2020

Water Quality Monitoring Plan
Flint and Spring Creek Watersheds, Barrington, Illinois

Final Quality Assurance Project Plan

for

Flint/Spring Creek Watersheds Partnership
Citizens for Conservation

KOT ENVIRONMENTAL CONSULTING, INC.
A Veteran Owned Small Business

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A1 Approval Sheet

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APPENDICES 52

A3 LIST OF ACRONYMS/ABBREVIATIONS

AES	Applied Ecological Services
Al	Aluminum
Ba	Barium
BMPs	Best Management Practices
BOD_5	Five Day Biochemical Oxygen Demand
C^{o}	Centigrade
Ca	Calcium
Cd	Cadmium
CFR	Code of Federal Regulations
COD	Chemical Oxygen Demand
COND	Specific Conductivity
Cu	Copper
DO	Dissolved Oxygen
E	East
e. g.	For Example
FAAA	Financial Assistance Agreement Administrator
EMT	Environmental Monitoring and Technology, Inc.
EPA	Environmental Protection Agency
F	Fluoride
F^{o}	Fahrenheit
FC/SCWP	Flint Creek/Spring Creek Watersheds Partnership
Fe	Iron
HNO_3	Nitric Acid
H_2SO_4	Sulfuric Acid
IBI	Index of Biotic Integrity
ID	Identification
i.e.	That is to say
K	Potassium
KOTECI	KOT Environmental Consulting, Inc.
L	Liter
LCS	Laboratory Control Spike
MBI	Macroinvertebrate Biotic Index
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MDL	Method Detection Limit
Mg	Magnesium
mg/L	Milligrams per Liter
µs/cm	Microsiemens per Centimeter
ml	milliliter
Mn	Manganese
MS4	Municipal Separate Storm Sewer System
N	North
N	Nitrogen
Na	Sodium
$Na_2S_2O_3$	Sodium Thiosulfate
NH_3-N	Ammonia Nitrogen

LIST OF ACRONYMS/ABBREVIATIONS (continued)

NIST	National Institute for Standards and Technology
NO_2	Nitrite
NO_3	Nitrate
NPDES	National Pollution Discharge Elimination System
NTIS	National Technical Information Service
NE	Northeast
NP	No Preservatives
ORP	Oxidation-Reduction or Redox Potential
Pb	Lead
%	Percent
pH	Value of Acidity or Alkalinity in a Media Expressed as the Negative Log (to the base 10) of the Hydrogen, H^+ or Hydronium, H_3O^+ Ion Concentration (i.e., $-\log_{10} [H^+]$)
POTW	Public Owned Treatment Works
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAP	Quality Assurance Plan
QAPP	Quality Assurance Program Plan
RL	Reporting Limit
RPD	Relative Percent Difference
RT	Route
S	South
SOP	Standard Operating Procedure
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSI	Trophic State Index
TSS	Total Suspended Solids
W	West
YSI	Yellow Springs Instruments
Zn	Zinc

A4 Distribution List

Each person listed on the approval sheet and each person listed under Project/Task Organization will receive an electronic copy of this quality assurance project plan. Individuals taking part in the project may request additional copies of the Quality Assurance Project Plan (QAPP) from the Flint Creek Watershed Partnership (FCWP) project manager as listed. The FCWP project manager will also retain the original approved QAPP containing the approval sheet with the original signatures.

This document has been prepared according to the Illinois Environmental Protection Agency (EPA) Bureau of Water and the United States Environmental Protection Agency publication *EPA Requirements for Quality Assurance Project Plans* dated March 2001 (QA/R-5). It will be reviewed annually and modified accordingly.

A5 Project/Task Organization

Personnel involved in project implementation are listed in Table 1.

Figure 1 is an organizational chart for the project.

The Flint Creek Watershed Partnership (FCWP) will contribute water quality stream data for Flint and Spring Creeks by undertaking the following activities:

- Conduct stream and public owned treatment works (POTW) sampling in accordance with the approved QAPP.
- Submit samples to the laboratory (Environmental Monitoring and Technologies, Inc.), for analysis- here and after referred to as the contract laboratory.
- Submit analytical results to Illinois EPA.
- Submit POTW effluent analytical results to Illinois EPA.

The FCWP Project Manager will be responsible for the execution of the individual organization's part in the project. Below is a listing of tasks.

The Illinois EPA Financial Assistance Agreement Administrator (FAAA) is responsible for the administration of the project and the grant that is partially funding the project.

The FCWP Project Manager will be responsible for the following activities:

- Provide a sampling crew for the locations on the Flint and Spring Creeks.

- Deliver to or arrange for pickup of samples by the contract laboratory within the prescribed holding times.
- Collect a POTW effluent sample and deliver it to the contract laboratory for analysis.
- Update the QAPP as necessary.
- Prepare a report summarizing the implementation activities.

The Illinois EPA Bureau of Water Quality Assurance Officer (QAO) will review and approve this QAPP as meeting the QAPP requirements in USEPA's publication QA/R-5. The QAO will conduct audits if deemed necessary.

The FCWP QAO monitors the quality assurance activities of the sampling contractor, those of the contract laboratory, and the oversight of all the project Quality Assurance/Quality Control (QA/QC) activities

Environmental Monitoring and Technology, Inc.(EMT) project manager will provide a sampling team consisting of field technicians who will take the required samples. Field technicians will be responsible for equipment preparation, sample collection, field measurements, and sample transportation. The field technicians will also sample the POTW effluent.

The sampling team will be responsible for prompt delivery of fecal coliform or E-coli enumeration samples to the contract lab for analysis. This is required because of the 6-hour hold time on fecal coliform or E-coli enumeration samples.

The contract laboratory project manager shall be responsible for all the laboratory analysis and the maintenance of the laboratory's internal quality control/assurance.

A6 Problem Definition/Background

The Flint Creek/Spring Creek Watersheds Partnership will implement a water quality monitoring plan that has been prepared for the Flint and Spring Creek watersheds [KOT Environmental Consulting, Inc. (KOTECI), 2015]. The plan's immediate objective is to establish baseline water quality conditions. Implementation will take place in 2015. The establishment of baseline water quality characteristics of the watersheds and continued monitoring will allow us to realize the following goals; 1) assess the current state of water quality resulting from non-point source pollution within the wetlands, creeks and lakes; 2) assess changes in water quality to see how well implemented best management practices (BMPs) are working to remove pollutants for meeting water quality targets and ultimately milestones and project goals; and 3) assess the volume of groundwater discharge to the creeks to make preliminary assessments of the viability of the ecological health of the watersheds and of the groundwater supply that is the area's only water resource. Subsequent water quality monitoring will be performed by collecting appropriate physical, chemical, and biological data as recorded in the watershed-based plan goals and objectives, and dependent on budgets constraints allow (AES, 2007 and 2012, and FCWP 2018). The QAPP should be updated as needed and no later than 2025.

This QAPP will describe how the resources will be used to obtain quality, usable data for documenting the water quality of Flint and Spring Creeks.

A7 Project/Task Description

Several jurisdictions and interested organizations have been collecting water quality data from the Flint and Spring Creek watersheds (Figures 2 and 3 respectively) for several years. These data have been reviewed and will provide a foundation of the database that will be developed as part of this monitoring program. Six of the jurisdictions have National Pollution Discharge Elimination System (NPDES) permits and are participating in the EPA's municipal separate storm sewer systems (MS4) program. Lake Barrington, North Barrington, Deer Park, Barrington, and Barrington Hills are all collecting MS4 data in the Flint Creek watershed and Barrington Hills and South Barrington are collecting MS4 data from the Spring Creek watershed. Additionally, the Citizens for Conservation collects biological data in the Flint Creek watershed and the River Watch organization occasionally collects biological data in both watersheds.

