A2. Table of Contents

A3. Distribution List

Tamara Lipsey, EGLE, Water Resources Division
Paul Steen, Huron River Watershed Council, MiCorps VSMP Manager
Marcella Domka, Tip of the Mitt Watershed Council

A4. Project Organization

Management Responsibilities –

A. Marcella Domka, Water Resources Manager
   - Update QAPP every two years and adhere to the Quality Assurance Project Plan.
   - Oversee volunteer stream monitoring activities.

B. Eli Baker, Education Manager
   - Promote Watershed Academy (WA) stream monitoring activities, solicit volunteers, and seek stream access permissions from local community.
   - Research and purchase necessary equipment for performing WA stream monitoring activities.
   - Coordinate and conduct WA stream monitoring training sessions.
   - Coordinate WA stream monitoring field data collection sessions.
   - Coordinate and implement macroinvertebrate sorting and identification sessions.

C. Anna Watson, Water Resources Specialist
   - Promote volunteer stream monitoring activities and solicit volunteers and stream access permissions from local community.
   - Research and purchase necessary equipment for performing stream monitoring activities.
   - Coordinate and conduct volunteer stream monitoring training sessions.
   - Coordinate volunteer stream monitoring field data collection sessions.
   - Coordinate and implement macroinvertebrate indoor sorting and identification sessions.
   - Database development, data entry, and data analysis.

- Write reports and update website with latest information on an annual basis to share with volunteers and the general public.
- Provision of products and deliverables to MiCorps. All data collected will be sent electronically to the MiCorps database manager on an annual basis.
- Project evaluation.
- Catalog and store collected specimens.

Field Responsibilities –

Field sampling will be performed by volunteers. Team leaders and collectors will receive training in field data collection methods by Tip of the Mitt Watershed Council staff.

D. Leaders will organize and coordinate stream monitoring efforts by individual teams. In the field, leaders will complete data sheets, collect water samples, measure stream water temperature, take depth measurements, and communicate with the collector to ensure thorough biological sampling of the site. In addition, leaders will provide instruction and guidance to team pickers. After field days, leaders will be responsible for returning equipment, biological samples, water samples and data sheets to Watershed Council staff.
E. Collectors will sample all in-stream habitats that exist at the site and provide sample contents to pickers for processing.
F. Pickers will pick macroinvertebrate specimens from sample contents provided by the Collector, pre-sort the macroinvertebrates, and preserve up to 100 specimens per site in alcohol for later identification.

Laboratory Responsibilities – Anna Watson, Monitoring Coordinator, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181, awatson@watershedcouncil.org will be responsible for calibrating and maintaining the Watershed Council YSI Kor EXO I Probe, which will be used to measure conductivity.

Corrective Action – Marcella Domka, Water Resources Manager, Tip of the Mitt Watershed Council, 426 Bay St., Petoskey, MI, (231) 347-1181, mdomka@watershedcouncil.org, will be responsible for initiating, developing, approving, implementing, and reporting corrective actions.

A5. Problem Definition/Background

According to U.S. Census Bureau statistics, the number of inhabitants in the northern counties of Michigan's Lower Peninsula more than doubled between the years 1970 and 2020. Population pressure is expected to increase at even greater rates, resulting in urban area expansion and consequent negative impacts on surface water quality. Water quality data from various Watershed Council monitoring initiatives has revealed water quality impacts from invasive species and nonpoint source pollution throughout Antrim, Charlevoix, Cheboygan, and Emmet Counties.

Although volunteers have monitored lake water quality in the northern Lower Peninsula for several decades, streams had been largely neglected until 2005. A growing number of lake associations expressed interest in monitoring stream water quality to determine the effects of tributaries draining into their lakes, which prompted the Watershed Council to establish the Tip of the Mitt Watershed Council Volunteer Stream Monitoring (VSM) program. In 2005, volunteers began monitoring streams to collect baseline water quality data, determine the current health of the streams, and begin monitoring changes that may result from human influence.

Originally, three watersheds were targeted, but the program has expanded to include about 70 sites on 30 different stream systems over the years. Some of these sites include ones monitored by students participating in the Watershed Council's Watershed Academy. The Watershed Academy was developed in 2015 in response to requests to engage school-aged volunteers within the Watershed Council's service area. The Watershed Academy is a stream monitoring program that allows high school students to learn about and monitor a stream in their community. The students are trained to monitor the stream using the same protocols as the Watershed Council's Volunteer Stream Monitoring Program and the data collected by Watershed Academy teams can be utilized in the same manner as other stream quality data. Fourteen streams are monitored by the participating schools each spring and fall.

Three of the Watershed Council's monitoring sites have known populations of the federally and state-endangered Hungerford's crawling water beetle (*Brychius hungerfordi*). The sites are the Black River at Barber Bridge, the Boyne River at Thumb Lake Rd., and Mullett Creek at Straits Highway (M-27). While the presence of the beetle was known at the Black River and Boyne River prior to Watershed Council stream efforts, Water Council volunteers were responsible for collecting the beetle in Mullet Creek in May 2009. This was not discovered until Watershed Council staff and volunteers inspected collections with *Haliplidae* in 2020, following an accidental collection of the beetle by volunteers at the Black River/Barber Bridge. The beetle was added to the List of Endangered and Threatened Wildlife and Plants on April 6, 1994. Its populations are very small and are located in a few isolated locations in Michigan and Ontario, Canada. Interestingly, beaver dams may be part of the beetle's habitat.

However, stream dredging, channelization, bank stabilization, and impoundments may harm the beetle's habitat, along with the removal of beaver dams.

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

Results from the program are summarized and presented in annual reports that are sent to Watershed Council members, lake/stream associations, local governments, and other organizations/agencies. Problem areas discovered by volunteer monitoring efforts are investigated collaboratively with local, state, federal and Tribal aquatic resource professionals. Results are also used to describe effects of best management practices related to nonpoint source pollution such as the installation of greenbelts and improvements in road/stream crossings.

