Quality Assurance Project Plan
For the
Branch County Conservation District

Coldwater River Watershed
Volunteer Stream Monitoring Program

#VSM2010-02

Version 1.0, July 2010

SECTION A: QAPP Organization and Project Description

This QAPP covers monitoring activities to assess benthic macroinvertebrate communities, in-stream habitat, and select water quality parameters, which combine to measure the ecological condition of the streams within the Coldwater River Watershed.

A1. Title and Approval Sheet *(Attached as a separate document)*

A2. Table of Contents

A3. Distribution List

The following agencies, organizations and individuals will receive copies of the approved Quality Assurance Project Plan (QAPP):

Table 1. Distribution List for Copies of the Approved Plan

Name	Agency/Organization
Kathy Worst	Branch County Conservation District (BCCD)
Bill Earl	Branch Area Careers Center
Paul Rentschler	ASTI Environmental
Paul Steen	Michigan Clean Water Corps
Ric Lawson	Michigan Clean Water Corps

A4. Project Organization

Table 2 lists key personnel with the assigned role/responsibility.

Table 2. Program Key Personnel, Involved Organization and Specific Role/Responsibility.

Key Personnel	Role(s)	Organization	Contact: email	Phone
Kathy Worst	Program Administrator, Project Coordinator	Branch County Conservation District	kathy.worst@mi.nacdnet.net	517-278-8008 ext 5
Bill Earl	Teacher & MACC NRAT Project Coordinator	Branch Area Career Center	Earlb@branch-isd.org	517-279-5721
Paul Rentschler	QAQC Manager	ASTI Environmental	prentschler@asti-env.com	810-923-5278

1. Kathy Worst

In serving as the BCCD Administrator for the past 3 years, Kathy's duties have included coordinating outreach events, school presentations, administering grants, monitoring stream stability, and coordinating volunteer storm drain inlet marking and demonstration garden planting. Kathy also served 4 years as a substitute teacher for Branch County schools and 13 in quality control. Kathy will oversee the entire program including all adult and BACC programming, storage of datasheets and bug samples, QAPP updates and grant reporting, both short and long term.

2. Bill Earl

Bill has taught Natural Resource and Agricultural Technology at the Branch Area Careers Center for 25 years. For the past 20 years, Bill has conducted student stream monitoring activities as part of the class curriculum. He has also been trained as a teacher for the Grand Valley research vessel (student lab on Lake Michigan) and has attended additional natural resource related training workshops. Mr. Earl is responsible for BACC's involvement in the program, overseeing student training and data collection.

Adult volunteers for the program will be recruited from throughout the community, but young adults (high school seniors) enrolled in the BACC NRAT program are anticipated to provide a strong nucleus from which to grow the volunteer monitoring program.

3. Paul Rentschler

Paul Rentschler, aquatic ecologist with ASTI Environmental, will serve as an advisor to the program, assisting with training and collection activities, providing QAQC reviews of the macroinvertebrate identification conducted by volunteers and comparing each collection's data against our QAQC targets (precision, completeness, etc.). Additionally, he will provide completed/reviewed/corrected (as needed) data sheets back to BCCD. For the duration of ASTI's contract, Paul, will maintain the database, enter the data into STORET, if needed and submit a copy of the updated spreadsheet/database to BCCD following each collection/identification. (After which BCCD will re-evaluate its oversight needs and negotiate accordingly.)

A5. Problem Definition/Background

The Coldwater River Watershed (Appendix A, Watershed Monitoring Plan) contains some of Branch County's most valuable natural resources and inland waterways. Yet, Tallahassee Creek is listed in MDEQ's Integrated Report as impaired due to substrate alteration. Other areas exhibit high bacteria, nitrate, and phosphorus concentrations, sedimentation, and unstable stream channels.

These have been documented through observation or short term sampling, but no long term records of water and habitat quality exist for watershed streams.

The Branch County Conservation District (BCCD) has developed an MDEQ approved Watershed Management Plan (WMP) for the Hodunk-Messenger Chain of Lakes Watershed under a CWA Section 319 Watershed Planning Grant. The Hodunk-Messenger Chain of Lakes Watershed is the downstream sub-watershed of the Coldwater River Watershed. Watershed Management Planning for the upper sub-watershed was conducted in 1996.

This monitoring program will be coordinated with the Coldwater River Watershed Implementation Project (CRWIP) if funded. The BCCD's CRWIP will utilize the collected data to further prioritize and target areas for BMP implementation and to track BMP efficacy and progress in improved water quality.

Project Goals and Objectives
The primary goals of a volunteer monitoring program in the Coldwater River Watershed are to:

(1) Document the extent and locations of possible threats and impairments in the watershed
(2) Establish a baseline for quantifying changes
(3) Foster a stewardship ethics among watershed residents.

The health of the Coldwater River watershed is a vital concern to all watershed stakeholders and partner organizations. Each works to protect and restore it. Volunteer Stream Monitoring Program results will serve to inform the community and leverage further efforts to protect the watershed.