Review of the existing data emphasizes the inconsistency of the data collection effort indicating the lack of coordination between the data collection entities. Data were collected at different times of the year and the selected analytes and field measurements were not consistent over the data collection entities. One thing that was evident in reviewing the existing data was that the data collection locations provided good coverage of the Flint and Spring Creek watersheds.

A7.1 MS4 Sampling Locations

Prior to 2015, the MS4 sampling locations provided the basis for the monitoring plan data collection locations. A review of those existing MS4 sampling locations indicated that several jurisdictions were collecting data from the same locations and a few sampling locations did not have optimal placement. Duplicate MS4 sampling locations were eliminated and some of the locations were shifted but were still able to meet jurisdictional requirements for the MS4 permits. Additionally, Lake County has been sampling the major lakes in the Flint Creek watershed and they will continue to do so. The final 2015 MS4 sampling stations and their locations are listed in Table 2 and shown in Figure 4. Stations may be reduced due to budget constraints.

The monitoring plan relies on the MS4 sampling stations. Water quality data for the monitoring plan and MS4 data required for NPDES permitting will be collected annually in summer.

June was chosen because it is more cost-effective to collect water quality data when the area hydrologic system exhibits average characteristics. This was determined by studying the discharge records of the Fox River. The Fox River presents the largest short-term external stress on the area's hydrology. The ideal sampling time is the month when the monthly river discharge is closest to the annual average discharge. The annual average discharge is 927 cubic feet per second over a 94 year record and June had an average monthly discharge of 941 cubic feet per second.

A7.2 Recording Stream Gages

Eight sites were selected for installation of recording stream gages. Five stream gages have been installed and three more are planned when funding is available. The stream gage data will be used to study the effect of significant storm events on the hydraulics of the creeks, monitor the annual base flow (groundwater discharge), and establish surface flow and base flow trends once sufficient data are available. The stream gage locations will also be sampling stations. These eight sampling stations will be sampled annually after a significant precipitation event (>1.0 inches) in addition to the normal sampling event in June. Stream gage locations are presented in Table 3 and in Figure 5.

A7.3 Biological Sampling Locations

The Macroinvertebrate Biotic Index (MBI) and Index of Biotic Integrity (IBI) have been conducted on a fairly regular basis by the Citizens for Conservation and by the River Watch organization. These two entities will continue with their monitoring activities. Lake County has monitored the larger lakes in the Flint Creek watershed and has been reporting the Trophic State Index (TSI) on a regular basis and will continue to do so. In addition, we have designated the stream gage station locations as additional sites for collection of biological data. It is expected that biological sampling will occur at each of the eight locations, but may be reduced to two or three locations annually because of funding constraints. The biological sample stations are shown in Table 4 and in Figure 6.

Table 5 summarizes the maximum sampling station information. Included is a description of the sampling station, the latitude and longitude of the location and the criteria for which the station location was selected.

A7.4 Analytes and Field Measurements

Table 6 lists the maximum number of analytes for which samples will be analyzed in the laboratory and the measurements that will be taken in the field. An independent contractor will be contracted to conduct field measurements, collect samples and deliver the samples to the contract laboratory for analyses. The information in Table 6 is divided into four groups: field measurements, standard water quality analytes, geochemical characterization analytes, and biological assessments. The field measurements are standard measurements that are usually taken in the field with the exception of oxidation-reduction potential (ORP). ORP is required for the geochemical characterization. Data from the standard water quality analyses will be used to assess the health of the watershed and establish a Total Maximum Daily Load (TMDL) for the watershed to ensure that TMDL requirements are met in the future. Geochemical analysis information is used to establish the type of water, its origin, and anthropogenic impacts. The information may also be used to identify groundwater discharge areas within the watershed. The number of analytes may be reduced due to budget constraints.

A7.5 Frequency

It is expected that the baseline sampling event will occur in August 2015. All of the analyses and measurements in the four groups shown in Table 6 will be conducted during this initial sampling event. Results from this effort will be used to establish the baseline conditions of the Flint and Spring Creek watersheds. Subsequent monitoring will take place annually conducting field measurements and analyzing collected samples from the analytes listed in the standard water quality analytes group. Every fifth year the measurements and analysis of analytes in the geochemistry characterization group may be included. Sampling frequency is summarized in Table 6. All subsequent sampling event results will be compared to baseline conditions to determine if conditions in the watersheds are improving or degrading. Once enough data has been collected (five years or more) statistical analysis will be conducted to establish trends.

Once a year, abbreviated sampling will take place after a storm event of one inch or more to evaluate the effect of stormwater runoff on the watersheds, dependent on budgets constraints.. Measurements will be conducted and samples collected at the eight stream gage locations. Samples will be analyzed for the analytes that are representative of stormwater runoff as shown in Table 6.

Samples will be collected, delivered to or picked up by, the contract laboratory as described in Appendices 1 and 2. Tables 7 and 8 describe the containers, field preservation, methods and holding times for the samples.

A8 Data Quality Objectives and Criteria for Measurement Performance

Many analytes measured for this project are present in analytically low concentrations throughout the Flint and Spring Creeks. Analyte concentrations will vary as discharged effluents and stormwater runoffs are introduced into the streams. All analytes are subject to chemical, biological, and physical processes that will alter their presence in the streams. It is the intent of this project to employ methods of measurement that will detect and quantify all analytes of interest wherever possible.

Although there are many intended and potential uses of the data, minimum measurement criteria will be established at the lowest analyte concentration required for planned uses of the measurement data. Minimum measurement criteria are State of Illinois water quality standards for general use waters where applicable. Where no minimum measurement criteria can be identified, the water samples will be analyzed to the lowest concentration readily achievable by the contract laboratory. The monitored parameters and the established minimum measurement criteria are shown in Table 9 and EMT Parameter and Method Standard Operating Procedures in Table 10.

A8.1 Precision

Precision is a measure of agreement among repeated measurements of the same property under identical, or substantially similar, conditions; calculated as either the range or as the standard deviation. Precision may also be expressed as a percentage of the mean of the measurements, such as relative range or relative standard deviation (coefficient of variation). Precision will be measured in the laboratory during the analysis of matrix spike (MS) and matrix spike duplicate (MSD) samples. The analyses of the duplicate samples are considered acceptable if the calculated relative percent difference (RPD) of the measurements is within the acceptance limits listed in Table 9. The results of the duplicate analyses are used to calculate the RPD for evaluating precision using the following formula:

$$RPD = [(A - B) / (A + B)/2] * 100$$

where
A = Original sample concentration
B = Duplicate sample concentration

A8.2 Bias

Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction.

A8.3 Accuracy

Accuracy is a measure of the overall agreement of a measurement to a known value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations.

Accuracy will be measured during the analysis of environmental water by using laboratory control spike (LCS) samples. In the laboratory, samples of deionized water will be fortified (or spiked) with the analytes of interest. These LCS samples will be analyzed with each batch of samples. The analyses of the LCS samples are considered acceptable if the calculated concentrations for all analytes of interest are within the acceptance limits listed in Table 9.

The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy using the following formula:

$$\text{Percent Recovery} = [(S - U) / T] * 100$$

where

S = Spiked sample concentration
U = Un-spiked sample concentration
T = True spike concentration

A8.4 Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness of data will be ensured using established field and laboratory procedures and their consistent application. To aid in the evaluation of the representativeness of the sample data, field and laboratory blank samples will be evaluated for the presence of contaminants.

A8.5 Comparability

Comparability is a measure of the confidence with which one data set or method can be compared to another. Comparability will be maximized by using standard analytical methods and standardized, documented sampling techniques. Documentation will include all sampling locations, conditions, and field sampling methods. All results will be reported in standard units or, for field parameters, as defined in the method. All laboratory calibrations will be performed using standards traceable to the National Institute for Standards and Technology (NIST) or another certified reference standard source.