A6. Project Description

The goal of the Tip of the Mitt Watershed Council Volunteer Stream Monitoring program is to protect and improve the water quality of the streams of the northern Lower Peninsula of Michigan. Specific objectives of the program include: collect baseline data, characterize stream ecosystems, identify specific water quality problems, determine water quality trends, evaluate best management practices, and inform and educate the public regarding water quality issues and aquatic ecology.

The key to accomplishing the stated goals is fostering stewardship of aquatic resources through community involvement and education. As more people become involved in monitoring activities and receive water quality education, particularly concerning information regarding the health of local streams, the more likely they are to take care of their streams and become involved in community decision-making that could impact water quality. The information gleaned from monitoring activities, such as water quality trends, is shared with and utilized by local governments and citizens for educational and resource management purposes.

This monitoring program focuses on biological monitoring as a tool to assess stream water quality and ecosystem integrity. Aquatic macroinvertebrates are collected and identified to determine diversity in the benthic community and the presence of pollution-sensitive macroinvertebrate families. These results are then utilized to gauge

the health of the stream in question. In addition to biological monitoring, volunteers collect water samples to measure conductivity, which is a good indicator of impacts to the stream ecosystem caused by urban and agricultural activity within a watershed. Volunteers also record stream water temperature to note variation within a stream system, identify areas that suffer from thermal pollution, and detect changes over time.

The service area for the Tip of the Mitt Watershed Council includes the counties of Antrim, Charlevoix, Cheboygan, and Emmet as well as portions of major watersheds within these four counties that extend into adjacent counties. Based upon input from local residents, lake/stream associations, and findings from Watershed Council monitoring, streams from five major watersheds are included in the monitoring program.

A7. Data Quality Objectives

Precision/Accuracy: Streams monitored in this program are assessed by examining aquatic macroinvertebrate community diversity. Quality control during field data collection, to guarantee precision and accuracy, is accomplished by the Program Manager or other trained staff who accompany teams to observe their collection techniques and note any divergence from protocols. The Program Manager also performs independent side-by-side collection (duplicate sample) at one of the two sites monitored by the volunteer team. New volunteers and sites where it may be difficult to collect (e.g. poor habitat, deep water, etc.) will be prioritized for side-by-side sampling. The Program Manager alternates between teams during each sampling event. Considering the number of teams now included in the program, quality control for field data collection is carried out approximately once every five years for each team. As the program expands, the Program Manager or other trained staff accompanies new teams during their first macroinvertebrate sampling event and collects duplicate samples.

For sites with known Hungerford's crawling water beetles, staff with permits from the USFWS and MDNR must be present during macroinvertebrate collection (Appendix A). Techniques reviewed in the field include [1] collecting style (must be thorough and vigorous), [2] habitat diversity (must include all habitats and be thorough in each one), [3] picking style (must pick thoroughly through all materials collected and pick all sizes and types) [4] variety and quantity of organisms (must ensure that diversity and abundance at site is represented in sample), and [5] the transfer of collected macroinvertebrates from the net to the sample jars (specimens must be properly handled and jars correctly labeled). Side-by-side sampling results (by program manager) are compared with volunteer team results to determine if there is a strong divergence between diversity measures. If diversity scores vary strongly (using an 80% threshold), then follow-up is carried out wherein program manager reviews methods with team members and encourages attendance at future training sessions.

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

A given site's total diversity (# of families) will be compared to the composite (median) results from the past three years and should be within two standard deviations of the median. 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 and resampled if within a two-week time frame from the original sample. Volunteer teams that generate more than one outlier should be observed by the Program Expert at the next sampling event and be considered for an upcoming side-by-side.

If no sampling error can be determined and the site has a diversity less than two standard deviations from the median, the site will be resampled by the Program Manager to double-check the diversity numbers and to look for any signs of habitat and water quality degradation.

Regarding physical water quality data collection, accuracy and precision are accounted for by following procedures similar to those established for macroinvertebrate data. The Program Manager accompanying the team measures the stream's conductivity and water temperature at the site using a YSI Kor EXO I Probe (calibrated via procedure outlined in the manual prior to sampling event). Results by teams are compared to expert results. Conductivity measurements between team and expert should not vary by more than 50 microSiemens and temperature should not vary by more than 2 degrees Celsius. If results are outside limits of comparability, data collection techniques will be reviewed with leader. Furthermore, measuring equipment will be calibrated and checked to ensure that it is functioning correctly as detailed in section B5 of this plan. This protocol will help determine the source of error if unacceptable disparity in readings occurs again.

Completeness: Following a QA/QC review of all collected and analyzed data, data completeness will be assessed by dividing the number of measurements judged valid by the number of total measurements performed. The data quality objective for completeness for each parameter for each sampling event is 95%. If the program does not meet this standard, the Program Manager will consult with MiCorps staff to determine the main causes of data invalidation and develop a course of action to improve the completeness of future sampling events.

Representativeness: Study sites for the program are selected following the methodology described in section B1. As indicated, all available habitats are sampled and documented to assure that the site is representative of other stream segments in the subwatershed. Resulting data from the monitoring program are used to summarize the biological conditions of the contributing subwatershed, as an initial screening mechanism. Since there are not enough resources available to allow the program to cover the entire watershed, some subwatersheds may not initially be represented. Additional subwatershed sites are added as resources and volunteers allow.

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

A8. Special Training/Certifications

The Program Manager coordinates trainings and ensures that all program personnel and volunteers are properly trained. Trainings can include Volunteer Stream Monitoring Grantee Training or a combination of education and experience.

Volunteer team Leaders and Collectors are trained by the Program Manager in basic stream monitoring methods prior to field day collections. The training covers program goals and objectives, biological and physical data collection methods, filling out field data sheets, safety issues, and quality assurance practices. A database is maintained by Tip of the Mitt Watershed Council that lists all volunteers that have received training as well as the date of the training. Leaders and Collectors, as well as other volunteers, are encouraged to attend a training at least every three years to refresh their knowledge of program components and to learn about any changes incorporated into the program. Training refreshers are also accomplished through side-by-side monitoring with the Program Manager.

