

MiCorps
Quality Assurance Project Plan
For the
Thornapple River Monitoring Project
Barry Conservation District
2006-2008

SECTION A: PROJECT DESCRIPTION AND QUALITY OBJECTIVES

A4. Project Organization

1. Management Responsibilities

- The Barry Conservation District (BCD) will act as the lead agency for the Thornapple River Monitoring Project. Project staff includes BCD Co-Executive Directors Lori Phalen and Joanne Barnard, who each have extensive grant administration experience and have completed water quality monitoring training through MSU Extension. Phalen, who holds a B.S. from WMU, has a background in natural resource management. Barnard, with an M.A. in English from MSU, brings experience in project management and education.
- Joanne Barnard will act as the project administrator and steering committee liaison. Barnard will also recruit volunteers, develop press releases and oversee data management.
- Lori Phalen, the Quality Assurance Manager, will coordinate the training, monitoring events and data collection procedures.
- Office Assistant Hailey Norton will assist with road-stream crossing surveys and handle data entry.
- Jane Herbert, District Water Quality Educator for MSU Extension's Kellogg Biological Station will act as the project's scientific advisor.

2. Field Responsibilities

Barnard, Phalen and Norton will each act as team leaders. Additional team leaders will be recruited from the Thornapple River Watershed Steering Committee and the Thornapple River Watershed Council. Some members of both organizations have previous monitoring experience, either through participation in other monitoring projects or through employment in the Health Department, Drain and Road Commissions, or conservation organizations. Prior to monitoring events, team leaders will participate in a one day training session or attend the two-day spring monitoring session provided by MSU Extension. Training will include proper monitoring procedures, stream safety, use of equipment and macroinvertebrate identification and storage.

3. Laboratory Responsibilities

Sorting and identifying macroinvertebrates culled in this project will take place at the Barry Conservation District (BCD) conference room at 1611 S. Hanover, Hastings, Michigan. All samples will be stored in the BCD's storeroom, located in Suite 105 of the same complex. Laboratory staff includes Phalen, Barnard, Norton and Herbert.

4. Corrective Action

As Quality Manager, Phalen will be responsible for initiating, developing and implementing corrective action subject to the approval of Herbert, the Scientific Advisor.

A5-6. Problem Definition/Background and Project Description

The Thornapple River Watershed, which spans the five-county region of Kent, Barry, Allegan, Eaton and Ionia, is amidst one of the fastest growing areas in relation to land development in Michigan. Once primarily agricultural and rural, southern Kent County, northern Barry County and central and northern Eaton County are fast becoming urbanized, with populations growing by 20-45% since 1990, according to the 2000 Census. In addition, small agricultural operations are combining, and the number of Certified Animal Feeding Operations (CAFO's) is increasing in the agricultural areas of the region. The Thornapple River, its tributaries and lakes play a central role in the surrounding communities, providing recreational and sports fishery opportunities. However, recent data show that water quality in several tributaries and lakes is on the decline. To address this issue, the Barry Conservation District has organized a Thornapple River Watershed Steering Committee to assess water quality and develop a plan to manage water resources and develop strategies to improve declining areas. The first step in this process is to gather current data on water quality in the areas potentially impacted by development and increased agricultural pressures.

Ten tributaries flow into the Thornapple River upstream or at Thornapple Lake, which was rated by the DEQ in 2003 as hypereutrophic. Many of these tributaries have received low acceptable macroinvertebrate ratings and fair to marginal habitat ratings in past DEQ studies. Further study in these tributaries is planned to isolate sources contributing to water quality decline. Downstream of the lake, as the river heads northward toward Kent County, increased development and industrialization are also affecting water quality. Sites around Middleville, Caledonia and Cascade Township will be monitored to gage changes from human impact. Additionally, four coldwater tributaries – Glass Creek, Bassett Creek, Cedar Creek and Quaker Brook – exist outside the Coldwater River TMDL area in the Thornapple Watershed. Because of their importance as fisheries, monitoring locations will also be established on each to assess macroinvertebrate and habitat conditions.