A8.6 Completeness

Completeness is a measure of the amount of valid data needed to be obtained from a measurement system. The percent completeness is calculated by dividing the number of valid sample results by the total number of samples planned, and multiplying the result by 100 percent. Completeness will be reported as the percentage of all measurements judged valid. The following equation will be used to determine completeness:

$$\text{Percent Completeness} = (V/T) * 100$$

where

V = Valid number of sample results
T = Total number of samples planned

For this project, the QA objective for degree of completeness for both field and laboratory data is 90 percent. If completeness is less than the target of 90 percent the FCWP Project Manager and FCWP Quality Assurance Officer will evaluate the data to determine whether there are enough data to complete the study or if additional data collection is necessary.

A8.7 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. Many analytes measured for this project are present in analytically low concentrations throughout the source media: i.e., waters of streams and lakes. All analytes are subject to chemical, biological, and physical processes that will alter their presence in the source media. It is the intent of this project to employ methods of measurements that will detect and quantify all analytes of interest wherever possible. Although there are many intended and potential uses of the data, minimum measurement criteria will be established at the lowest analyte concentration required for planned uses of the measurement data. Minimum measurement criteria are State of Illinois water quality standards for general use waters where applicable. Where no minimum measurement criteria can be identified, the water samples will be analyzed to the lowest concentration readily achievable by the contract laboratory. The monitored parameters and the established minimum measurement criteria are shown in Table 9.

Table 9 also gives the minimum measurement objectives for the project. The minimum measurement objectives will be set at approximately one-fifth of the minimum measurement criteria shown to ensure that analytes will be measured with reasonable accuracy at the minimum measurement criteria concentrations, and measured to reasonable levels below the minimum measurement criteria.

The minimum measurement objective for any analyte will be achieved when the analytical procedure selected for sample analysis can be shown to have a method detection limit (MDL) at or below the minimum measurement objective. Table 9 compares the minimum measurement objective against the reporting limit (RL) achieved by the contract laboratory. All analytes meet the minimum measurement objective.

Analyte MDLs shall be determined by the USEPA method given in the Code of Federal Regulations (CFR), Volume 40, Part 136. The MDL is defined as "the minimum concentration of a substance that can be measured and reported with 99% confidence that the measured concentration is distinguishable from method blank results."

For analytes without minimum measurements criteria, the minimum measurement objectives will be understood to be the MDL level that is readily achievable using analytical methods generally employed at the contract laboratory. For parameters where MDLs are not applicable such as pH, temperature, specific conductivity and dissolved oxygen, the minimum measurement objectives shown in Table 9 are the sensitivity to be obtained by the measurement method. The accuracy, precision, and completeness for each parameter are also indicated in Table 9.

A9 Special Training Requirements

Environmental Management and Technologies, Inc.(EMT) will train the field technicians from their in-stream water sampling team. The field technicians will demonstrate competence to their trainer. All field personnel will be trained before sampling events occur.

Chemical analyses shall be performed by trained analysts who have successfully completed performance requirements as set forth in the contract laboratory's QA/QC Manual referenced throughout this document.

A10 Documents and Records

The FCWP Project Manager shall retain all updated versions of the QAPP and be responsible distribution of the current version of the QAPP. The contract laboratory and the Illinois EPA FAAA and EPA QAO will approve any updates.

Sampling collection records, field notebooks, and all records of field activities shall be retained for five years by the FCWP Project Manager. Sample collection records shall document proper sampling protocol performed in the field.

The FCWP Project Manager shall retain all laboratory analytical results and all correspondence with the contract laboratory. Chain-of-custody forms submitted for the laboratory shall also be retained along with analytical results. The FCWP Project Quality Assurance Officer (QAO) and the Illinois EPA QAO shall be made aware of any problems encountered during any phase of the project.

The FCWP Project Manager shall retain copies of all management reports, memorandums, and all correspondence between the Illinois EPA.

B MEASUREMENT DATA ACQUISITION

B1 Sampling Process Design

Sampling Stations

Data sampling stations are described in Table 5. Stations were refined during a field reconnaissance by the FCWP Project Manager. Sample location sites were selected according to the criteria listed in Table 5.

Sample Method

In-stream subsamples will be collected mid-depth and mid-point within the stream channel, using a PVC bucket to create a composite sample if needed. The baseline thirty sample locations will be sampled over a three-day period in June. The exact sampling times and date will be recorded on the chain of custody sheets.

POTW effluent sampling will be performed as a one-time grab sample directly from the effluent. Field measurements will be conducted at the site. The effluent sample will be transported to the contract laboratory within the prescribed sample holding times for analysis.

In-depth sampling procedures are explained in Appendix 1.

Selection of Parameters for Monitoring

Parameters for chemical analysis were selected because these specific nutrients, bacteria, and other parameters will be beneficial to assess change to water quality resulting from implementation of TMDL's and in establishing future NPDES permit limits. Most of the parameters selected for monitoring are identified as Pollutants of Concern by Illinois EPA in their 303(d) listing of the stream segments.

B2 Sampling Methods

Manual samplings are conducted by a minimum of two-person teams at the locations specified in Table 5.

Sampling

Grab samples are taken from the stream. Sample bottles are filled directly from the stream, labeled, and packed on ice. Bacteria samples are bottled in sterilized sample bottles (Appendix 1). A clean pair of latex free gloves is worn for each fecal coliform or E-coli enumeration sample collected by the sampling team.

Temperature, dissolved oxygen (DO), pH, specific conductivity and oxidation reduction potential are measured in the field using a YSI (or equivalent) field probe. These readings are measured directly in the stream, at the center location and at mid depth.

POTW effluent sampling will be conducted by taking a grab sample. Measurement of pH, temperature, conductivity, DO and oxidation reduction potential will be performed on-site and the collected samples will be sent to the contract laboratory for analysis.

Refer to Section B5 Field Quality Control for individuals responsible for corrective action.

B3 Sample Handling and Custody

Field measurements (temperature, DO, pH, specific conductivity and oxidation reduction potential) are measured directly in the stream or from stream water collected in a stainless steel bucket. If using a stainless steel bucket, the bucket must be cleaned before samples are collected and between sampling sites. The equipment shall be cleaned with phosphate-free detergent and deionized water. Deionized water is also used for rinsing.

Sample containers provided by the laboratory will be filled from a grab sample taken from the center of the stream to overflowing if no preservative is required. Sample containers containing a preservative are not completely filled so that an airspace is provided for mixing the preservative and the sample water. Wherever possible, samples should be collected at mid-point and mid depth within the stream channel.

All sample containers are chilled in an ice-filled cooler immediately after collection and kept on ice during transport to or pick up by the contract laboratory. The contract laboratory is supplying the sample containers and labels. Preservatives, if necessary, come in the containers provided by the contract laboratory. Table 7 describes field collection containers and field preservation.. All samples will be analyzed that same day or properly preserved and analyzed within the holding time. Tables 7 and 8 describe field collection containers, field preservatives, methods and holding times.

Samples are to be transported to or picked up by the laboratory within the prescribed holding times. Samples will be taken to the contract laboratory by a member of the sampling team. Samples for fecal coliform or E-coli enumeration will be taken directly to the laboratory. The manager for each sampling team will be responsible for contacting the laboratory, and coordinating fecal coliform or E-coli enumeration sample delivery. The other samples will be delivered to the appropriate laboratories by the sample team.

The laboratory shall record temperature upon arrival at the laboratory using a thermometer calibrated against a NIST traceable certified thermometer. Samples that require thermal preservation are refrigerated after sample acceptance at the laboratory.