Macroinvertebrate collection at streams with known Hungerford's Crawling Water Beetles must have someone with a USFWS Federal Fish and Wildlife Recovery Permit in attendance. Below is a list of local people with permits:

Eli Baker, Tip of the Mitt Watershed Council
Lauren Dey, Tip of the Mitt Watershed Council
Josh Leisen, Huron Pines
Bert Ebbers, Great Lakes Ecosystems
Bob van de Koppel, retired University of Michigan Biological Station professor

A9. Documentation and Records

All data, including information recorded on field datasheets, conductivity measurements, and aquatic macroinvertebrate data are entered into and managed in Microsoft Excel workbooks. Paper datasheets are scanned in as electronic files, and then are filed and stored at the TOMWC office. Electronic data are stored on a server and backed up daily, with rotating back-up media stored off premises. Computer passwords provide data security. Data will be stored indefinitely at the Watershed Council office. Raw datasheets are kept for a minimum of ten years.

B1. Study Design (Experimental Design) & Methods

Monitoring Sites

Monitoring sites were chosen to assess water quality in areas of concerns and to monitor longitudinal variation in stream systems. Watershed Council staff visited potential monitoring sites on target streams and assessed the sites in terms of habitat diversity present, accessibility, safety, and likelihood of impairment. Watershed Academy sites are often located close to schools for short travel times. Sites that are on private property, unsafe, or flooded are not monitored or retired on a case-by-case basis. A map of sites can be found in Appendix B and a list of sites and information about each can be found in Appendix C.

Methods

Volunteers monitor stream water quality by collecting physical and biological data two times per year, during the months of May and September (Table 2). Physical monitoring includes water temperature and conductivity (Appendix D). Biological monitoring consists of collecting a representative sample of the benthic community (Appendix E).

Water temperature is measured by volunteers using hand-held thermometers to note longitudinal variations in the stream system and impacts on the macroinvertebrate community. Temperature data provide valuable insight into stream systems that contain impoundments and help gauge thermal impacts from streams that flow through urban areas. Water samples collected by volunteers are used to measure conductivity. Conductivity measurements have been demonstrated to be a good surrogate indicator of human activity in a watershed and are therefore pertinent for streams that flow through or near urban areas.

Table 1. *Annual events schedule for Volunteer Stream Monitoring program.*

Event	Date	Participants
Fall Training	August (4th week)	Leaders, Collectors, Pickers
Fall Field Window	September 15-30	Leaders, Collectors, Pickers
Fall Indoor ID	October--December	Experts
Spring Training	May (1^{st}-2^{nd} week)	Leaders, Collectors, Pickers
Spring Field Day	May 15-31	Leaders, Collectors, Pickers
Spring Indoor ID	June-August	Experts

Table 2. *Annual events schedule for Watershed Academy program.*

Event	Date	Participants
Fall Training	September (2nd to 4th week)	Leaders, Students
Fall Field Day	October (1st to 3rd week)	Leaders, Students
Fall Indoor ID	October (4th week)	Experts
Spring Training	April (2nd to 4th week)	Leaders, Students
Spring Field Day	May (1st to 3rd week)	Leaders, Students
Spring Indoor ID	June-August	Experts

The biological evaluation of stream water quality consists of a complete sample of the different groups present rather than a random sub-sample because it is based upon community diversity. We do not assume that a single collection represents all the diversity in the community, but rather, we consider our results reliable only after repeated collections spanning at least three years. During field data collection efforts, volunteers attempt to collect specimens from the benthic community from all habitats present at the site. Macroinvertebrates collected from the benthic community are identified to the family level and tallied to calculate diversity indices. Diversity scores are used to rate the health of the stream ecosystem and provide a basis for trend analyses. Results from this program are compared with other data sets available through EGLE and other agencies/organizations for the site in question and compared with locations in the same river system included in this program.

B2. Study Methods

The Watershed Council will contact existing volunteers and promote the recruitment of additional volunteers approximately one month prior to each sampling event. For each sampling event, monitoring by volunteers will be completed within the same two-week period each year. If a site is temporarily inaccessible, due to factors such as prolonged high water, the monitoring time may be extended for two additional weeks. If the issue concerning inaccessibility is continued beyond the extended dates, then monitoring data will be collected during that time and the change will be noted in quality control report. If a team is unable to monitor their site during the specified time, the Team Leader will contact the Project Manager as soon as possible, and no later than the end of the first week in the sampling window, in order for the Manager to arrange for another team to complete the monitoring. If no team is available, the Project Manager will be responsible to see that the site is monitored unless sufficient redundancy has been included in the monitoring schedule that additional data is not needed.

Team leaders will be given a binder with directions and history about their site, datasheets (Appendix F), and procedural information about monitoring.

B3. Sample Handling and Custody

At the sample site, volunteers write relevant information on a label, including stream name, location, date, and number of containers used to collect specimens, which is placed inside every container used at the site. The field datasheet includes a section to record the number of containers used at the site. Containers used for collecting water samples have the stream name and site location written with indelible marker on label tape that is affixed to the container. The team leader is responsible for putting labels in containers, securely closing the containers, and returning all containers and equipment to the Program Manager. Upon delivery to the Program Manager, all containers are checked for labels. All containers from an individual site are secured together with a rubber band and placed together in a bag that includes a site label. In addition, datasheets are checked for completeness and to verify that the correct number of containers from the sample site is indicated on the data sheet.

Samples are stored in the Watershed Council office until the expert ID session. Conductivity is measured for water samples within a calendar year. Team leaders turn field datasheets into the Program Manager, information is entered into a database, and then, datasheets are scanned and electronic and hard copies are filed and stored at the Watershed Council office for a minimum of 10 years.

During subsequent "expert-only" identification sessions, experts work on one site at a time, identifying all organisms from that site, before packing specimens in a container for long-term storage. All specimens from an individual site are stored in glass containers with Polyseal lining to ensure safe, long-term storage. Labels made of Rite-in-the-Rain paper are inserted into containers to provide relevant information, such as stream name, sample site location, and date collected. The containers are checked periodically for ethanol content and refilled as necessary. In the event that the container or lid is found to be faulty, all contents and label are transferred to a new container that is filled with 90% ethanol. Preserved samples are securely stored for a minimum of five years at the Tip of the Mitt Watershed Council office for future reference.