The Branch Area Careers Center (BACC) Natural Resource and Agricultural Technology (NRAT) Program has long trained young adults to study macroinvertebrates and water quality as preparation for careers in natural resource management and farming, but has not maintained records of the data collected. This project will be incorporated into the NRAT curriculum, providing useful training and in-the-field experience, and will develop a database for record retention and trend analysis.

Some specific intermediate objectives:

1. Train all volunteers in collection and identification techniques to provide reliable data.
2. Inform the public of the intended activities and opportunities to become involved.
3. Convey the results to the community and other interested parties.
4. Monitor land development in the watershed to evaluate possible impacts and adjust monitoring site locations, if necessary.
5. Contribute monitoring data to MiCorps database.

A6. Project Description - Overview

The goal of the volunteer stream monitoring program is to collect precise, accurate and representative data to use in collaboration with the MiCorps Program and provide public education regarding local water quality conditions. Specifically, volunteers will learn proper sampling techniques, how to use macroinvertebrate as indicators of water quality, information regarding existing watershed conditions and the principle causes of impairment. This monitoring project will also provide an opportunity for the public to ask questions related to the watershed and educate the public on efforts by local municipalities to enhance the water quality of the Hodunk-Messenger Chain of Lakes and the Coldwater River Watershed. Additionally, this program is intended to establish a long-term monitoring program to track progress in water quality.

Initially, ten (10) sites are to be monitored within the Hodunk-Messenger Chain of Lakes watershed, a subwatershed of the Coldwater River, to document the extent and locations of possible threats and impairments in the watershed, establish a baseline for quantifying changes, and foster a stewardship ethic among watershed residents. Results from the proposed study will serve to inform the community and leverage further efforts to protect the watershed.

<u>MiCorps Program</u>
This program is a cooperative effort with the Michigan Clean Water Corps (MiCorps) Program currently established in Michigan. MiCorps is a network of volunteer monitoring programs in Michigan. It was created through an executive order by Governor Jennifer M. Granholm to assist the MDEQ in collecting and sharing water quality data for use in water resources management and protection programs.

The MiCorps approved Coldwater River Watershed Volunteer Monitoring Program will provide education for the Program Team Leader and MiCorps certification for the Quality Assurance Manager. Data results will be distributed to the appropriate MiCorps representative.

Volunteer Monitoring Program Tasks

Initial monitoring in the Hodunk-Messenger Chain of Lakes Subwatershed is scheduled to begin in October 2010. An alternative date will also be established in the event that rain or other conditions cause postponement of the event. Volunteers will be urged to sign-up in advance of the event in order to provide sufficient time for the Program Team Leader to assign Team Leaders and other roles. Subsequent years target is to collect samples in April and September.

A7. Data Quality Objectives for Measurement Data (MiCorps Methods)

The Coldwater River Watershed Volunteer Monitoring Program strives to collect and analyze, to the best of our ability, data that meet the seven data quality objectives (DQOs) listed below. Methods to analyze DQOs will be used during the data collection and review process. Work being conducted outside of a certified laboratory and results obtained from a certified laboratory will be verified by appointed team leaders to meet DQOs. The DQOs for this program include:

- Precision
- Accuracy
- Analytical Sensitivity
- Bias
- Completeness
- Representativeness
- Comparability

Precision

The evaluation of how consistently a program produces results. Along with bias, precision measures how close the measurements are to the true value of results. Measures of precision and bias are critical to assuring that a program's data are credible and reflect actual conditions.

The following will be reviewed every three years to evaluate the *precision* DQO:

- Sample collection style (must be thorough and vigorous)
- Habitat diversity (must include all habitats present and be thorough in each one)
- 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, the goal for quality assurance will be conservative. A 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 30%. This statistic will be measured using the following formula:

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

Where Xc is the composite measurement and Xv is an individual measurement for each parameter.

Note that this evaluation requires that all stream data records must include the personnel of the monitoring team and the number of each type of habitat sampled. A project quality assurance check will be designed by the Quality Assurance Manager to help verify identifications made by the volunteer teams during macroinvertebrate identification. A system using a random sampling method will be used for checking data. An error rate will 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. For more information on Quality Assurance Manager certification, please see Section A8 of this report.

Analytical precision for water quality samples will be assessed by collection and analysis of a minimum of one field duplicate sample per parameter. The number of duplicates will equal or exceed 10% of the number of sites sampled/samples collected during each monitoring event. The DQO for field duplicate data of laboratory chemical data and for data generated by field instruments will be a relative percent difference (RPD) of ≤ 20%, calculated as follows:

$$RPD = [(X_1 – X_2) / (\text{mean of } X_1 \text{ and } X_2)] \times 100$$

where X_1 is the analyte concentration in replicate 1, and X_2 is the analyte concentration in replicate 2.