The basic questions directing the project are: 1) Which tributaries are probable sources for negative impacts on the Thornapple River's overall water quality? And 2) What is the relative water quality of the Thornapple's coldwater streams? In order to answer these questions, two monitoring procedures, the Stream Habitat Assessment and Stream Macroinvertebrate Monitoring, will be conducted on 22 sites within the watershed over a 5-10 year period. Initially, the Stream Habitat Assessment will provide snapshots of the Thornapple's tributaries, indicating potential sources of pollution. Over time, macroinvertebrate monitoring will rank stream quality, helping to pinpoint critical areas within the watershed.

The goals of the Thornapple Watershed Monitoring Project are 1) to gather data on potential critical areas to provide a valid assessment of the Thornapple River Watershed, 2) to determine locations where remedial actions will have the most beneficial effects, 3) to increase public awareness and involvement in watershed and water quality issues, and 4) to establish a trained and committed network of volunteers to conduct an annual monitoring program beyond the scope of the proposed project.

Goals and Objectives

Gather data on potential critical areas to provide a valid assessment of the Thornapple River Watershed

- Complete the outlined work plan in accordance with the proposed timetable
- Characterize key rivers and streams and their ecosystems
- Pinpoint pollutants, sources, and causes affecting water quality in these water bodies

Determine locations where remedial actions will have the most beneficial effects

- Establish baseline data for critical areas
- Assess potential for water quality improvement through remedial actions to determine 5-10 sites for implementing Best Management Practices

Increase public awareness and involvement in watershed and water quality issues

- Publicize the monitoring process and results through at least 10 press releases
- Develop a regional volunteer network consisting of residents of all watershed counties
- Engage at least 3 related organizations in the volunteer monitoring process
- Establish a trained and committed network of volunteers to conduct an annual monitoring program beyond the scope of the proposed project.
- Train 10 team leaders to assist in monitoring program
- Involve an additional 20 citizen volunteers for each monitoring event

- Achieve a 50% retention rate for citizen volunteers
- Receive favorable evaluations regarding the educational value of the volunteer monitoring events

Sampling Locations

Thornapple River Watershed, Eaton, Ionia, Barry, Kent and Allegan Counties

Water body name: Thornapple River

Location: Eaton County

Number of sampling sites: 2

Previous monitoring efforts: DEQ 1998 and 2003 indicated fair to marginal habitat ratings and acceptable macroinvertebrate ratings, with concern over channelizing and sedimentation

Environmental description: primarily agricultural and forested acreage

Water body name: Little Thornapple River

Location: Eaton County

Number of sampling sites: 1

Previous monitoring efforts: DEQ 2003 indicated acceptable macroinvertebrate rating and marginal habitat rating

Environmental description: Forest and rangeland

Water body name: Shanty Brook

Location: Eaton County

Number of sampling sites: 1

Previous monitoring efforts: DEQ 2003 indicated acceptable macroinvertebrate rating and good habitat rating

Environmental description: Agricultural & forested acreage

Water body name: Quaker Brook

Location: Barry County

Number of sampling sites: 1

Previous monitoring efforts: DEQ 1998 indicated acceptable macroinvertebrates and good habitat ratings

Environmental description: Mix of urban and forested acreage

Water body name: Mud Creek

Location: Barry County

Number of sampling sites: 2

Previous monitoring efforts DEQ 2003 indicated low acceptable macroinvertebrates and marginal habitat due to sedimentation

Environmental description: Agricultural, forested

Water body name: High Bank Creek

Location: Barry County

Number of sampling sites: 2

Previous monitoring efforts: DEQ 1998 indicated acceptable macroinvertebrates and good habitat.

Environmental description: Urban to agricultural, forested

Water body name: Cedar Creek

Location: Barry County

Number of sampling sites: 1

Previous monitoring efforts: DEQ 1998 indicated acceptable macroinvertebrates and good habitat.

Environmental description: Agricultural, rural residential

Water body name: Fall Creek

Location: Barry County

Number of sampling sites: 2

Previous monitoring efforts: DEQ 1998 indicated excellent macroinvertebrate rating and excellent habitat rating in agricultural area.

