can be calculated, if the percent varies by more than 40%, then a re-sample will take place.

B) Field crews will randomly be assigned each sampling. Random selection will minimize bias over several years of testing. Each team will consist of a team leader. Rob Karner, John Hayes and Mike and Sarah Litch are team leaders. At least one team leader will be at each site to monitor and instruct the volunteers. Each team leader will rotate sites each sampling session. Team leaders will not have random assignment.

C) The PM will review results shortly after testing. Year one, no corrective action will take place unless there is a protocol error. Year three and thereafter, the PM will assess the site data and determine if the results are suspicious. If the results have an RPD more than 40% different, then the PM will resample the site in question.

D) Before each sampling, new volunteers will be given an on stream training. Once the results are obtained from the training and the volunteers have been explained the protocol, volunteers will be given kits and sent to appropriate areas.

E) Each sample point will be marked with a GPS. The PM will mark the sample area beforehand with a red flag and the volunteers will sample 150ft up and down river from the flag. We want to measure the same stretches of creek and do it consistently into the future. It will take many years of complete site sampling to be able to make any assessment on the creek.

B5. Instrument/Equipment Testing, Inspection and Maintenance

A) The critical equipment are the nets. The PM will individually check each net before and after each sampling to ensure its integrity.

B) Waders will be checked for leaks, collection jars will be checked for a tight fit and forceps, magnifying glasses, and suction tools will be visually inspected.

C) All groups will open each kit at the designated meeting place before the sampling takes place and verify each piece of equipment is in the kit and working. A checklist is included in each kit and will be signed and given to the PM by each team leader.

B7. Inspection/Acceptance for Supplies and Consumables

A) Each piece of equipment will have a key affixed to it indicating when and where it was purchased. The key will allow the PM to determine if new equipment needs to be purchased.

B) The key will be stored in the Access database and referenced one month prior to each sampling.

C) The PM is responsible for all equipment purchases and maintenance. The PM will enter into the database the time and date of the kit inspection.

B9. Data Management

A) Microsoft Access database will be used. Raw data from the datasheets will immediately be entered by the PM after each sampling.

B) All data for this project will be stored on a server that is housed in a data center located in Ann Arbor, MI. The server has the following technical specifications:

- Linux operating system
- Apache web server
- Single 2.8 GHz Xeon processor
- 2 GB RAM
- Nightly backups

The data center is a high-security facility with biometric and pass-card systems, 24 hour surveillance (digitally archived), access logging, climate-controlled environment and FM-200 fire protection. Kitty-corner from the police headquarters and across the street from the city's main fire station, the building is ideally located for rapid response by Ann Arbor's emergency services. The data center occupies the entire 3rd floor, which means the entire floor has restricted access for data center staff only. The 3rd floor is approximately 30 feet off the ground, so the chance of a breach through an outside facing wall is low given the height from ground level. The data center has 6 separate rooms: Battery & Power; Network Infrastructure; customer workroom with KVM access; spare parts closet; data center technician offices; and customer co-location room. This separation of equipment helps to further segment risk and damage. Non-data center staff have access only to the customer co-location room and customer KVM workroom. These rooms are separated from all power equipment, network infrastructure and network operations equipment which are all in separately locked and secure rooms.

In addition to these physical security measures, the data center employs the following network security features:

- Redundant firewalls that restrict ping
- IP block assignment (separate subnet for each customer)
- Notifications from cert
- Regular updates of firewall rules
- Updates of all security patches (as released)
- Instruction detection systems
- Wireless-free network
- Virus scanning on all incoming and outgoing traffic
- Regular review of network traffic logs and statistics

C) The data will be assessed using bar Prism Statistical Software version 3. Graphs will be created in Prism to help visualize trends in the data. The RPD will be calculated using a Microsoft Excel.

D) Once every year, data will be uploaded to the MiCorps website. The PM will store the pdf copies of the data sheets on Innercircle Media's server. A paper copy of each sample data sheet will be filed with the Glen Lake Association Water Quality Committee for 10 years.

C1. System Audits and Response Actions

A) Side-by-side sampling will take place once every two years with a group of volunteers and an outside committee. The results must be at least 70% in agreement. If they are not, MiCorps will be contacted and the GLA will follow their recommendation. The committee will be a leading expert(s) in macroinvertebrate identification from MiCorps or other appropriate agency. The GLA will defer to MiCorps.

B) The MiCorps data sheets will be used and an itinerary will be packed with the data sheets clarifying specific questions regarding sampling time and net samples. It will be very clear to the volunteers what is expected of them.
C) Team leaders will report any suspicious collection techniques to the PM and appropriate corrective action will be taken. If the collection protocol is found to be faulty, then if possible, there will be a new sample by a new team of volunteers and a new team leader. If re-sampling is not possible, then no data for the site will be collected.

C2. Data Review, Verification and Validation

A) Data will be reviewed immediately after sampling and analysis. After year three, datasheets that contains outliers will be discarded and a new sampling will take place. An outlier would be the final score given in the macro invertebrate assessment that is substantially different as defined by the RPD % difference. If the new data is similar to original sample, then the first collected data will be included. If it is not possible to re-collect data, the area will noted as "An area of concern" and Rob Karner will lead a team of volunteers in a new collection the following cycle (two samples). Re-sampling is necessary because the nature of the data we are collecting. Extreme swings in data from year to year should not occur (as measured from same season). If there is a large variance, then there is fatal problem with the collection protocol or there is a severe problem with the creek. It will hard to explain in year one and two why there are differences in the data. If we notice a significant change (two level change in the SQI), a re-sample will take place and compared against the original sample. If the SQI is the same, then the original datasheet will be used.
B) Each MiCorps data sheet that is submitted will be spot checked by the PM for errors or omissions. If there several problems, a re-sampling will take place soon thereafter. If this in not possible, then there will be a gap in the data.
C) Rob Karner is responsible for analyzing the data. He is a highly trained in macroinvertebrate identification. He will use either a 10x,20x or 40x for identification. If there is a sample that he cannot identify, he will photograph and send it to Jo Latimore, MiCorps Program Manager, for clarification.
D) Data will be entered into the database by the PM. The final score cell in the Access database will connected to previous scores. If there is a 1 level change, the database will be programmed to alert the PM. Data will be re-checked for proper data entry.
E) There will be a yearly report of the data to the Glen Lake Association that includes charts. This report will include the number of sample sites and number of times sampled, any re-sampling or gaps in the data.

C3. Reconciliation with Data Quality Objectives

A) The project data objectives will be measured after each sampling session. The PM will follow the data quality protocol. If the data does not meet the quality standards, the PM will notify the project committee. If a solution is not found, MiCorps will be contacted for advice.

B) Data collection procedures, data and volunteer collection techniques will be evaluated after each sampling. If the Committee feels there are flaws the process, committee recommendations will be followed.

C4. Reporting

A) Status reports will be submitted to MiCorps on a quarterly basis. The following reports will be used for reporting purposed to MiCorps:

   a. Individual sample sheets that include field notes,

   b. Volunteers survey report

   c. Riparian survey report

   d. Committee survey report