The DQO for field duplicate data for *E. coli* data will be is calculated as follows:

$$RPD = (\log X_1 – \log X_2)$$

where X_1 and X_2 are the bacteria counts in CFU/100 mL, as above. The DQO for bacteria replicate RPDs is less than $3.27\ \Sigma R_{log}/n$, where R_{log} is the difference in the natural log of replicates for the first or most recent set of 15 duplicate samples.

Accuracy

Accuracy of laboratory chemical analyses will be assessed by analysis of matrix spikes, laboratory duplicate samples, and other laboratory control samples, at a frequency stated in the MDEQ's laboratory standard operating procedures.

Accuracy of the data generated by field instruments will be assured by carefully following the instrument manufacturer's maintenance and calibration procedures.

Analytical Sensitivity

Sensitivity is assessed by comparing the detection limits of the field and laboratory analyses to the objectives of the study (described in Section A5). These limits (described in Standard Operating Procedures for Water Quality Sampling page 11 and Table 3 page 15) have been reviewed and judged to be adequate for the purposes of this study.

Bias

Bias is a measure of systematic error. Bias can be introduced by the methods used in all sampling events or by individual samplers or teams. The above examinations should serve to measure bias in the methods of the program. Procedures must be in place to detect bias in sampling teams.

Sites will be sampled by different team leaders at least once every three years in each season (two events among six sampling events, assuming the program continues and is 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 30%. Sites not meeting this DQO will be evaluated as above by the Quality Assurance Manager.

Completeness

Completeness is a measure of the proportion of data obtained that is judged to be valid. Completeness combines the results from all teams to give the manager a measurement of how the program is functioning overall. Not all data generated in a study is automatically acceptable for use in addressing the objectives of the study since data may fail QA reviews.

Following a QA review of all collected and analyzed data (macroinvertebrate and water quality samples), data completeness will be assessed by dividing the number of measurements judged valid by the number of total measurements performed. The DQO for completeness for each parameter for each sampling event is 90%. If the program does not meet this standard, the Project Coordinator will consult with MiCorps and MDEQ staff to determine the main causes of data invalidation and develop a course of action to improve the completeness of future sampling events.

Representativeness

This refers to the degree to which the measured data reflect the true conditions in the environment being studied. Since this cannot usually be measured directly, a qualitative discussion of the site selection and sampling methodologies should be presented. The site selection methodology should include a rationale that directly addresses the goals of the program and does not lead toward

conclusions being drawn beyond the scope of the data collected. Generally, sampling sites should be located at or above stream junctions and then move upstream to segment the watershed into increasingly smaller contributing basins or better pinpoint a problem source. The sampling methodology should indicate that all representative habitats will be sampled and documented.

Study sites are selected to represent the full variety of stream habitat types available, 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.

Representativeness of water quality analytical data is an expression of the extent to which measurement data accurately represent actual field conditions. This is addressed by the sampling survey design (primarily the number and location of samples, sampling frequency, duration of the study) described in Section B1, and by carefully following the appropriate sample collection, handling and analysis procedures.

Comparability

Comparability is a measure of the confidence with which one data set or method can be compared to another. At the core of this measure is the degree to which sampling methods are identical across all sampling events. The primary goal is for the data on all parts of a given watershed to be comparable, despite being measured by different people at different times.

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

Comparability of water quality data generated by this study to that of other studies will be assured by carefully following standard sample collection and analysis techniques and by documentation of the flow and weather conditions associated with each sampling event.

Direction and Options for Invalid Data

Data that does not meet the DQOs listed above will be labeled as outlier data and kept on file. The data will not be distributed or used for in watershed documents, scientific documents or state documents.

Habitat Assessment

Although habitats assessments do include quantitative measures, many of the habitat assessment metrics are qualitative and subjective in nature. As such, methods to measure quality assurance for habitat assessment data are limited. To ensure the highest quality data possible, all volunteers conducting habitat assessments will receive 3 hours of classroom and in-field training prior to assessing habitat. Training will involve site visits to sites exhibiting different types and quality of in-stream and riparian habitat in order to help “calibrate” volunteer assessments.

All data will be reviewed by the Quality Assurance Manager, who will follow-up with volunteers if data appear out of the ordinary. The Quality Assurance Manager will review data in the context of drawings and site photographs provided by the volunteers.

A8. Special Training/Certifications

The Project Administrator/Coordinator, the BACC Program Co-Leader, and the Quality Assurance Manager have all attended MiCorps Training Workshops to learn MiCorps standard operating procedures.

MiCorps Certification

The Quality Assurance Manager and Project Coordinator will be evaluated after the training and certified by a MiCorps representative. The MiCorps representative will conduct a method validation review consisting of a joint sampling event, with MiCorps staff jointly collecting, sorting and identifying the macroinvertebrates with the Project Coordinator (s) and Quality

Assurance Manager. Any monitoring issues will be addressed on site. If no major concerns remain, the Quality Assurance Manager and Project Coordinator will be considered "certified" by MiCorps.