B4. Analytical Methods

Aquatic macroinvertebrates collected by volunteers during sampling events are identified to the family level or lowest taxonomic level possible. Although reference literature for taxonomic identification is dependent upon the preference of the expert, copies of *Aquatic Insects of North America* by R. W. Merritt and K. W. Cummins, *Aquatic Insects of Wisconsin* by W. L. Hilsenhoff, and *Guide to Aquatic Invertebrates of the Upper Midwest* by R.W. Bouchard, Jr. are available during indoor identification sessions. Volunteer experts record specimen identifications from an individual site on a datasheet that includes a list of aquatic macroinvertebrate order and family names most commonly found in Northern Michigan streams (Appendix G). Stereo microscopes with up to 65x magnification are also available during indoor identification sessions to aid the experts. If unable to process all samples during

the identification sessions, Tip of the Mitt Watershed Council staff will complete the identification process.

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

Annual stream monitoring reports will include an average score (spring and fall data) for each site and stream alongside the site and stream's historical average score, which includes all Watershed Council data for that site and stream.

B5. Quality Control

Equipment Quality Control

1. YSI EXO I Handheld unit must be checked and charged if necessary before each event.
2. Calibration solution standards must be checked to ensure that they are not expired and that there is sufficient volume to perform calibrations.
3. YSI Kor EXO I must be calibrated before each field event according to the standard calibration procedures from the user manual, using a two-point calibration with standard solutions. If either piece of equipment will not calibrate correctly or if experiencing any other technical problems, the unit must be sent into company for service. If the either piece of equipment is not ready for use during the sampling event, the Watershed Council will use a backup YSI Conductivity Meter (separate from the YSI Kor EXO I) that has been calibrated according to specifications. Equipment and calibration solutions will be securely stored in the laboratory of the Watershed Council office.
4. Thermometers must be inspected physically for damage prior to use. In addition, thermometers will be checked to verify that they are functioning correctly, by emersion into both boiling and ice water. If the thermometer is damaged or not working correctly, it will be disposed of properly and replaced with a new unit.
5. D-frame nets must be inspected for damage and repaired or replaced as necessary.
6. Containers for water sample collection must be checked for damage and cleanliness and cleaned or replaced as necessary.
7. All equipment must be cleaned, dried and stored securely after sampling events.

Field Procedures Quality Control:

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

Indoor Sorting and Identification Quality Control

1. All containers with macroinvertebrate specimens must be checked by a program manager upon receipt from the volunteer team to assure that they contain labels and are secured together with a rubber band and site label, and placed together in one bag.
2. Field datasheets used by volunteers must be checked for completeness and to verify that the correct number of containers from the sample site is indicated on the form.
3. Prior to identification, datasheets and containers must be checked to ensure that all containers, and only containers from that collection, are present prior to emptying them into a white pan for sorting.
4. During the indoor session, if any specimens are separated from the pan during sorting and identification, a site label must accompany them.
5. All samples must be checked and verified by a qualified expert.
6. Following identification, all specimens from the sample site in question must be stored in 90% ethanol in an air-tight container and a label included in the container that includes all relevant information (e.g., stream name, sample site location, and sample event date.).

Data Analysis Quality Control

1. Field datasheets must be reviewed for errors upon receipt by a program manager to minimize errors before entry into a database and subsequent analysis.
2. Calculations for diversity indices must be verified by a program manager to minimize errors before entry into a database and subsequent analysis.
3. Data entered into the computer must be reviewed by comparing hard copy print-outs of database with field data sheets.
4. Data analysis methods must be reviewed on a five -year basis by qualified professionals.

A quality control check list was developed for use by project managers (Appendix H).

B6. Instrument/Equipment Testing, Inspection, and Maintenance

D-frame nets are inspected before each sampling event to ensure that they are intact. If the nets have come loose from the frame, they are fixed, and if holes or tears are found in the netting, nets are replaced prior to use. Containers for collecting water samples are also be inspected before each event and cleaned or replaced as necessary.

The YSI Kor EXO I Probe is calibrated prior to use and calibration records are kept in the Watershed Council's lab. If service is needed, the Watershed Council will work with the companies of origin.

Thermometers are inspected physically for damage and compared to other thermometers and/or the YSI Kor EXO I Probe to verify that they are functioning correctly, prior to the sampling event. If equipment has been damaged or is malfunctioning, replacement thermometers are purchased by the Tip of the Mitt Watershed Council.

Decontamination

The following decontamination methods will be employed to prevent the spread of aquatic invasive species (below). In particular, efforts will be made to prevent the spread of New Zealand mudsnail which has been found in the Watershed Council's service area (Shanty Creek in Antrim County). The New Zealand mudsnail is of special interest because it is often spread via waders, which are used frequently in stream monitoring. The New Zealand mudsnail can also survive drying for longer periods compared to other invasive species.

Watershed Academy
A field day for Watershed Academy involves going to one stream site at one stream or river. Watershed Council staff is always present. Waders and gear will be sprayed with Formula 409 when returned to the office. When possible, they will dry for 5 days before reusing. The Watershed Council has many sets of waders and will make an effort to use different sets of waders from site-to-site.

Volunteer Stream Monitoring
A field day for volunteer stream monitoring sometimes involves more than one site and sometimes more than one stream (but always in the same watershed). In between sites, volunteers will spray down all waders and gear with a Formula 409 and let soak for 10 minutes. Waders and gear will be rinsed with clean water (stream water may be used, but must be done away from the stream). Waders and gear must again be sprayed with

Formula 409 when returned to the office. When possible, they will dry for 5 days before reusing.

B7. Instrument/Equipment Calibration and Frequency

Conductivity is measured in the lab using a YSI Kor EXO I Probe that is properly calibrated prior to use. In the field, a YSI Kor EXO I Probe will be used as well.