Environmental description: Agricultural, forested to urban in Hastings City Center

Water body name: Sand Creek
Location: Barry County
Number of sampling sites: 3
Previous monitoring efforts: no
Environmental description: Agricultural, urban, forested

Water body name: Glass Creek
Location: Barry County
Number of sampling sites: 1
Previous monitoring efforts: DEQ 1998 – Excellent macroinvertebrates, good habitat
Environmental description: Agricultural and forested

Water body name: Hill Creek
Location: Barry County
Number of sampling sites: 1
Previous monitoring efforts: DEQ 2003 rated habitat as marginal, no macroinvertebrate rating
Environmental description: Forested, rangeland and agricultural land

Water body name: Bassett Creek
Location: Barry County
Number of sampling sites: 1
Previous monitoring efforts: DEQ 1998 rated macroinvertebrates as excellent, habitat as good.
Environmental description: Wetlands, agricultural, forested

Water body name: Duncan Creek
Location: Barry County
Number of sampling sites: 2
Previous monitoring efforts: DEQ 2003 indicates upstream is acceptable macroinvertebrate rating and excellent habitat, downstream is marginal habitat with no macro rating.
Environmental description: Agricultural and forested

Water body name: Unnamed tributary of Thornapple River at Thornapple River Drive
Location: Kent County
Number of sampling sites: 1
Previous monitoring efforts: DEQ 2003 indicates acceptable macroinvertebrates and good habitat
Environmental description: urban, rangeland and forest

Water body name: Unnamed tributary to the Thornapple River at Tricklewood Drive
Location: Kent County
Number of sampling sites: 1
Previous monitoring efforts: DEQ 2003 found macroinvertebrates acceptable and habitat good, but indicated bank scour and possible airport runoff.
Environmental description: Urban, agricultural

In previous DEQ monitoring, many of these sites show declining habitat or macroinvertebrate ratings. Additional monitoring at different sites along the streams will help to pinpoint sources of pollutants causing decline. Besides declining sites, sites along the four coldwater streams of Bassett, Glass and Cedar Creeks and Quaker Brook will also be monitored to determine trends and provide indications of changes in water quality. Other factors used to select these sites include Thornapple River Watershed Steering Committee tables of areas of concern based on citizen reports and related project data. As the included map indicates, these locations will give a broad sample of water quality issues within the watershed.

Task List

Tasks and Sub-tasks	% of Time	Responsible Party
Task 1 – Project Administration: Implement project tasks and meet granting agency requirements	15%	J. Barnard
1.1 Complete and submit QAPP within 60 days of activating grant and 60 days prior to initial sampling event.		
1.2 Attend 1-day MiCorps training session in Fall, 2006		
1.3 Develop and submit quarterly status and financial reports		
1.4 Develop and submit final report following MiCorps guidance and project completion		
1.5 Submit a release of claims statement at project completion		
1.6 Provide products and deliverables in hard copy and electronic format		
1.7 Submit data to MiCorps Data Exchange Network on semi-annual basis		
Task 2 – Public Awareness & Involvement:	10%	J. Barnard
2.1 Recruit team leaders		
2.2 Recruit citizen volunteers		
2.3 Develop press releases & ads to publicize monitoring events		
2.4 Develop press releases and fact sheets to publicize water quality issues and monitoring results		
Task 3 – Volunteer Training	8%	L. Phalen & Volunteers
Connect team leaders with training opportunities through MiCorps or MSU Extension		
Provide refresher training for repeat team leaders		
Conduct citizen volunteer mini-training and wrap-up at monitoring events		
Develop volunteer evaluation instrument		
Task 4 – Macroinvertebrate Data Collection	40%	Steering Committee & Volunteers
4.1 Identify and map stream access points for monitoring		
4.2 Conduct monitoring events		
4.3 Report data on monitoring forms		
4.4 Properly label and store samples for identification sessions		
Task 5 - Conduct macroinvertebrate identification sessions following monitoring events	7%	L. Phalen & Staff
5.1 Conduct sorting and identification session following QAPP protocols		
5.2 Report data on monitoring forms		
5.3 Have identifications checked by Scientific Advisor		
5.3 Label and store samples following QAPP protocols		
Task 6 – Conduct road-stream crossing surveys	8%	H. Norton
Task 7 – Data collation and distribution	7%	H. Norton
7.1 Obtain access to data entry option for MiCorps database		
7.2 Review and enter data		
7.3 Check data using quality control procedures		
Task 8 – Evaluation	5%	
8.1 Conduct evaluation sessions based on goals, work plan		Steering Committee

and timetable progress		
8.2 Distribute and collect evaluation instruments from volunteers following monitoring sessions		Team Leaders
8.3 Discuss monitoring event evaluation at team leaders' macroinvertebrate identification session		J. Barnard
8.4 Collate and document evaluation conclusions		H. Norton
8.5 Arrange joint sampling evaluation event with MiCorps staff.		J. Barnard
8.6 Outline and disseminate evaluation recommendations for future actions		J. Barnard