Specialized MiCorps Training

The Quality Assurance Manager and the Project Coordinator will assign Project Team Leaders upon the close of the volunteer sign-up. These volunteers will be selected based on commitment to represent a group and preferably have prior sample collection experience. The number of Project Team Leaders solely depends on the number of volunteers that sign-up for this event. The Project Team Leader training will be provided by a certified Quality Assurance Manger. Specialized training includes:

- Operating water quality meters to collect dissolved oxygen, pH, temperature and conductivity data
- Collecting grab samples for analysis of *E.* coli and total suspended solids (TSS)
- Properly labeling sample bottles and completing chain of custody forms
- Operating flow rate equipment and collecting flow data
- Using a turbidimeter for turbidity sampling
- Stream crossing observation techniques using MDEQ Stream Crossing Evaluation forms

Training for Macroinvertebrate Monitoring

Selected volunteers will act as leaders of the benthic macroinvertebrate monitoring teams or the instream habitat assessment. Program staff will initially serve as Team Leaders with volunteer Team Leaders being selected following training and repeated monitoring experience. Training will include monitoring methodology, proper field data entry, monitoring procedures, stream safety and an introduction to benthic macroinvertebrates. Each benthic team will consist of two (2) trained collectors and a minimum of 1 person sorting and picking through the samples. All team members will be trained in the proper methods for data recording.

Only collectors will enter the water. They are responsible for collecting water quality samples and meter readings, if any, and collecting macroinvertebrates from all of the habitats. Collector training occurs primarily in the creek to allow volunteers to learn and practice the methods of collecting samples from all habitat types. Training sessions will be offered approximately two weeks prior to the spring and fall collections. All volunteers will receive a quick review of methods and expectations prior to collecting.

Team Leaders instruct the team and are responsible for filling out the data sheets, labeling the jars, helping people learn about the study and how to pick the macroinvertebrates and reminding collectors to cover all available habitats.

Contact information for all volunteers will be kept in an Excel spreadsheet, along with the date they received training and the dates they participated in macroinvertebrate collections. Each volunteer is required to be re-trained every three (3) years.

Training for Habitat Study

Team Leaders assessing habitat quality attend a 3-hour training session. At the Habitat Training volunteers learn how to "read a river" by examining characteristics of the stream such as the stream banks, measuring the stream widths and depths, and recording the type of material (such as sand and gravel) located along 10 transects on the stream bottom. Volunteers also learn how to make a simple map of the locations of various features, such as pools and riffles that are important homes for aquatic animals. Training includes both classroom instruction and in-field site visits so that volunteers may try and practice the methods.

Personnel and documentation

The Project Coordinator and Quality Assurance Manager are responsible for leading the training sessions for volunteers from the general public. MACC NRAT Project Coordinators responsible for training BACC student volunteers. Records of training and monitoring experience will be retained as described above.

SECTION B: Measurement/Data Acquisition

B1. Study Design and Methods

Sampling Locations/Study Design

The BCCD has developed a Watershed Monitoring Plan (Appendix A) identifying a total of 26 potential sampling locations on streams within the Hodunk-Messenger Chain of Lakes Subwatershed, including 3 locations on connecting channels between the lakes. Of these, 10 sites have been identified as primary sampling locations. The Coldwater River Watershed Volunteer Monitoring Program

will begin by sampling these primary locations, with the potential to expand the monitoring network as resources allow and program participation grows.

Sampling stations were selected based on existing MDEQ/MDNRE data, known problems, and by analysis of the drainage area and differences in local land use/land cover. Site evaluations will be conducted by program staff prior to sampling to ensure each location is suitable and safe. Some locations may be changed to provide safe and comparable sampling conditions.

Monitoring Task Schedule

Initial Volunteer Monitoring Program Timeline:

1. Side-by-Side MiCorps Training/QAQC Assessment	August 25, 2010
2. Volunteer Recruitment	August – September 2010
3. Macroinvertebrate Collection Training Workshop	September 25, 2010
4. Macroinvertebrate Collection	October 2, 2010
5. Macroinvertebrate Identification	October 6, 2010
6. Subsequent Training & Collection Dates	April & September

Macroinvertebrate Collections

Samples will be collected at the 10 primary locations during volunteer monitoring sampling events. Samples will be collected from all habitat types at the sample site, including riffles, rocks or other large objects, leaf packs, submerged vegetation or roots, depositional areas, etc. Macroinvertebrate samples will be collected using standard (0.3-meter frame width) D-frame dip nets with 500-mm mesh, transferred to white sorting trays and picked in the field. Most teams should contain three to six members depending upon the site data collection requirements. This will be predetermined by the Project Coordinator, Quality Assurance Manager, Team Leader and/or the MACC NRAT Project Coordinator ahead of the sampling date. At a minimum, each benthic team will consist of two (2) trained collectors and a minimum of 1 person sorting and picking through the samples. All team members will be trained in the proper methods for data recording.