When received by the laboratory, the samples are logged into the laboratory logbook and/or laboratory database. Maximum holding times before analysis, as stated in applicable laboratory method standard operating procedures (SOPs) are followed. Parameters of particular concern because of short maximum holding times include E-coli enumeration analysis (6 hours), biochemical oxygen demand (48 hours), nitrate/nitrite (28 days), and orthophosphate (48 hours).

Refer to Section B6 Laboratory Quality Control for individuals responsible for corrective action.

B4 Analytical Methods

All methods used by the laboratories for data analysis shall be USEPA approved methods listed in 40 CFR Part 136. Table 8 describes the contract laboratory's methods and holding times, which are in accordance with the 40 CFR Part 136.

B5 Field Quality Control

All field sampling personnel are responsible for ensuring that proper sampling methods, sample preservation, and sample custody of the delivered samples to the designated laboratory are followed.

An investigation and corrective action report prepared by the responsible supervising field personnel in the event of a quality control or noncompliance issue will be submitted to the EMT Project Manager. The EMT Project Manager will then forward this report to the FCWP Project QAO. The accuracy and precision of all data measurements must be quantifiable. Analytical procedures used for data analysis must be performed according to approved standard methods. Data measurements should be recorded in a controlled environment in which a quality control program can be maintained.

B6 Laboratory Quality Control

The contract laboratory is responsible for implementing their QA/QC Manual which is an internal quality assurance plan for laboratory procedures. The contract laboratory is responsible for the accuracy and reliability of analytical methods and final data reports according to their QA/QC Manual. An investigation and corrective action report will be submitted to the FCWP Project Manager and the FCWP Project QAO from the Laboratory's District Manager as quality control or noncompliance issues arise. The contract laboratory is responsible for providing data qualifiers and/or case narratives to inform the FCWP Project Manager and the FCWP Project QAO of any analytical exceptions that fall outside of routine method protocols. The laboratory's QA/QC Manual contains the procedures for quality control and for calculating QC statistics.

B7 Instrument/Equipment Testing, Inspection and Maintenance

All laboratory equipment shall be routinely maintained according to the manufacturer's manuals. Any equipment used for field data measurements shall be tested and inspected prior to sampling events and after the equipment returns from the field.

An adequate supply of spare parts shall be maintained by the laboratory for equipment maintenance. Spare parts shall be routinely inventoried.

B8 Instrument Calibration and Frequency

Instruments used in the field and in the laboratory shall be calibrated prior to use according to the manufacturer's manual. The laboratory shall calibrate instruments according to internal quality assurance plans. The laboratory is also to keep adequate records of equipment calibration and to use NIST traceable standards when possible. The YSI (or equivalent) field probe shall be calibrated on the day of a sample event, and the calibration shall be confirmed upon return that same day. Record all calibration data on the field equipment calibration sheet (Appendix 3b).

B9 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables used in the field shall be inspected by the field sampling teams to guarantee their usability. Supplies and consumables used in laboratory procedures shall be inspected by laboratory managers to confirm compliance with laboratory quality assurance plans (QAPs) and SOPs.

B10 Non-Direct Measurements

Non-direct measurements will not be obtained for the project.

B11 Data Management

Field books, field measurement records, and other data gathered in the field shall be maintained for five years in project files by the FCWP Project Manager. The files will be secured in a fireproof file box or cabinet located in the FC/SCWP office. The contract laboratory will convey all laboratory analytical data to the FCWP Project Manager in the contract laboratory's standard report form. The contract laboratory and the POTW analytical data will be transmitted to the FCWP project manager. All data communicated to the Illinois EPA shall be verified by the FCWP project manager and the project QAO for reliability and usability.

All the project data will be verified using computers and the Access and Excel Microsoft software programs. Additionally, an appropriate software program called Statisticx or similar, may be used to conduct more robust statistical analysis.

C ASSESSMENT/OVERSIGHT

C1 Assessment and Response Actions

Performance evaluations of the sampling teams will be conducted by the FCWP Project Manager. The sampling team will be evaluated to determine if sampling protocols were followed, and evaluations will be documented by the FCWP Project Manager. Quality control and noncompliance issues related to field activities will require an investigation and corrective action plan submitted to the Illinois EPA FAAA and the Illinois EPA Project QAO.

Laboratories contracted for data analysis shall maintain internal quality assurance programs described in their quality assurance plans. Most laboratories maintain quality control checks for procedures. When the possibility of quality control problems or noncompliance issues arise that may affect the usability of data, an investigation and corrective action report will be submitted by the Laboratory District Manager to the FCWP Project Manager and reviewed by the FCWP Project QAO.

Also, the FCWP Project Manager shall make certain that the project data associated with any quality control or other nonconformance issue is made available to data users with the appropriate data qualification. When data previously released to data users may have been affected by a quality control problem or other nonconformance issue, the FCWP Project Manager shall notify other data users of the problem.

C2 Reports to Management

The FCWP Project Manager will receive investigation and corrective action reports in case of any quality control or noncompliance issue and will forward any reports to the FCWP Project QAO. Reports shall be prepared by the FCWP Project QAO in the area related to the quality control issue. The FCWP Project QAO shall prepare and review performance evaluations and audits, and data quality assessments. Any QA problems affecting the final reported values shall be reported to all data users.

D DATA VALIDATION AND USABILITY

D1 Data Review, Validation, and Verification Requirements

The FCWP Project Manager and the FCWP Project QAO will review final analytical data reports and address any issue related to data reliability as mentioned in pertinent investigation and corrective action plans. Qualified laboratory data will be listed as such in any reports or data submitted to the Illinois EPA (see Section B6). It will be the responsibility of the Illinois EPA FAAA to determine the usability of any qualified data.

D2 Verification and Validation Methods

Sample collection and field measurement records shall be verified by field technicians and the records kept by the FCWP Project Manager. Laboratory data shall be verified by the laboratory managers of the laboratories that produced the data. Field and laboratory records shall be archived by the FCWP Project Manager.

In the case of data verification resulting in a change to data, the FCWP Project Manager shall inform all data users and make corrections.

The FCWP Project Manager and the FCWP Project QAO shall be responsible for resolving issues with the Illinois EPA.

The Project Manager shall be informed if data accuracy, reliability, or usability has been reduced as the result of errors in stored data or corrupted data files. All data users shall be notified of the problems and corrections made. The Project Manager shall submit a report documenting the problem and shall revise the QAPP as appropriate.

D3 Reconciliation with User Requirements

The Illinois EPA FAAA or their outside consultant shall review project data and its usability and determine if it meets requirements of the project objectives. The project objectives are stated in Section A6, Problem Definition/Background.

The execution of the project shall follow the procedures outlined in this QAPP. Personnel listed under Section A5, Project Task Organization are responsible for implementation of the quality control measures during each stage of the project.

Updates of the QAPP shall be submitted to the Illinois EPA FAAA, Illinois EPA QAO and Project QAO for review and comment.

The QAPP shall be reviewed by all persons listed on the approval page. The review shall determine issues to be addressed as the project progresses. Issues to be discussed may include:

1. The number and location of sampling stations.
2. Sampling procedures.
3. Parameters measured.
4. Data quality objectives and minimum measurement criteria.
5. Analytical procedures.
6. Project reporting.
7. Corrective actions taken.

The project shall be modified as directed by the FCWP Project Manager. Changes in procedures shall not be made without the approval of the Illinois EPA FAAA. All changes shall be documented in a memorandum that will be distributed to those listed on the approval sheet.

The FCWP Project Manager shall update the QAPP after review and keep a separate record of changes.