A7. Data Quality Objectives

Precision: 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 macroinvertebrates 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 macroinvertebrate 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:

$$RPD = [(X_c - X_v) / (\text{mean of } X_c \text{ and } X_v)] \times 100,$$

where X_c is the composite measurement and X_v 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.

The Quality Assurance Manager will also verify all identifications made by the volunteer teams. An error rate should be calculated for each identified sample using the same statistic as above. The RPD of identifications should be less than 5%.

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 Quality Assurance Manager at the next sampling event and be considered for retraining.

Additionally, MiCorps staff will conduct a method validation review with the designated Quality Assurance Manager to ensure his or her expertise, preferably prior to the first training session held by the Quality Assurance Manager. This will be conducted with each new Quality Assurance Manager 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 Quality Assurance Manager will be considered "certified" by MiCorps.

Bias: The above examinations should serve to measure bias in the methods of the program. 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 Quality Assurance Manager.

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

Comparability: To ensure data comparability, all volunteers in the watershed will follow the same sampling and site selection methods and use the same units of reporting. 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 Administrator as soon as possible and no later than the end of the first week in the sampling window in order for the Administrator to arrange for another team to complete the monitoring. If no team is available, the Project Administrator will, if feasible, sample the site. Otherwise, the site will go unmonitored for that season.

A8. Special Training/Certifications

All staff and volunteers conducting Stream Habitat Assessments must first attend a training session held by DEQ, MiCorps or project staff, then complete a sample assessment verified by the trainer before receiving certification. Certification will be valid for three years, at which point the course and validation should be repeated.

All Macroinvertebrate Stream Monitoring team leaders will complete a macroinvertebrate stream monitoring training course modeled after that provided by MiCorps, then become certified through a sampling event by the course instructor before they lead a volunteer team. Certification will be valid for three years provided the team leader participates at least annually in a monitoring event. After three years or following a one-year lapse in participation, the course and sampling event certification should be repeated.

SECTION B: PROJECT DESIGN AND PROCEDURES

B1. Study Design and Methods

Stream Habitat Assessment: The Project Administrator will provide the trained Assessor(s) with a map of the subwatershed to be assessed, with locations and station numbers for each assessment point. One or two trained assessors will conduct the assessments on an entire subwatershed during the course of a day. If two assessors are present, they will work as a team, with one conducting measurements and taking photographs, and the other completing the visual survey. The assessment will begin at the furthest upstream point designated and proceed downstream toward the stream mouth. Prior to departing to the subwatershed, the DO/temperature meter will be calibrated following steps outlined in section B5. Other equipment will be checked for operation and against the calibration schedule, and calibrated as needed. Stream name, assessment date and time, monitoring team information and location data will be entered first. Coordinate determination will be made by GPS or by topographic map if GPS unit is unavailable. The Assessor(s) will photograph each site following the guidelines of the Watershed Survey Photo Log (Attachment 2) to complete photos of upstream, downstream, road and culvert/bridge and may include additional photos of problem areas or unusual features of the reach. The Assessor(s) will then conduct the physical habitat inventory, potential sources inventory and site summary information as represented on the Watershed Survey Data Sheet (Attachment 3) following the guidelines of the *MiCorps Volunteer Stream Monitoring Procedures* by Jo Latimore, August, 2006. The Assessors are responsible for filling out the form completely. Any problem areas, concerns or comments regarding the responses on the form or other observations should be noted in the "Comments" section. Completed inventories will be submitted to the Project Administrator within 24 hours of completion.