Only collectors will enter the water. They are responsible for collecting water quality samples and meter readings, if any, and collecting macroinvertebrates from all of the habitats. One person designated as a runner may be used to transport samples on the shore from the Collectors to the Picker(s). In-stream sampling will be conducted for a period of 30 minutes. The Team Leader will assign duties to any additional trained volunteer's onsite including site/habitat assessments, mapping, photographing, or other items required for the individual site. The team Leader will assure any data sheets or paper work is properly filled out on site. (Please see data sheets in Appendix B). Macroinvertebrates found in the sorting trays will be collected and preserved in 70-95% Ethyl alcohol solution, labeled, and delivered to program leaders for storage at the BACC storage shed, confirmation that they are appropriately labeled and subsequent identification.

Macroinvertebrate Identification

Organisms will be identified at a later date in a laboratory or classroom setting. Separate sessions will be conducted to train volunteers in methods for sorting, then identifying macroinvertebrates. Taxonomic identification will be to the family level following Hilsenhoff (1995), and Bouchard (2004). Macroinvertebrate scores will be assigned for each station based upon both the macroinvertebrate metrics described in the MDEQ/MDNRE's Procedure 51 and MiCorps macroinvertebrate identification assessment worksheets.

Other Water Quality Parameters

Secondary samples may be collected during the Volunteer Stream Monitoring Program at each designated site as volunteer turnout and other resources permit. This determination will be made prior to sampling in order to prepare the equipment for the program. Secondary samples may include, but will not be limited to:

- Dissolved Oxygen
- Flow Rate (stream velocity)
- *E.* coli
- Suspended sediment concentration
- Temperature
- pH
- Conductivity

Standard Operating Procedures for Water Quality Sampling

ASTI Standard Operating Procedures for Surface Water Sampling, Water Quality Sampling and Macroinvertebrate Sampling will be used in addition to procedures and reference procedures listed in this document. When measurements of physical water quality parameters are recorded or samples are collected for chemical analysis, samples will be collected after the macroinvertebrate collection is complete. Samples will be collected upstream of the area sampled for macroinvertebrates to avoid disturbed sediment from entering the sample.

Water quality parameters (dissolved oxygen, temperature, pH, and conductivity) will be measured using an YSI Multi-parameter hand held meter. The probe of the meter will be placed directly in the current of the channel toward the center of the water column. Each parameter is required to remain stable for at least 30 seconds prior to recording the data. Stability for each parameter is to be determined according to the following limits:

Temperature	$\pm 0.15^{o}$ C
Dissolved Oxygen	±0.1 mg/L
pH	±0.1 std. units
Specific conductance	±10mS/cm

The YSI meter will be calibrated prior to use according to the YSI Operation Manual (Appendix C). Dissolved oxygen, temperature, pH and conductivity readings will be recorded in field data forms (Appendix B). Copies of ASTI Standard Operating Procedures can be found in Appendix D.

Water Quality Sample Analysis

The water quality samples collected during the Volunteer Stream Monitoring Program will be recorded on field data sheets (Appendix B). Water quality results will be compared to data collected previously from the same sites and between sites. Additionally, for reporting purposes, dissolved oxygen, temperature and pH data results will be compared to MDEQ Part 4 Water Quality Standards.

Standard Operating Procedures for Suspended Sediment and *E. coli*

Water samples may be collected for laboratory analysis; specifically, suspended sediment concentration (SSC) or total suspended solids (TSS) and *E.* coli. Volunteers will use the appropriate sample container and collect grab samples from the middle of the water column in the center of the channel. In order to avoid flushing preservative from the sample bottles, a water dipper or dedicated sampling jar may be used to collect water prior to filling sample bottles. If such a device is used, proper decontamination methods are required between sample stations. Decontamination is to be conducted following ASTI Standard Operating Procedure for Sampling Equipment Decontamination (Appendix D). In some cases, SSC samples will also be collected outside of the Volunteer Monitoring Program in order to capture wet weather events.

SSC and *E. coli* Sample Analysis

Wet weather suspended sediment concentrations will be compared to the <80 µg/l TSS target described in the 1965 European Inland Fisheries Advisory Commission's *Water Quality Criteria for European Freshwater Fish*. Total suspended solids (TSS) concentrations are generally lower than SSC concentrations for the same samples (Gray, J.R., et al. [USGS], 2000). *E. coli* results will be compared to MDEQ Part 4 Water Quality Standards.

Standard Operating Procedures for Stream Flow Measurements

Prior to stream flow data collection, Team Leaders will be trained how to operate the wading rod and flow meters. One ASTI field representative will assist with stream flow data collection to insure proper methods are being used.

For flow velocity data collection, stream cross-sections will be used that exhibit certain criteria. These criteria include:

- A straight reach with the threads of velocity parallel to each other.
- A stable streambed free of large rocks, weeds, and protruding obstructions such as piers or root wads, which would create turbulence or eddies.
- A flat streambed profile to eliminate vertical components of velocity.

If sampling locations do not contain sections that exhibit all of these conditions, the cross-section should be selected to best satisfy these criteria.