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Figures

Figure 1 PROJECT ORGANIZATION CHART

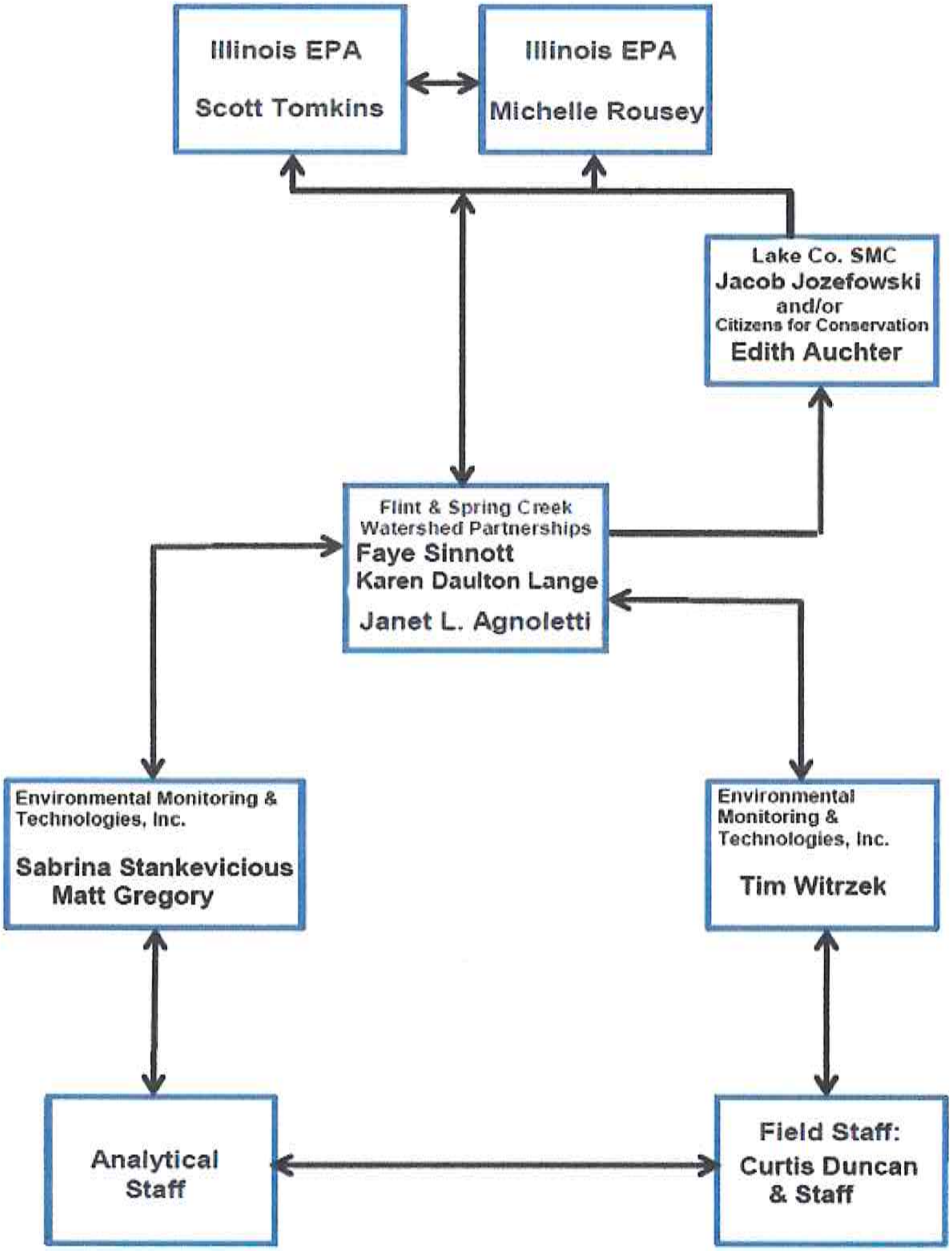


Figure 2 FLINT CREEK WATERSHED LOCATION