B8. Inspection/Acceptance for Supplies and Consumables

A list of monitoring supplies and consumables is available in Appendix I. Supplies will be maintained by program managers and stored at the Watershed Council office.

B9. Non-Direct Measurements

Data from the Michigan Department of Environment, Great Lakes, and Energy (EGLE) streams database may or may not be used to make comparisons between sites, with the same site, or for trend analysis. Information about stream data collected by EGLE can be found at the following website: http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728---,00.html. Data from other agencies or organizations, such as the Little Traverse Bay Band of Odawa Indians, may be used for the same purposes. All data generated outside the Tip of the Mitt Volunteer Stream Monitoring program are only used if field methods are similar and specimens have been identified to the same taxonomic level (typically the family level). Outside sources of data may also be used to quality assure data collected through the Volunteer Stream Monitoring program.

B10. Data Management

Tip of the Mitt Watershed Council staff ensure that field datasheets are turned in with collected specimens when brought in by volunteers from the field. Following the indoor session, information from both field datasheets and specimen identification datasheets is put into the Watershed Council's database. Either program managers or a single trained volunteer inputs the data into the database. All data inputs are verified with raw data from datasheets.

Once a year, all new data are exported to a compatible format and sent to MiCorps for inclusion in the MiCorps data exchange. Digital data are stored on the Watershed Council server, which is backed up daily, a copy of which is taken home each week day by a designated staff person. Hard-copy data sheets are stored at the Watershed Council office for a period of at least ten years. If the program were to be discontinued, the Watershed Council would consult with MiCorps staff regarding the fate of stored data.

C1. Assessments and Response Actions

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

If deviation from the QAPP is noted at any point in the sampling or data management process, the affected samples are flagged in the database and are not used for stream assessment or comparisons. Re-sampling is conducted if feasible, given that the deviation is noted soon after occurrence and volunteers are available. Otherwise, a gap must be left in the monitoring record and the cause noted. All corrective actions are documented and communicated to MiCorps.

C2. Reporting

Watershed Council staff will publish yearly reports to share results of the program with volunteers, lake and stream associations, and the general public. Data and reports are made available on www.watershedcouncil.org.

Quality control reports will be generated as quality control issues occur and stored on the Watershed Council's server. They will also be sent to MiCorps. Quality control reports will provide information regarding any problems or issues that are directly related to quality control of the project. These could include, but are not limited to: deviation from quality control methods outlined in this document relating to field data collection procedures, indoor identification, data input, diversity calculations and statistical analyses.

D1. Data Review, Verification, and Validation

A standardized data-collection form is used to facilitate spot-checking to ensure that forms are completely and correctly filled out. A program manager or a single trained volunteer reviews data before it is stored in a computer or file cabinet. After data has been compiled and entered into a computer file, they are verified with raw data from field and identification datasheets. Volunteer experts conduct identification with the aid of dissecting microscopes (with a maximum enlargement of 65x), consultation with dichotomous keys (*Guide to Aquatic Insects of the Upper Midwest*, Bouchard, *Aquatic Insects of Wisconsin*, Hilsenhoff and *Aquatic Insects of North America*, Merritt and Cummins), and the use of a reference collection of specimens on-hand at the Watershed Council office. Identification results from volunteer experts are confirmed by experienced aquatic entomologists.

Experts who assist in macroinvertebrate identification quality control include:

1. Eli Baker, Tip of the Mitt Watershed Council, B.A. in Elementary Education, 8 years of experience with macroinvertebrate identification
2. Lauren Dey, Tip of the Mitt Watershed Council, B.S. in Conservation Biology from Lake Superior State University, 10 years of experience with macroinvertebrate identification.
3. Kathy Germain, Volunteer, retired Biology Professor at North Central Michigan College with experience in aquatic macroinvertebrate taxonomy and related coursework.
4. Mike Winnell, M.S. from the University of Michigan, 40 years experience in aquatic macroinvertebrate identification with Freshwater Benthic Services, Inc.
5. Doug Fuller, Volunteer, retired Director of Stewardship at Little Traverse Conservancy, former Director of Monitoring and Research at Tip of the Mitt Watershed Council.

D2. Reconciliation with Data Quality Objectives

Data quality objectives are reviewed on an annual basis to ensure that objectives are met. Any data quality problems are reported to program managers and MiCorps for assessment and corrective actions. In addition, data quality issues are recorded as a separate item in the database and provided to all data users. Specific response to and reconciliation of problems that occur in data quality are outlined in section A7.

Appendix A.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

IN REPLY REFER TO:

FWS-AES/TE

LIST OF AUTHORIZED INDIVIDUALS
TE75495D-0
Caroline Keson (Principal Officer)

C.1. Individuals authorized to independently conduct activities under this permit:

The following individuals are authorized to conduct scientific research in accordance with all conditions in this permit.