The Project Administrator will check each survey for completeness and sign it. All photographs will be printed and checked against the photo logs, then labeled to correspond with the appropriate Watershed Survey Data Sheet and Photo Log. A folder containing the checked original Watershed Survey Data Sheet, Photo Log and printed photos will be labeled with the station number and date and placed in the data file cabinet. Within two weeks, the data will be entered into the MiCorps database by the Office Assistant and checked by the Project Administrator. Date of data entry will be logged at the bottom of the Assessment form.

Macroinvertebrate Monitoring: The Team Leader and Streamside Assistant will verify the location and limits of the site before monitoring. At least three measurements of stream depth will be taken by the Team Leader and averaged to provide depth data. The Team Leader and Streamside Assistant will collaborate on judgments regarding stream conditions. If they are not in agreement, both viewpoints will be noted in the comment portion of the data sheet. Multiple collections (at least 3) will be taken from each habitat type present at the site, including riffle, rocks or other large objects, leaf packs, submerged vegetation or roots, and depositional areas, while wading and using a D-frame kicknet. The trained Streamside Assistant will record the number of locations sampled within the monitored reach in each habitat type. The trained Team Leader will transfer the material from the net into white pans. The volunteers (Pickers) will pick out samples of all different types of macroinvertebrates from the pans and place them into jars of 70% ethyl alcohol for later identification. During the collection, the Team Leader will provide information to the team Streamside Assistant in response to questions on the data sheet that review all habitats to be sampled and any changes in methodology or unusual observations. The Streamside Assistant 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 Team Leader and the Streamside Assistant will decide together whether a site needs to have an extended collection time or other variations in procedure. (See Stream Macroinvertebrate Data Sheet, Attachment 4.)

Following the collection, the Team Leader will be responsible for assuring that waders, nets, pans and pails are rinsed streamside to remove any debris, then re-rinsed with tap water and inspected for debris before they are packed and transported from the site. When equipment is checked in at the central location, it will be inspected for damage by the Office Assistant, laid out to dry, then checked in and returned to storage containers at the BCD office.

B2. Sample Handling and Custody

Macroinvertebrate Monitoring: At the collecting site, all invertebrate sample jars receive a label written in pencil, stating date, location, name of collector, and number of jars containing the collection from this site, which is placed inside the jar. The data sheet also states the number of jars containing the collection from this site. The team leader is responsible for labeling and securely closing the jars, and the team manager is responsible for returning all jars and all equipment. Upon return to the Program building, the collections are checked for labels, the data sheets are checked for completeness and for correct information on the number of jars containing the collection from the site, and the jars are secured together with a rubber band and site label and placed together in one box. They are stored in the central office until they are examined and counted on the day of identification (one or two weeks later). The data sheets are used on the identification day, after which they remain on file indefinitely. 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 identification, volunteers sort all individuals from a single jar into look-alike groups, and then are joined by an identification expert who confirms the sorting and provides identification of the taxa present. These identifications are then verified by the Quality Assurance Manager. When identification of a sample is complete, the entire collection is placed in a single jar of fresh alcohol with a poly-seal cap and a printed label inside the jar and stored at the Program office indefinitely. The alcohol is carefully changed in the jars every few years.

B3. Analytical Methods

Stream Habitat Assessments will be conducted at least every 5 years in the summer or fall. See Section B1 for monitoring procedures. For equipment utilized in the Stream Habitat Assessment, see B5.

Macroinvertebrate Monitoring will be conducted at least annually in either April or October. Monitoring sessions will be clustered within a two-week period during these months. Specimens will be identified to order level using the *Guide to Aquatic Invertebrates of the Upper Midwest* by R.W. Bouchard, Jr., University of Minnesota, 2004, as a reference. See Section B1 for monitoring procedures. See Section B5 for equipment used.

B4. Quality Control

Equipment Quality Control:

Checking out equipment:

- Visually inspect all equipment to assure it is in working order and all parts are present.
- Check for working batteries in each piece of powered equipment.
- Properly clean any dirty or contaminated equipment.
- Check equipment log for last use and expiration dates
- Fill out equipment logs for all equipment being taken out in field – include name, date and equipment condition.
- Calibrate any equipment on the calibration schedule.

Returning equipment:

- Check that all equipment is clean and dry. Wet or damp items should not be stored until dried thoroughly.
- Note any damage to equipment on its log and report damage to Office staff.
- Fill out equipment logs with name, return date and equipment condition.
- Have office staff verify equipment return and condition.
- Replace equipment in proper containers on proper shelves in the storage shed or locker.