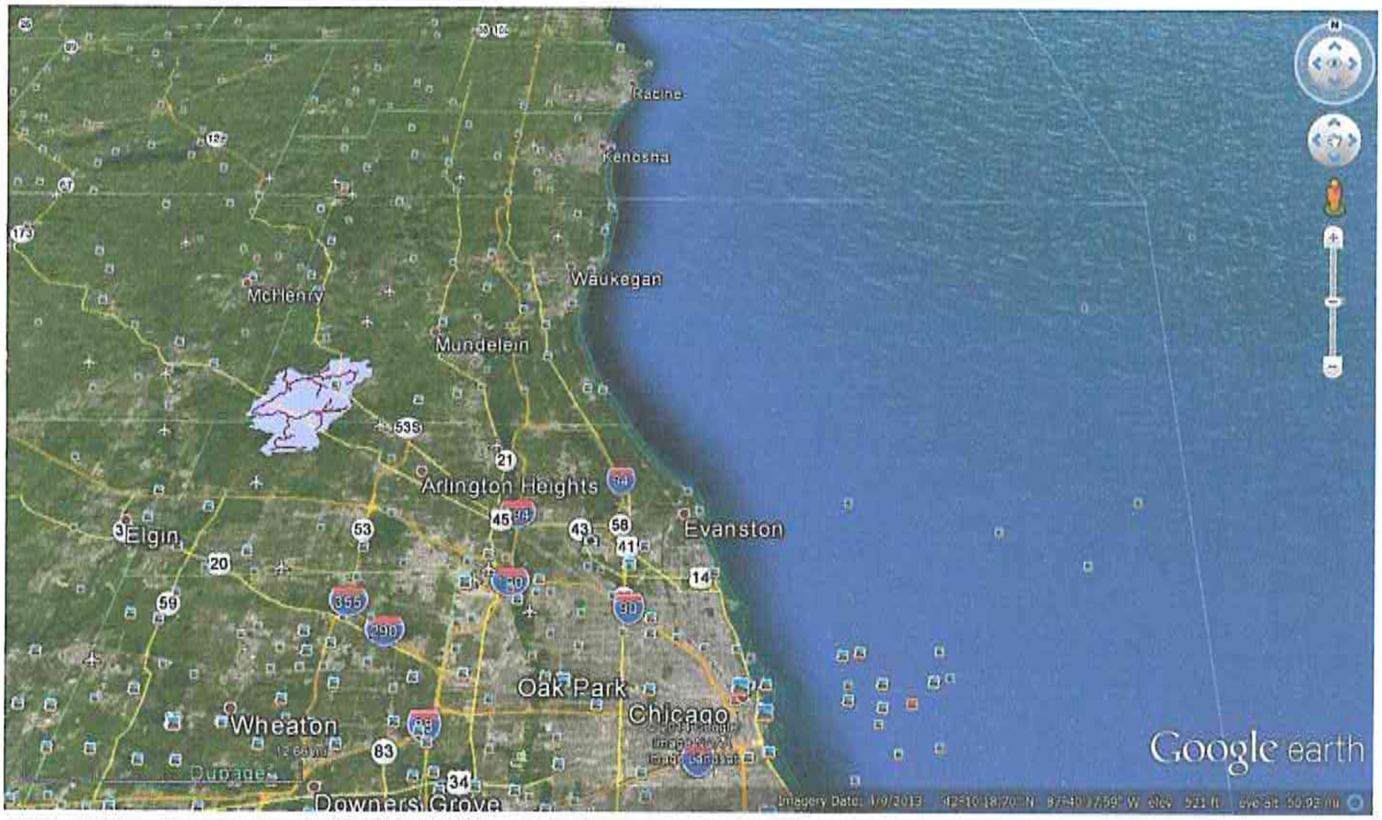


Figure 3 SPRING CREEK WATERSHED LOCATION

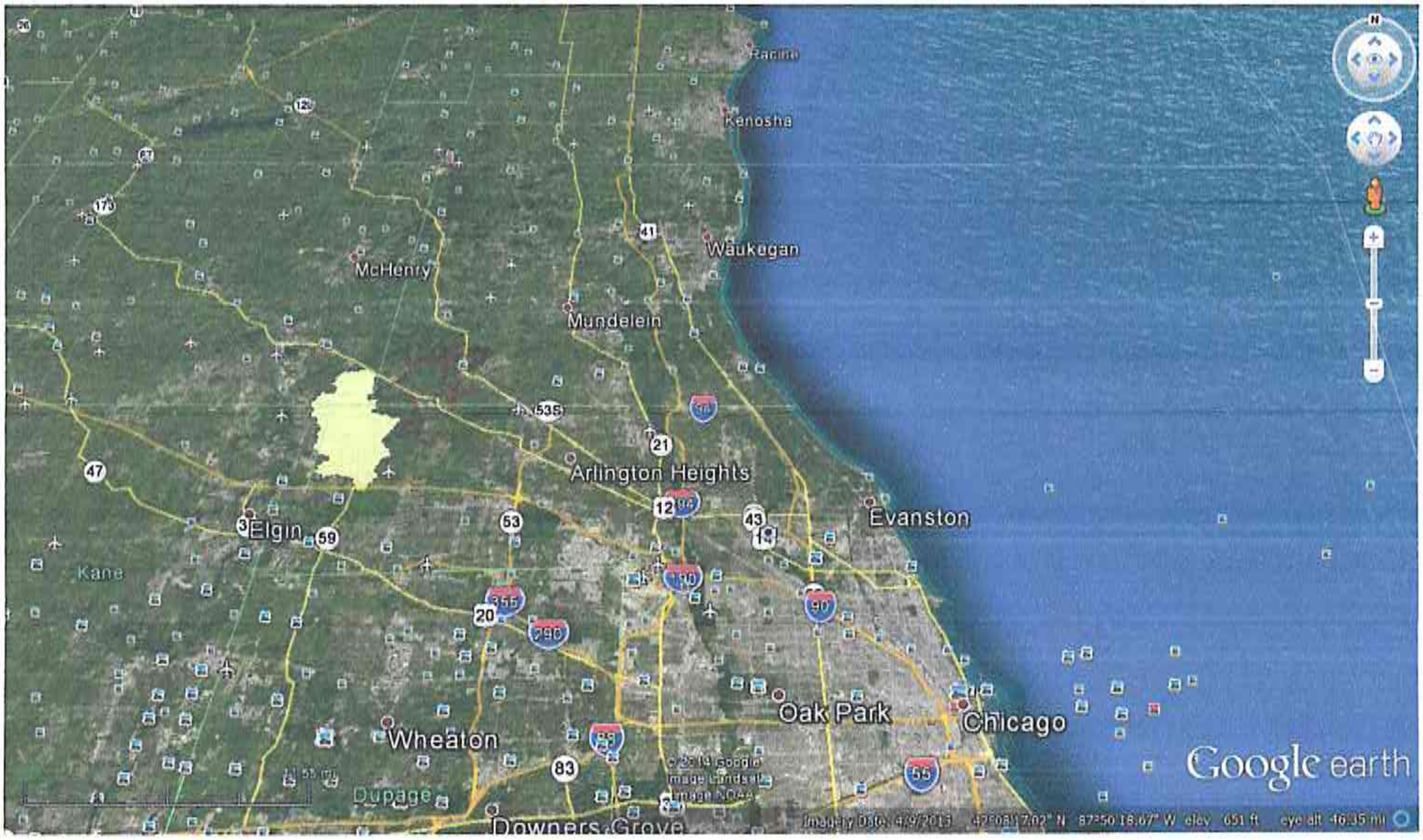


Figure 4 MS4 sampling station locations