After the cross section has been selected, a measuring tape should be strung across the stream channel at right angles to the direction of flow. Sampling personnel should determine the width of the stream from the measuring tape and determine the number and spacing of verticals (partial sections) at which depth, distance, and velocity are to be measured. Volunteers will record depth, tape distance, and velocity for 25 to 30 partial sections. A minimum of 20 partial sections shall be the target for most streams/rivers. It may be difficult to measure this many partial sections in very narrow channels. The guiding quality assurance objective for stream flow measurement shall be to ensure that no partial section represents/contains more than 5 percent of the total discharge. As such, the width of partial sections should be reduced in areas of the channel that exhibit shallower depths and/or greater velocities.

Measuring Current Velocities

Prior to each sampling event, each current meter shall be inspected to ensure that all parts are sufficiently lubricated, and free of rust or debris. A spin-test shall be performed prior to each sampling event. A spin test is conducted by causing the buckets to spin and timing how long they spin freely. This should be conducted in an area free of air currents and with the current meter held steady on a flat surface or plane. Field personnel shall undertake equipment maintenance or adjustments, as necessary, to ensure that the bucket-wheel of the AA meter spins freely for 2 minutes or more and that the Mini meter spins freely for 30 seconds or more.

Volunteers will anchor the measuring tape on both stream banks and record the tape distance directly over the edge of water on the side of the channel where measurements begin (preferably the end of the tape closest to zero). Measured stream depth and stream velocity will determine the method of velocity measurement and the current meter to be used.

The 0.6-depth method (described below) is to be employed for streams/verticals less than 2.5 feet in depth. The two-point method (described below) is used for deeper streams or deeper verticals within a stream cross-section. Rating limits of the two current meters are provided below:

Meter Type	Rating Limits
Price AA	0.25 ft/s to 8 ft/s 0.076 m/s to 2.4 m/s
Mini	0.25 ft/s to 3 ft/s 0.077 m/s to 1 m/s

The Mini meter should be used when velocities are less than 2.5 feet per second (fps). The Type AA meter may be used in depths as shallow as 0.5 foot, but its use is not recommended below depths of 1.0 foot because the registration of the meter is affected by its proximity to the water surface and to the streambed. If a Type AA meter is being used in a cross section with an average depth greater than 1.5 feet, it is neither necessary nor desirable to change to the Mini meter for a few depths less than 1.5 feet or vice versa. Neither the Type AA meter nor the Mini meter should be used to measure velocities less than 0.25 fps unless absolutely necessary.

Volunteers shall determine the appropriate method for each partial section vertical, compute the setting-depth for the meter, and record the meter position relative to depth from the water surface (i.e., 0.8, 0.6, or 0.2). After the meter is placed at the proper depth, it should be permitted to become adjusted to the current before the measurement of velocity begins. The time required for such adjustment is usually only a few seconds if the velocities are greater than 1 fps, but a longer period of adjustment is needed for lower velocities. After the meter has become adjusted to the current, the number of revolutions made by the bucket-wheel over a period of 40-70 seconds is recorded. Measurements should encompass 3 or more rotations *and* 40 seconds or more.

The number of rotations may be recorded by counting audible clicks marking the rotation of the current meter “buckets,” using headphones connected to the wading rod. A stopwatch should be used to measure the duration of time. The stopwatch should be started simultaneously when a click is heard on the headphones. The first signal or click should be counted as "zero," not "one." Volunteers will record both the number of revolutions and the time interval. It is imperative that the current meter that is being used (i.e., Type AA or Mini) be recorded on the flow data sheets (Appendix B) when either of these methods is used, so that the proper formula can be employed to determine velocity.

Alternatively, volunteers may attach the digimeter to the wading rod. The digimeter is a digital interface attached to the wading rod that converts revolutions per unit of time to measurements of velocity. Sampling personnel must check to make sure that the digimeter is set for the appropriate current meter and the appropriate "cat whisker" within the contact chamber, and that either metric or English units are used consistently and are recorded in the field book. Mode I on the digimeter automatically determines when the minimums of 3 revolutions and 40 seconds are met.

If the velocity is to be observed at more than one depth in the vertical, volunteers should determine the meter setting for the additional observation, time the revolutions, and record the data. Volunteers then shall move to each of the partial section verticals in the channel cross-section and repeat this procedure. At each partial section, volunteers will record the distance from the initial point, the depth of the channel at that point, the meter-position depth, the number of revolutions, and the time interval, until the entire cross section has been traversed.

Volunteers should stand in a position that least affects the velocity of the water passing the current meter, downstream and in a manner that produces minimal disturbance to flow. Stream flow velocity sampling should take place facing upstream and not concurrent with macroinvertebrate sample collection, grab sampling or during water quality sampling. Holding the wading rod at the measuring tape, the hydrographer should stand 18 inches or more from the wading rod (arm's length is preferable). The meter should be placed ahead of and upstream from the hydrographer's feet. Volunteers should avoid standing in the water if their feet and legs would occupy a considerable percentage of the cross section of a narrow stream. The wading rod must be kept vertical and the current meter parallel to the direction of flow with the bucket-wheel facing upstream while measuring velocity.