Field Procedures Quality Control:

- For Watershed Survey sites, one in 12 sites will have a repeat assessment conducted every five years by separate Assessors to check data.
- In each macroinvertebrate monitoring session, one in ten sites will conduct a repeat and/or side by side monitoring by separate field crews to check data.
- At least once in every six monitoring events, the composition of the field crew in a given site must be changed to maintain objectivity and minimize bias.
- Field records will be reviewed by Project Administrator or Quality Assurance Manager before given to Office assistant for data entry.

Data Analysis Quality Control:

- All calculations should be checked twice.
- Measurements of stream flow should be provided and calculation method shown.
- Hard copies of computer entered data will be reviewed against originals by Quality Assurance Manager to assure accuracy.
- Data analysis and results will be reviewed by MiCorps staff periodically to assure accuracy.

For watershed survey assessments, which are conducted every five years, data is reviewed to determine the need for additional study. Sites with high potential source contributions, poor overall site rankings and/or high site follow-up indications will be subject to aerial photo assessment and/or additional field study to determine if actual non-point source pollution can be identified.

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

B5. Instrument/Equipment Testing, Inspection and Maintenance

Stream Habitat Assessment Equipment:

The equipment listed below will be subject to the Equipment Quality Control procedures outlined in B4. Equipment logs detailing the check out and check in procedures and inspections are included as Attachment 5. Equipment will be inspected by Team Leaders before departure to sampling locations. If equipment is not in proper working order, it must be repaired or replaced before leaving for the field. Any repairs must be indicated on the equipment log. Items not suitable for use will be tagged and sent to the BCD office for repair or replacement, not returned to the storage shed. BCD staff will be responsible for repair or replacement of deficient equipment.

Temperature and pH Meter: Hanna pHep (HI 98128) is cleaned monthly during the assessment period and before first use using Hanna's general purpose electrode cleaning solution. The unit is calibrated monthly during the assessment period using a single point method with pH 7.01 buffer solution. The unit's battery life is checked prior to the assessment trip. When equipment is returned following the assessment, it is rinsed with tap water and stored with Hanna's storage solution HI 70300 until next use. The Hanna pHep produces readings with a resolution of 0.01 pH and 0.1 C/0.1 F, with accuracy of +/-0.05 pH and +/-0.05C and +/-0.01F.

The pH meter should be turned on and checked for battery life before operating. Submerge the electrode directly in the water and swirl it in a stirring motion until the stability symbol disappears. Press the SET/HOLD button to freeze the display. Remove the electrode from the water and record the pH and temperature. Temperature should be recorded in Fahrenheit. Return to normal mode and turn the unit off. Rinse with tap water and replace protective cover.

DO Meter: YSI DO200 is calibrated each day before use by creating a 100% water saturated air environment using a sponge saturated with distilled water in the calibration bottle. The probe is inserted in the bottle with the probe membrane not touching the sponge. The unit is then turned on and allowed to run for 10-15 minutes until the dissolved oxygen and temperature readings are stabilized. When calibration is initialized, then the local pressure is inputted in mBar. Salinity (0 for distilled water) is inputted, then the unit is ready for use. Proper storage is checked each time the unit is returned to the office. Probes are cleaned and membranes replaced monthly during the monitoring season. The meter provides 0.01 mg/l or 0.1% resolution with +/-2% of reading or air saturation (whichever is greater) accuracy.

The DO Meter must be turned on and allowed to perform a self-diagnostic test before each use. The unit is ready when the temperature is displayed in the lower right of the display window. DO Meter readings are taken directly in the water by immersing the probe approximately half-way into the water's depth, then moving it in a slow circular motion until the readings are stabilized. Temperature should be recorded in Fahrenheit and dissolved oxygen in ppm. The unit should be turned off immediately following the measurement recording and returned to its storage case.

In the event that the unit is submerged in water, dry the connector immediately and replace the probe. Rinse the unit carefully with distilled water and dry. Inspect all connections and remove contaminants. Let probe and unit dry completely, then recalibrate the unit to assure accuracy. If accurate readings aren't obtained, return the unit and mark the condition as "damaged."