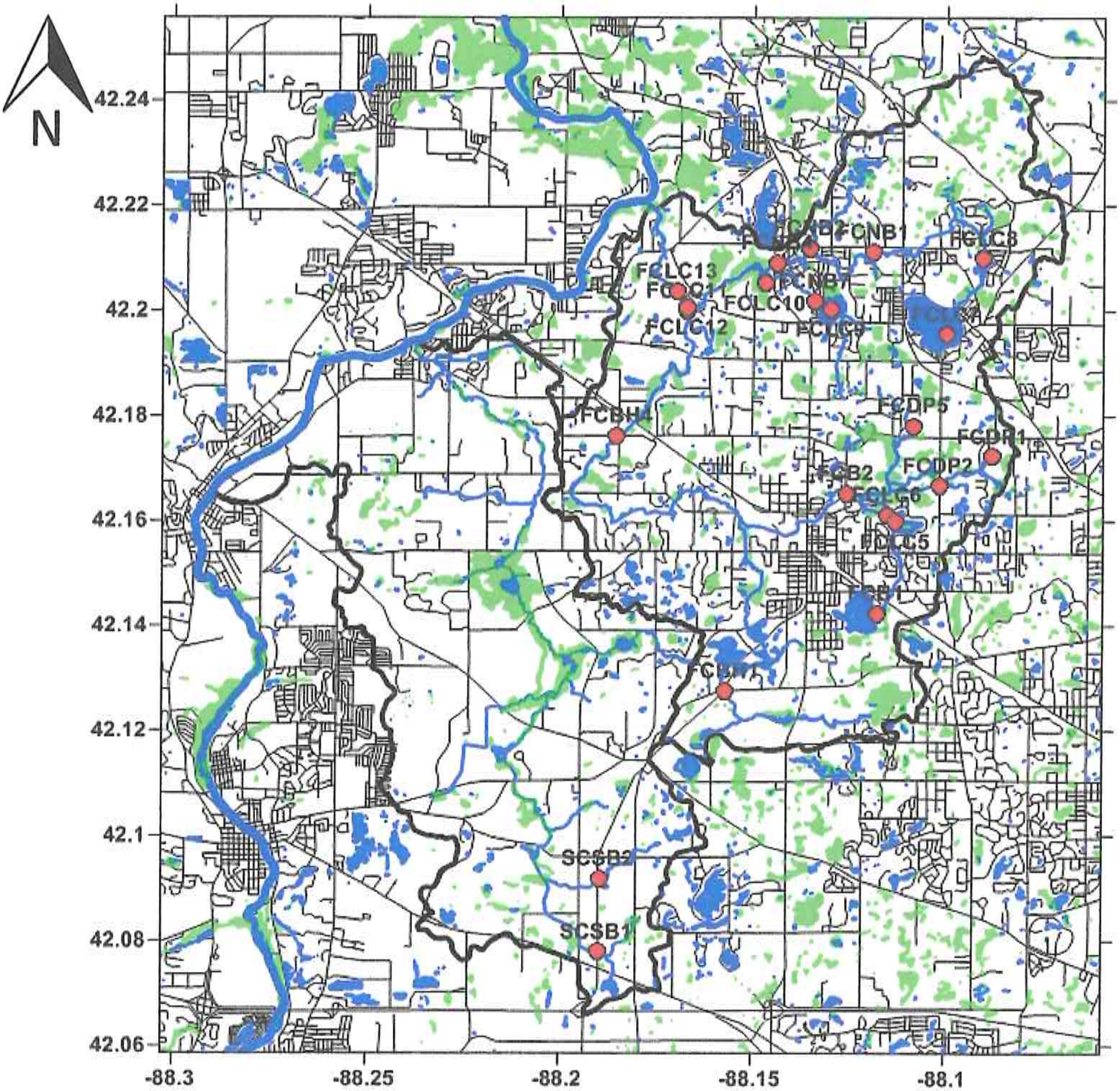


Figure 5 STREAM GAGE/SAMPLING STATION LOCATIONS

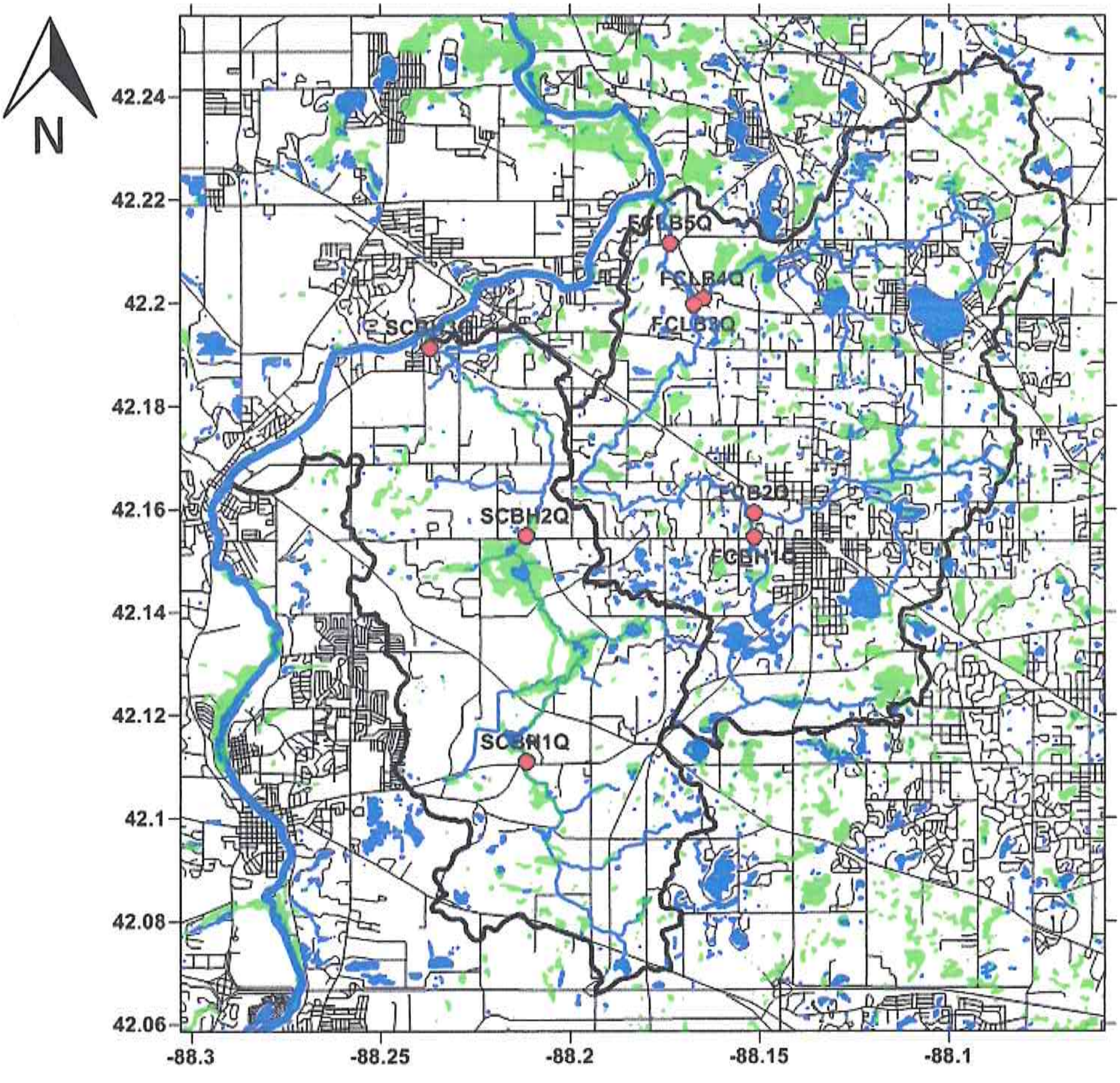
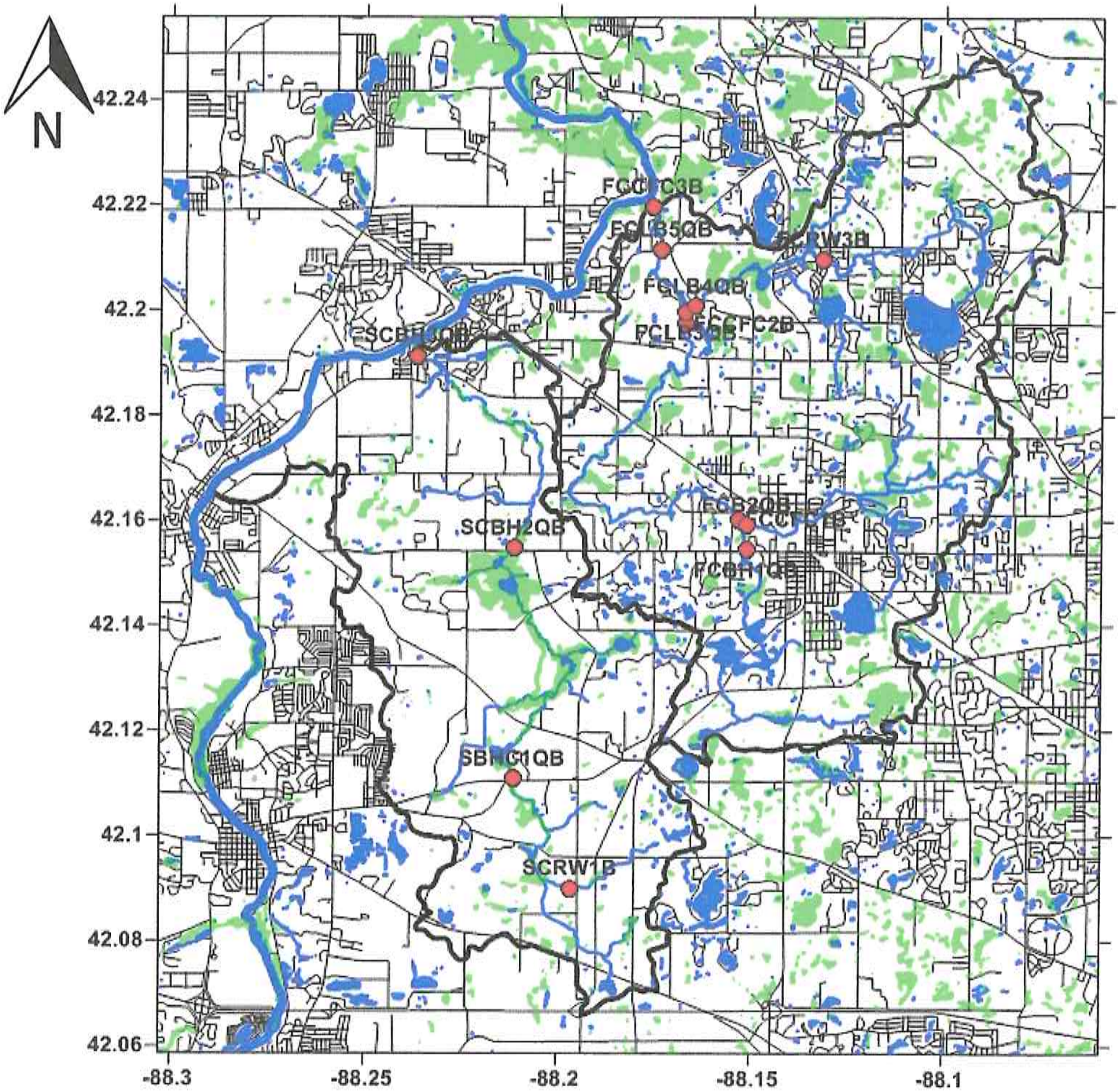