- Caroline M. Keson
- Elijah (Eli) J. Baker
- Lauren M. Dey

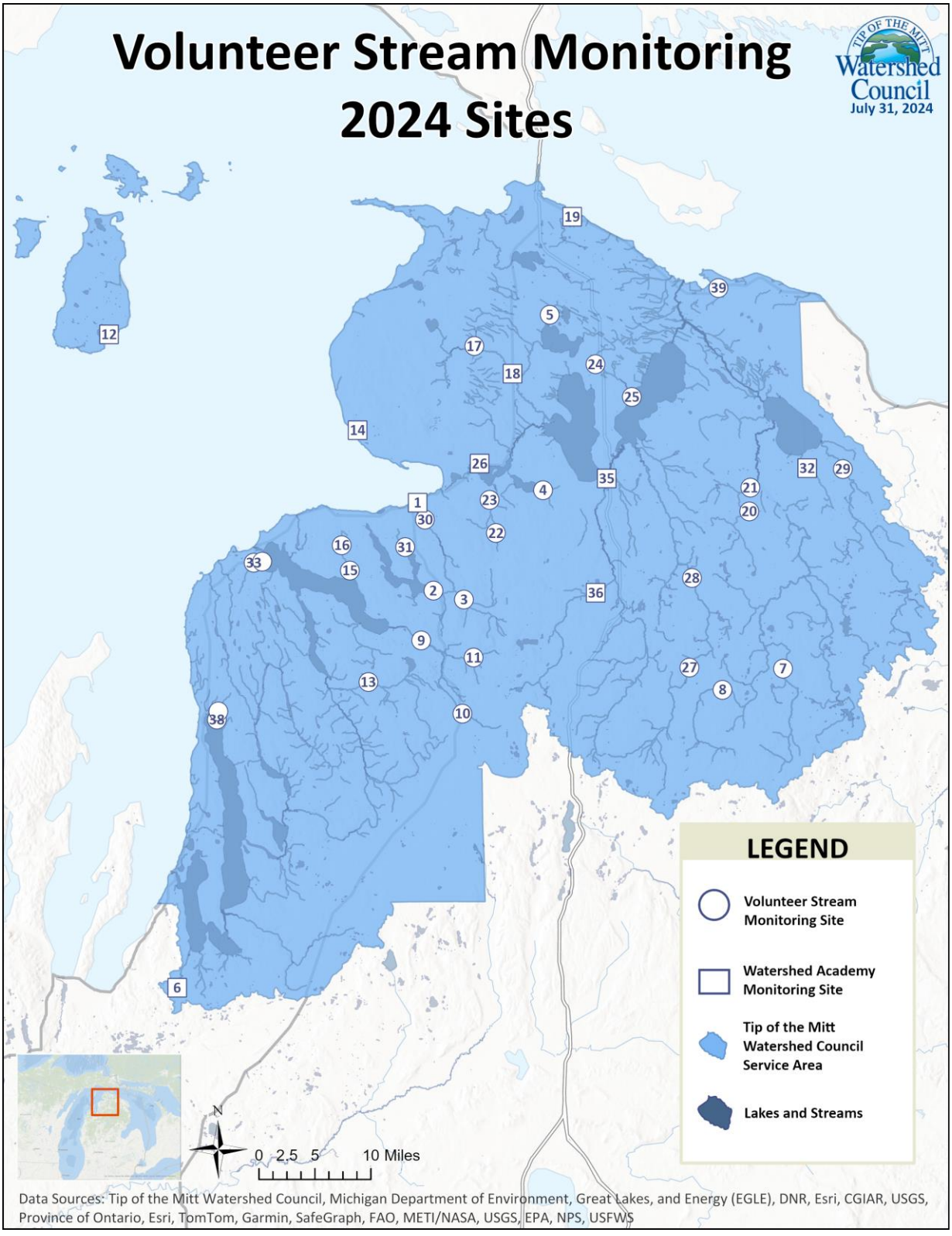
Unnamed trained assistants may conduct activities pursuant to this permit only under the direct and on-site supervision of an above-named individual. "On-site supervision" is defined as having the Permittee at a distance close enough to enable immediate assistance to a supervised individual, as needed, while the supervised individual conducts an authorized activity.

PHILIP DELPHEY Digitally signed by PHILIP DELPHEY
Date: 2021.09.14 15:08:46 -05'00'

Acting For Alisa Shull, Chief, Division of Endangered Species — Date
Region 3, U.S. Fish &Wildlife Service

This List of Authorized Individuals (LAI) is valid only when it is dated on or after the permit issuance date. Federal Permit TE 75495D-0 will be considered invalid without this LAI.

Appendix B.


Volunteer Stream Monitoring
2024 Sites
Tip of the Mitt Watershed Council
July 31, 2024
LEGEND
Volunteer Stream Monitoring Site
Watershed Academy Monitoring Site
Tip of the Mitt Watershed Council Service Area
Lakes and Streams
N
0 2.5 5 10 Miles
Data Sources: Tip of the Mitt Watershed Council, Michigan Department of Environment, Great Lakes, and Energy (EGLE), DNR, Esri, CGIAR, USGS, Province of Ontario, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, USFWS

Appendix C.

Field Physical Parameter Data Collection: Conductivity and Temperature

Each team will be provided with clean containers that will be used to collect water samples at each site. The Leader will collect water from the middle of the stream at mid-depth, rinsing container and lid three times with stream water before collecting the final water sample. Water samples will not be frozen because freezing affects conductivity readings. Instead, water will simply be placed in the bucket containing monitoring supplies and then delivered to the Watershed Council office on Indoor Sorting Day. Watershed Council staff will measure conductivity of all water samples using a YSI EXO 1s Multiparameter Sonde that has been calibrated prior to use.

A handheld thermometer will be used by the Leader to measure water temperature. The thermometer will be placed in the middle of the stream and left in the water for a minimum of ~30 seconds before reading. The Leader will record the water temperature to the nearest degree Celsius.

A separate "expert-only" session is coordinated within three months of the field data collection. At this session, volunteer experts with macroinvertebrate taxonomic identification skills identify specimens to the family level. Aquatic macroinvertebrate identifications are checked by the Program Manager as necessary. Family names and the number of specimens belonging to each family are recorded on the ID data sheet (Appendix G). Results at each site are tallied on the ID datasheet to determine index scores. Once identification is complete, all specimens collected at a site are packed into a glass jar with a poly-seal lid and a label with sample site information and sampling date is put inside the jar. If necessary, the Program Manager coordinates additional experts-only sessions to complete sample identification.

Appendix D.

Field Macroinvertebrate Data Collection

Upon arriving at the site, the team leader and the remainder of the sampling team (typically volunteers and/or Watershed Council staff) will inspect the sampling gear to ensure that it is clean. If there is debris or aquatic life on any of the equipment, water withdrawn from the stream with a clean container will be used to clean the equipment at a distance of not less than 100 feet from any water body. The Leader will instruct and assist other team members in techniques for finding and collecting macroinvertebrates in the sorting pans.