GPS Unit: Magellan eXplorist 100 is checked for battery life before the equipment is taken into the field. The GPS unit is initiated to the satellite positions at the first station of each assessment before a reading is

taken. All readings are recorded on the data sheet and saved in memory for verification. The GPS unit must produce an accuracy reading to +/- 30 ft. with satellite verification before location is accepted.

A GPS reading is taken from the center point of the bridge at the road stream crossing, or at either end if the accuracy reading at the center is unacceptable or traffic is prohibitive. The location of the reading should be noted in the comment section if it is not in the bridge center. The location should be noted in lat./long. to a 0.000 reading.

Macroinvertebrate Monitoring Equipment:

The equipment listed below will be subject to the Equipment Quality Control procedures outlined in B4. Equipment logs detailing the check out and check in procedures and inspections are included as Attachment 5. Equipment will be inspected by Team Leaders before departure to sampling locations. If equipment is not in proper working order, it must be repaired or replaced before leaving for the field. Any repairs must be indicated on the equipment log. Items not suitable for use will be tagged and sent to the BCD office for repair or replacement, not returned to the storage shed. BCD staff will be responsible for repair or replacement of deficient equipment.

Waders
D-nets
Kick nets
Collection jars
Collection pans
Collection buckets
Forceps
Magnifying glasses

B6. Instrument/Equipment Calibration and Frequency

See section B-5

B7. Inspection/Acceptance for Supplies and Consumables

See Thornapple River Monitoring Project Equipment Log, Attachment 5

B8. Non-direct Measurements

N/A

B9. Data Management

Data will be entered from data sheets directly into the online MiCorps database by the Office Assistant for storage within the MiCorps data exchange system. Backup copies of the electronic data will be requested from MiCorps and stored at the BCD office. Original data sheets will be stored in the office for a period of at least seven years.

SECTION C: System Assessment, Correction and Reporting

C1. System Audits and Response Actions

- Repeat assessments of Watershed Surveys will be conducted by the Quality Assurance Manager for one in 12 sites every five years. Agreement in descriptors should be 70% or greater.
- Side by side or repeat monitoring will take place on one in ten sites during each monitoring session. Sample composition agreement between volunteer samples and those conducted by the Quality Assurance Manager should be 70% or greater.
- Data sheets will incorporate essential QAPP procedures, such as the number of net samples taken from each type of habitat.
- Team Leaders or Assessors trained through the above described programs (see A8) will monitor that quality assurance protocols are followed and will report any occurrences possibly affecting data quality.
- Identifications made by volunteers will be verified by the Quality Assessment Manager. The relative percent difference should be less than 5%.
- 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 Quality Assurance Manager at the next sampling event and be considered for retraining.
- Additionally, MiCorps staff will conduct a method validation review with the designated Quality Assurance Manager to ensure his or her expertise, preferably prior to the first training session held by the Quality Assurance Manager. This will be conducted with each new Quality Assurance Manager 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 Quality Assurance Manager will be considered “certified” by MiCorps.
- A given site’s Stream Quality Index (SQI) score or total diversity (D) measure across macroinvertebrate taxa will be noted as “preliminary” until three spring sampling events and three fall sampling events have been completed. 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:
$$RPD = [(X_c - X_v) / (\text{mean of } X_c \text{ and } X_v)] \times 100$$
where X_c is the composite measurement and X_v is an individual measurement for each parameter. If time permits, samples which do not meet the less than 40% RPD will be resampled by the Quality Assurance Manager to verify or discard such unusual results. Otherwise, a gap may be left in the monitoring record.
- If deviation from the 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

Stream Habitat Assessments: Assessment data sheets and photo logs will be checked by the Project Administrator for completeness upon receipt. Any comments will be reviewed and discussed with the Assessor to assure all aspects and issues reported are clarified. Stream flow calculations will be checked

for accuracy. Photos will be processed and attached to the corresponding data sheets within one week of receipt to complete the assessment package. Once the Project Administrator has validated the assessment package, it will be entered into the database by the Office Assistant. Hard copy of the entered data will be checked against the original assessment by the Project Administrator. The original assessment package will be filed at the BCD office.