For discharge measurements of flows too small to measure with a current meter a volumetric method, Parshall flume, or weir plate may be used.

Six-tenths-depth Method:
In the 0.6-depth method, an observation of velocity made at 0.6 of the depth below the surface is used as the mean velocity in the vertical. Actual observation and mathematical theory has shown that the 0.6-depth method gives reliable results and is to be used under the following conditions:

- Whenever the depth is between 0.3 foot and 2.5 feet.
- When large amounts of slush ice or debris make it impossible to observe the velocity accurately at the 0.2 depth, thus preventing use of the two-point method.
- When the stage in a stream is changing rapidly and a measurement must be made quickly.

Use of the top-setting wading rod helps automatically calculate 0.6-depth. Water depth is recorded by comparison to the gradations on the wading rod staff. Each gradation equals 0.1-foot. One-half foot marks are indicated by two closely spaced lines and 1-foot intervals are denoted with three closely spaced lines. This depth is then "set" at the top of the rod by matching the numeral on the moveable part of the rod against the gradations on the non-moving portion of the road (e.g., a water depth of 1.55 feet is set by placing the numeral 1 on the moveable, thin section of the staff exactly opposite the gradation halfway between the 5 and 6 and the immobile portion of the rod).

Two-point Method:
In the two-point method of measuring; velocity observations are made in each vertical at 0.2 and 0.8 of the depth below the surface. The average of these two observations is taken as the mean velocity in the vertical. The two-point method is to be used when water depths exceed 2.5 feet.

The top-setting rod can also make placing the current meter at the proper depth easier for the two-point method. Setting the top-of-rod reading at 2x the depth places the current meter at 0.8-depth from the water surface. Setting the top-of-rod reading at 1/2x the depth places the current meter at 0.2-depth from the water surface.

Decontamination
Proper training of decontamination methods will be given to volunteers and Project Team Leaders prior to sampling. Decontamination is required when re-usable equipment such as the YSI meter, kick nets, flow equipment, 5-gallon buckets, sorting pans etc. are used. Decontamination is to be conducted following ASTI Standard Operating Procedure for Sampling Equipment Decontamination (Appendix D).

Sample Handling and Custody Requirements

All macroinvertebrate whirly packs or jars and grab samples will be properly labeled with a permanent marker and include the sample date, time, location, initials of collector, the number of packs or bottles site and analysis needed. Team Leaders will be in charge of organizing the samples and checking for proper labeling. The Quality Assurance Manger will be in charge of organizing all the samples collected throughout the day and checking each data sheet and jar for labeling consistency. The macroinvertebrate samples will be permanently preserved in ethyl alcohol for the duration of the project.

E. coli and TSS grab samples will be kept on ice and delivered to a contract laboratory or picked up by laboratory staff to insure safe delivery. Each sample set will be accompanied by a chain of custody record. The chain of custody record will be filled out by the Team Leader at the end of the sampling day.

Analytical Methods

Laboratory analytical methods will be used to analyze results for secondary samples (*E.* coli and TSS) only. Table 3 indicates the proposed EPA Method used, detection limit, sample volumes, bottle type, preservative and hold time for water sample collection of *E*. coli and Total Suspended Solids (TSS).

Table 3. Proposed sampling parameters, EPA methods for Analytical Results, Detection Limits, Bottle Type, Preservative and Hold Times for TSS and *E. coli* Samples.

Parameter	EPA Method	Detection Limit	Bottle Type	Preservative	Hold Time
SCC/TSS	ASTM D3977-97 Test Method B	10 mg/L	250 ml HDPE	None	7 days
E. coli	SM9213-D	1 CFU/100ml	100 ml sterile container	Sodium thiosulfate	8 hours

Quality Control

Prior to sampling, all equipment will be inspected and checked to insure proper working condition. All reusable equipment will be decontaminated prior to use in the field. All calibration solutions will be checked for expiration dates and equipment will be calibrated prior to field use.

The Quality Assurance Manager will review field records and insure bottles are labeled properly. The Quality Assurance Manager will also be sure that sampling methods are being performed adequately.

During the project duration, it will not be assumed that one single sample is representative of that location. Rather, we consider macroinvertebrate results reliable after repeated collections at the same location spanning at least three years. The results will be compared to other studies at the same locations within the watershed that have been sampled the same way. Additionally, field checks will be included in the program by the Quality Assurance Manager. The Quality Assurance Manager will conduct an evaluation during sample identification to insure each volunteer is identifying using the same techniques and is accurately identifying.

If secondary water quality samples are collected, quality control samples will be taken to insure proper laboratory procedures. A duplicate sample(s) for each parameter will be taken concurrently with the designated samples for at least one site during each monitoring event. The number of duplicate samples collected will equal or exceed 10% of the number of sites sampled. Duplicate samples will be used to evaluate compliance with DQOs.