The macroinvertebrate sampling team will collect numerous samples at each site with the goal of sampling each habitat type (i.e. riffles, runs, pools, woody debris, etc.) in the stream reach. A length of 300 feet of stream habitat is sampled by volunteers and/or Watershed Council staff. The sampling team will also gather rocks, logs, sticks and other debris to collect macroinvertebrates from. Sites on small streams will be sampled for a minimum of 30 minutes while those on large streams will be sampled for at least one hour. D-frame nets will be used to sample all habitat types, the contents of the net will be emptied into shallow white trays, and the sampling team will pick aquatic organisms from the tray and sort them, typically by order, into separate ice cube tray compartments.

The team member with the greatest knowledge of aquatic macroinvertebrate taxonomy will select a variety of presorted organisms that represents the diversity found at the site and store them in 70% ethanol for later identification. Volunteer teams are encouraged to collect a minimum of 100 specimens, but an emphasis will be placed on collecting a variety of aquatic organisms as opposed to quantity. Haliplidae will not be collected at sites with known Hungerford's Crawling Water Beetle populations, due to the possibility of collecting a Hungerford's Crawling Water Beetle. Haliplidae found at the site will be noted on a datasheet.

The Leader will fill out all sections of the field datasheet. The sampling team will provide information to the team Leader in response to questions on the data sheet that review all habitats to be sampled, stream conditions, and any changes in methodology or unusual observations. Potential sources of variability in the stream reach being sampled, such as weather, stream flow, turbidity, and erosion, will be noted on the datasheet. The field data sheet will include sections to record unusual procedures or accidents, such as losing part of the collection by spilling. The Leader will draw a site sketch on the back of the field datasheet that depicts physical features in and around the stream, the locations and types of habitats sampled, where water sample was collected, and other pertinent information (Appendix F).

The Leader and sampling team will decide together whether a site needs to have an extended collection time or other variations in procedure. Before leaving the site, the sampling team will thoroughly rinse the net to ensure that no organisms are transported to the next site and the Leader will inspect the site to make sure that no equipment or refuse is left behind.

Appendix E.

Tip of the Mitt Stream Monitoring Datasheet

Stream Name: _____ **Major Watershed:**_____

Location:_____(Please circle: *Upstream* or *Downstream* of road?)

Date:_____ **Water Sample Collected** Yes No **# of Glass Jars Used:**_____

Collection Start Time:_____(AM/PM) **Collection End Time**:_____(AM/PM)

Monitoring Team {please put number of years with program in parentheses, e.g. "Mary Smith (3)"}:

Name of Person Completing Datasheet:_____

Collector(s):_____
_____

Other Team Members:_____
_____

Stream Conditions: Water temperature: _____ (°C or °F) Air Temperature:_____ (°C or °F)

Is the substrate covered with excessive silt? ____ No ____ Yes (describe: _____)

Substrate Embeddedness in Riffles: ____ 0-25% ____ 25-50% _____ > 50% ____ Unsure

Water turbidity/clarity (circle): Clear Cloudy Muddy Average
Water Depth: _____ (ft)

Distance from water surface to top of culvert, bridge, etc (put location and details on sketch): _____(ft)

Weather (today and note rain from last few days):_____

_____
_____

Macroinvertebrate Collection: Sample all habitats found at the site and check the habitats sampled in the left box. Then, estimate percentages of each type in the 300' reach (total should equal 100%).

☐ Riffles____%
☐ Runs_____%
☐ Pools_____%
These three=100%
Cobbles____%
Submerged Wood____%
Wads____%
banks____%

☐ Aquatic Plants____%
☐ Leaf Packs____%
☐ Stream Margins____%
☐ Overhanging Vegetation____%
☐ Other____%
(describe:_____)

☐ Undercut
☐ Root
☐

Did you see, but **not** collect, any **live crayfish**? (___ Yes ___ No), or **large clams**? (___ Yes ___ No)?

Other wildlife & fish? (___ Yes ___ No)
Describe:_____

_____
_____

Stream Name:_____Location:_____
_____

SITE SKETCH

Please make a sketch showing the length and shape of the stream reach that was sampled by your volunteer group. Remember to include where water sample was collected, approximate locations of habitat types (riffles, runs, pools, woody debris, etc.), approximate distances of stream length sampled and stream width, water level measurement, flow direction, and north arrow.

Other comments (were there any changes in methodology or unusual observations?):_____
_____
_____
_____
_____

Appendix F.

Quality Control Check-List: Updated 7.16.2024

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

Date: _____ Name of Program Manager: _____

Prior to sampling event:

1. Charge YSI EXO 1s Multiparameter Sonde [ ]
2. Check calibration solutions (expiration and quantity) [ ]
3. Check thermometers for damage & accuracy [ ]
4. Check nets for damage and repair/replace if necessary [ ]
5. Check water sample containers for damage & cleanliness [ ]

During sampling event:

6. Review and guide volunteer leading procedures [ ]
7. Review and guide volunteer collecting techniques [ ]
8. Review and guide volunteer picking techniques [ ]
9. Collect replicate water sample for conductivity analysis [ ]
10. Collect replicate water temperature measurements [ ]
11. Collect replicate macroinvertebrate sample [ ]

After sampling event:

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

Indoor sorting and identification:

17. Ensure all (and only) jars from site are present [ ]
18. Ensure site labels accompany and specimens removed [ ]
19. Ensure that all samples are reviewed by an expert [ ]
20. Store samples (with labels) in ethanol
21. Completely and accurately fill out Macro Expert ID sorting sheets [ ]

Data review and analysis:

22. Review field records for errors prior to data entry [ ]
23. Repeat all diversity calculations prior to data entry [ ]
24. Compare database records with hard copies [ ]

Appendix G.

Equipment

Field sampling gear includes D-frame nets, sorting trays, waders, and a bucket that contains glass jars full of ethanol and with poly-seal lids, a plastic sample bottle, a thermometer, at least three forceps, at minimum of two eye-droppers, two or more ice-cube trays, a measuring tape, spoons with netted bottoms for easy collection, a meter stick, and pencils. All equipment is stored in the Tip of the Mitt Watershed Council office basement and made available for pick-up by volunteers prior to sampling events. After field sampling, equipment is returned directly to the Watershed Council office or to staff during the indoor sorting session. Equipment is maintained by Watershed Council staff.