Macroinvertebrate Monitoring: Stream Macroinvertebrate Datasheets will be checked for completion and signed by the Office Assistant when they are submitted at the end of the monitoring session. Sample jars accompanying the datasheets will be checked for labels and counted before being boxed with data sheets for transportation to the BCD office. During identification sessions, sample jars will be kept with their corresponding datasheets, systematically examined, identified and recorded by a Team Leader, then combined into a single jar and labeled following verification of the identification and count by the Quality Assurance Manager. If questions arise regarding a particular identification, the Scientific Advisor will be called in to provide verification. Completion of the datasheet for the collection in question will be suspended until the Advisor's determination is made. Following the identification session, the Quality Assurance Manager will perform calculations to obtain a Stream Quality Score, with an assistant re-checking calculations. The Quality Assurance Manager will review the datasheets for acceptable levels of sampling in each habitat, then calculate the RPD for each sample to determine any outlier samples. Samples with an RPD of over 40% will be considered for repeat monitoring. If time, weather and staff permit, these locations will be resampled within the week. If not, a blank will be left in the monitoring table for these sites, and a report will be made to MiCorps regarding the circumstance. Once datasheets are completed, reviewed and validated by the Quality Assurance Manager, they will be signed and released to the Office Assistant for data entry. Any sheets representing outlier data will be labeled "Rejected" and an addendum attached explaining the reasoning. Such sheets will not be entered into the database but will be placed on file in their original form. Once data entry has been performed, hard copies of the data will be printed and compared by the Project Administrator to the original datasheets. Once electronic data has been verified, original datasheets will be stamped as "entered" with the date of data entry and filed in the BCD office. All data sheets, macroinvertebrate collections and hard copies of electronic data will be housed in the BCD office and available for review by MiCorps staff should any questions arise regarding their veracity.

Timeline for progress reporting to MiCorps:

Reporting Timeline	July- Sept. 2006	Oct.- Dec. 2006	Jan.- Mar. 2007	Apr.- Jun. 2007	Jul.- Sept. 2007	Oct.- Dec. 2007	Jan.- Mar. 2008	Apr.- Jun. 2008
1.1 Complete and submit QAPP within 60 days of activating grant and 60 days prior to initial sampling event.	↔↔↔↔↔↔							
1.2 Attend 1-day MiCorps training session in Spring, 2006	↔↔↔							
1.3 Develop and submit quarterly status and financial reports	↔↔↔	↔↔↔	↔↔↔	↔↔↔	↔↔↔	↔↔↔	↔↔↔	↔↔↔
1.4 Develop and submit final report								↔↔↔↔↔↔

following MiCorps guidance and project completion								
1.5 Submit a release of claims statement at project completion								↔↔↔
1.6 Provide products and deliverables in hard copy and electronic format								↔↔↔
1.7 Submit data to MiCorps Data Exchange Network on semi-annual basis		↔↔↔		↔↔↔		↔↔↔		↔↔↔

C3. Reconciliation with Data Quality Objectives

Macroinvertebrate Monitoring: All Team Leaders will be trained and techniques reviewed every three years. All identifications will be verified by the Quality Assurance Manager the day of the identification session (within two weeks of the sampling event). The equation for determining RPD for sampling events will be applied following the specimen identification session for each monitoring session. If corrective actions such as repeat sampling are needed, they will be carried out within one week of the data validation process. If this is not possible, then a gap may be left in the monitoring record and that occurrence reported to the MiCorps staff.

C4. Reporting

Following the data validation procedure outlined in C1, the Quality Assurance Manager will make a brief written report to the Project Administrator listing the sites that were monitored, staff and volunteers working at each site, the SQI and RPD of each site, and whether the data were accepted or rejected, with explanations as necessary. In the event that repeat monitoring is conducted, a report of the repeat monitoring, following the format outlined above, will be attached to the initial report. This report will be included in the quarterly project report prepared for the MiCorps staff.

ATTACHMENTS:

Attachment 1	Map of Proposed Watershed Survey Sites
Attachment 2	Watershed Survey Data Sheet
Attachment 3	Watershed Survey Photo Log
Attachment 4	Stream Macroinvertebrate Datasheet vers. TRW 8.31.06
Attachment 5	Thornapple River Monitoring Project Equipment Logs