B2. Instrument/Equipment Testing, Inspection and Maintenance

Each Team Leader will be provided the necessary equipment such as kick nets, sorting pans, gloves, sample jars or whirly bags, spray bottles, ethyl alcohol and distilled water. Routine inspection of equipment will be performed by the Project Coordinator. Back-up equipment, if needed, will be provided by the Project Coordinator. Equipment testing will be performed on all equipment prior to use and calibration and testing will be performed on secondary sampling devices such as the YSI water quality meter.

B3. Instrument Calibration and Frequency

Equipment will be calibrated according to the Manufacturer's Operational Manual provided with the equipment. Meters will be calibrated prior to use and checked and re-calibrated, if necessary, once per day. Calibration records and a calibration field data form will be used when calibrating equipment and kept on file with all other program records.

B4. Inspection/Acceptance for Supplies and Consumables

Supplies and equipment needed for the Adopt-A-Stream Program include:

- Kick nets
- Whirly packs or sample jars
- Latex and nitrile gloves
- Sorting pans
- Spray bottles
- Sample bottles (provided by an approved laboratory)
- Coolers
- YSI meters
- Turbidimeters
- 70% -95% Ethyl alcohol
- Distilled water
- Alconox detergent
- Waders
- Sieve buckets
- Permanent markers (sharpies)
- Clip boards
- Wading rod and flow meter

(See Cabala's and Bio Quip for supplies sources.)

The amount of equipment needed will be dependent upon volunteer turnout. Due to the nature of equipment cost, wading rods, flow meters, YSI meters and turbidimeters may be shared from group to group. The Project Coordinator may appoint a volunteer to take charge of the equipment and transport the equipment from site to site.

B5. Non-direct Measurements

Not Applicable

B6. Data Management

Data collected from each site will be transferred onto field data forms. At the end of the sampling event, each Team Leader is responsible for delivery of the data to the Quality Assurance Manager. Each Team Leader will review the data sheets and bottle labels before the groups depart. The data from the field sampling event will be given to the Quality Assurance Manager for review and entered into a database and saved electronically. Microsoft Word and Microsoft Excel will be used for data entry. The data will be used in the final report submitted to MiCorps and entered into the Michigan Data Exchange annually. The Quality Assurance Manager will save all hard copies and electronic copies on site. Computer data is also backed up three times per week through the Federal, USDA backup system on tape. One tape per week is permanently stored offsite at a local bank. Additionally, ASTI will maintain a digital data base throughout the course of the initial grant, which is backed up nightly.

SECTION C: Data Validation and Reporting

C1. System Audits and Response Actions

Assisted and side-by-side sampling will take place with Program staff, volunteers, and Team Leaders. Team Leaders will monitor that quality assurance protocols are followed.

For macroinvertebrate sampling results, total diversity reported by each group must equal at least 70% of the diversity previously found at the site (for second year program only). Sites with results less than 70% will be re-sampled by the Project Coordinator and Quality Assurance Manager to verify or discard such unusual results, which could be the result of poor sampling. If the sampling event is the first of the volunteer monitoring program, background data should be used as comparative data; however, no percentage requirement for diversity is proposed.

Corrective Actions

If deviation from the Quality Assurance Project Plan (QAPP) is observed at any point during sampling, sample identification or data entry, the data may 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. All corrective actions will be documented and communicated to MiCorps.

C2. Data Review, Verification and Validation

The Quality Assurance Manager will review all data from the field data forms before the data is entered into spreadsheets. The data will be compared to well-known reference standards (as noted earlier in this report). Any abnormal data or data far from the reported standard will be reviewed, rejected or accepted by the Quality Assurance Manager. For macroinvertebrate identification, a skilled aquatic biologist or entomologist will be used to spot check the samples. Based on the results of the review, data may be deleted, accepted or thoroughly investigated.

C3. Reconciliation with Data Quality Objectives

The Quality Assurance Manager will review data forms from the Team Leaders the number and identifications of macroinvertebrates collected from each location, and data entry. The Quality Assurance Manager will evaluate the sampling stating whether or not DQOs were met during sampling. The Quality Assurance Manager will evaluate the macroinvertebrate identification procedure and report whether or not DQOs were met. If DQOs were not met, improvements for next years sampling event will be incorporated into the program and the data will not be reported to MiCorps.

C4. Reporting

The final report will be completed by the Quality Assurance Manager and will include the program overview, results compared to background data and quality control results. The report will be distributed to the appropriate MiCorps representative and to members on the QAPP Distribution List. Data will also at a minimum, be submitted annually to the MiCorps data exchange. Additionally, data will be submitted to the MDEQ for entry into the EPA STORET database. Electronic copies of all macrinvertebrate, habitat, and water quality data will be submitted utilizing the STORET data submission templates available on the MDEQ NPS Unit website.