List of Equipment Needed:

- 2 Ounce (oz) Flint (Clear) Glass AC Jar, 38-400 (288/Case)
- 38-400 Black Phenolic (Bakelite) Bold Ribbed Cap with Polyseal (Cone) Liner
- Aquatic invasive species card packet
- Bottle, Polyethylene, Widemouthed, 500 mL
- Buckets
- Celsius Red Alcohol Thermometers, -20° to +110°C, Total Immersion,
- Yellow and white sorting trays
- Clipboards
- Ethanol, 95%, Lab Grade, 20 L
- Fiberoptic light
- Forceps
- Netted Spoons
- Regular Spoons
- Ice cube trays
- Larval tray - sorting
- McCafferty ID Books
- Measuring tape
- Medicine Dropper, Plastic, 1-mL Nipple, 3 1/2 in, Pk 12
- Meter Stick, Wood
- Pencils
- Petri dish, glass
- Petri dishes - disposable
- Rite-in-the-Rain paper
- Sorting trays
- Sorting Trays (12 well)
- Stereo microscope
- Teasing needles
- Transparent rulers
- Unitary Wash Bottle, Widemouthed, 250 mL
- Unitary Wash Bottle, Widemouthed, 500 mL
- Waders, lug sole and felt sole
- Water bottles

Appendix H.

Station ID	Name	WQ_SITE	Watershed	X_COOR	Y_COOR	Number
VSM_2	Bear River (Lake St)	WA	Little Traverse Bay	45.375	-84.9608	1
VSM_3	Bear River (Melrose Twp Park)	VSM	Little Traverse Bay	45.261	-84.934	2
VSM_67	Bear River/Springbrook Creek (Springbrook Rd)	VSM	Little Traverse Bay	45.249	-84.8779	3
VSM_4	Berry Creek (Banwell Rd)	VSM	Cheboygan	45.3888	-84.73	4
VSM_6	Bessey Creek (Ingleside Rd)	VSM	Cheboygan	45.6127	-84.7127	5
VSM_8	Bissel Creek (Moore Rd)	WA	ERCOL	44.7504	-85.4086	6
VSM_9	Black River (Barber Bridge)	VSM	Cheboygan	45.1525	-84.2964	7
VSM_11	Black River (Tin Shanty Rd)	VSM	Cheboygan	45.1267	-84.4076	8
VSM_14	Boyne River (Dam Rd)	VSM	Charlevoix	45.1967	-84.9574	9
VSM_15	Boyne River (Dobleski Rd)	VSM	Charlevoix	45.1016	-84.8837	10
VSM_17	Boyne River (Thumb Lake Rd)	VSM	Charlevoix	45.173	-84.8596	11
VSM_19	Cabel's Creek (East Side Dr)	WA	Coastal/Islands	45.5965	-85.5254	12
VSM_24	Deer Creek (Fuller Rd)	VSM	Charlevoix	45.1442	-85.0551	13
VSM_83	Elliot Creek (Seffren Rd)	VSM	Cheboygan	45.64624	-84.4007	39
VSM_28	Five Mile Creek (Five Mile Creek Nature Preserve)	WA	Little Traverse Bay	45.4693	-85.0694	14
VSM_29	Horton Creek (Boyne City Rd)	VSM	Charlevoix	45.2884	-85.0864	15
VSM_30	Horton Creek (Church Rd)	VSM	Charlevoix	45.3213	-85.1009	16
VSM_41	Maple River (Ely Bridge Rd)	VSM	Cheboygan	45.5765	-84.8529	17
VSM_41	Maple River (US31)	WA	Cheboygan	45.5401	-84.783	18
VSM_46	Mill Creek (Mill Creek Discovery Park)	WA	Coastal/Islands	45.7422	-84.668	19
VSM_47	Milligan Creek (M68)	VSM	Cheboygan	45.3604	-84.3664	20
VSM_48	Milligan Creek (Waveland Rd)	VSM	Cheboygan	45.3861	-84.3496	21
VSM_50	Minnehaha Creek (Maxwell Rd)	VSM	Cheboygan	45.3342	-84.8179	22
VSM_51	Minnehaha Creek (Pickerel Lake Rd)	VSM	Cheboygan	45.3773	-84.8287	23
VSM_52	Mullett Creek (Crump Rd)	VSM	Cheboygan	45.5505	-84.6301	24
VSM_54	Mullett Creek (M27)	VSM	Cheboygan	45.5075	-84.5641	25
VSM_56	Oden Creek (US31)	WA	Cheboygan	45.4245	-84.8458	26
VSM_58	Pigeon River (Sturgeon Valley Rd)	VSM	Cheboygan	45.1563	-84.4675	27
VSM_59	Pigeon River (Webb Rd)	VSM	Cheboygan	45.272	-84.46	28
VSM_60	Rainy River (N Allis Hwy)	VSM	Cheboygan	45.5088	-84.1792	29

VSM_61	Russian Creek (NCMC Natural Area)	VSM	Little Traverse Bay	45.353	-84.9476	30
VSM_62	Schoofs Creek (Fields Preserve)	VSM	Little Traverse Bay	45.3184	-84.9855	31
VSM_68	Stony Creek (N Allis Hwy)	WA	Cheboygan	45.4109	-84.2443	32
VSM_70	Stover Creek (Brookside Cemetary)	VSM	Charlevoix	45.2997	-85.2624	33
VSM_71	Stover Creek (Irish Boat Shop)	VSM	Charlevoix	45.3009	-85.2471	34
VSM_74	Sturgeon River (M68)	WA	Cheboygan	45.4027	-84.6128	35
VSM_73	Sturgeon River (US27 S Straights Hwy)	WA	Cheboygan	45.2552	-84.6366	36
VSM_81	Wilkinson Creek (M88)	VSM	ERCOL	45.1075	-85.3299	37
VSM_82	Wilkinson Creek (NE Torch Lake Dr)	VSM	ERCOL	45.0972	-85.3329	38
VSM_84	Little Black River (US23)	VSM	Cheboygan	45.65863	-84.4918	