Figure 6 BIOLOGICAL SAMPLING STATION LOCATIONS



Tables

Table 1 PROJECT PERSONNEL

Organization	Project Role	Staff
Flint Creek/Spring Creek Watersheds Partnership	Project Manager	Faye Sinnott faye.sinnott@gmail.com
	Project Quality Assurance Officers	Karen Daulton Lange, PE, CFM kdlange@lakebarrington.org
		Janet Agnoletti J.Agnoletti@BACOG.org
Illinois EPA	EPA Officer	Scott Tomkins scott.Tomkins@illinois.gov
	Quality Assurance Officer	Michelle Rousey michelle.rousey@illinois.gov
Lake County StormWater Mgmt Commission	SMC Liaison	Jacob Jozefowski
Environmental Monitoring and Technologies, Inc.	Quality Control Manager	Sabrina Stankevicious sstankevicious@emt.com
	Laboratory Technical Manager	Matt Gregory mgregory@emt.com
	Laboratory Operations Manager	Nathan Fey nfey@emt.com
	Project Supervisor	Tim Witrzek twitrzek@emt.com
	Field Team Leader	Curtis Duncan cduncan@emt.com
	Field Technician	To be determined*
	Field Technician	To be determined*

Table 2 2015 MS4 SAMPLING STATION LOCATIONS

	Sampling Stations	Latitude	Longitude
Barrington	FCB1	42.1449	-88.1153
	FCB2	42.1653	-88.1260
	FCB3T	42.1582	-88.1453
Barrington Hills	FCBH1	42.1276	-88.1574
	FCBH4	42.1762	-88.1854
Deer Park	FCDP1	42.1723	-88.0877
	FCDP2	42.1667	-88.1019
	FCDP5	42.1781	-88.1085
North Barrington	FCNB1	42.2112	-88.1190
	FCNB2	42.2120	-88.1357
	FCNB4	42.2092	-88.1440
	FCNB7	42.2018	-88.1344
South Barrington	SCSB1	42.0779	-88.1899
	SCSB2	42.0918	-88.1896
Lake County	FCLC5	42.1599	-88.1131
	FCLC6	42.1611	-88.1152
	FCLC7	42.1955	-88.1000
	FCLC8	42.2100	-88.0903
	FCLC9	42.2004	-88.1301
	FCLC10	42.2053	-88.1472
	FCLC11	42.2007	-88.1672
	FCLC12	42.2037	-88.1703

Table 3 STREAM GAGE AND SAMPLING STATION LOCATIONS

Responsible Jurisdiction	Sampling/Stream Gaging Stations	Latitude	Longitude
Barrington Hills	SCBH1Q	42.1105	-88.2116
	SCBH2Q	42.1543	-88.2116
	FCBH1Q	42.1544	-88.1520
Barrington	FCB4Q	42.1592	-88.1512
Fox River Grove	SCFRG3Q	42.1913	-88.2367
Lake Barrington	FCLB3Q*	42.1996	-88.1672
	FCLB4Q	42.2007	-88.1660
	FCLB5Q*	42.2116	-88.1736

Table 4 BIOLOGICAL SAMPLING STATION LOCATIONS

Responsible Jurisdiction	Biological Sampling Stations	Latitude	Longitude
Barrington Hills	SCBH1QB	42.1105	-88.2116
	SCBH2QB	42.1543	-88.2116
	FCBH1QB	42.1544	-88.1520
Barrington	FCB4QB	42.1591	-88.1510
Fox River Grove	SCFRG3Q	42.1913	-88.2367
Lake Barrington	FCLB3QB	42.1996	-88.1671
	FCLB4QB	42.2007	-88.1660
	FCLB5QB	42.2114	-88.1735
Citizens for Conservation	FCCFC1B	42.1603	-88.1536
	FCCFC2B	42.1975	-88.1673
	FCCFC3B	42.2198	-88.1760
River Watch	SCRW1B	42.0900	-88.1964
	FCRW3B	42.2097	-88.1319

Table 5 SAMPLING STATION LOCATION DESCRIPTIONS AND CRITERIA

Site Number	General Description	Latitude	Longitude	Location Criteria
FCBH1	Flint Creek Main Branch 150" NE of RT 59 on RT 68.	42.1276	-88.1574	Determines the quality of the head waters of main branch of Flint Creek
FCBH1Q	Flint Creek. Main Branch Lake Cook Road 350" W of Hart Road	42.1544	-88.1520	Determines the quality of the main branch prior to the confluence with the east branch.
FCBH4	Flint Creek Main Branch Merrioaks Road 150" W of Buckle Road	42.1762	-88.1854	Determines the quality of the main branch at the midpoint between the east and north branch confluences
FCLB3Q	Flint Creek Main Branch east bank at stream gage 30" N of Woodland Drive	42.1996	-88.1672	Determines the quality of the main branch before entering Flint Lake
FCLC11	South end of Flint Lake	42.2007	-88.1672	Determines the quality of Flint Lake
FCLC12	Flint Creek Main Branch rear of property at 23357 N. Flint Drive	42.2037	-88.1703	Determines the quality of the Flint Lake outflow
FCLB5Q	Flint Creek Main Branch east bank at stream gage 50" north of the Kelsey Road bridge	42.2114	-88.1735	Determines the quality of the main branch before the confluence with the Fox River
FCDP1	Flint Creek East Branch Sub-Branch 1 250" S of Bobwhite Lane turn around circle 23410 W. Mallard Court	42.1723	-88.0877	Determines the quality of the east branch sub-branch 1 headwaters of the east branch
FCDP2	Flint Creek East Branch Sub-Branch 1 east side of Ela Road 0.375 miles north of Long Grove Road	42.1667	-88.1019	Determines the quality of the east branch sub-branch 1 before the Cuba Marsh Forest Preserve

FCDP5	Flint Creek East Branch Sub-Branch 2 150' W of turning circle off Braemar Lane 24363 W. Hunter's Lane	42.1781	-88.1085	Determines the quality of the east branch sub-branch 2
FCB1	Flint Creek East Branch Sub-Branch 3 west end of Makray Memorial Golf Club after culvert under Northwest Hwy (RT 14)	42.1449	-88.1153	Determines the quality of out flow of Baker Lake head water of sub-branch 3
FCLC5	North End Lake Louise	42.1599	-88.1131	Determines the quality of Lake Louise
FCLC6	Flint Creek East Branch Sub-Branch 3 Lake Shore Drive bridge over Flint Creek	42.1611	-88.1152	Determines the quality of Lake Louise outflow
FCB2	Flint Creek East Branch Lake Zurich Road 320" N of Elm Road	42.1653	-88.1260	Determines the quality of Jewel Pond and Cuba Marsh outflow
FCB3T	Flint Creek East Branch Barrington POTW	42.1582	-88.1453	Determines the quality of the Barrington POTW discharge
FCB2Q	Flint Creek East Branch Hart Road bridge 0.33 miles north of Lake Cook Road north bank 50' west of bridge	42.1591	-88.1512	Determines the quality of Flint Creek East Branch before confluence with Flint Creek Main Branch
FCLC7	South End Lake Zurich	42.1955	-88.1000	Determines the quality of Lake Zurich head waters of Flint Creek North Branch
FCLC8	North End Echo Lake	42.2100	-88.0903	Determines the quality of Echo Lake
FCNB1	Flint Creek North Branch Clover Hill Lane 380" S of Miller Road 30' E of Clover Hill Road north bank	42.2112	-88.1190	Determines the quality of Flint Creek North Branch between Echo Lake and the confluence with sub-branch 1

FCNB2	Flint Creek North Branch Sub-Branch N1 Miller Road 0.3 miles E of RT 59 south side of road.	42.2120	-88.1357	Determines the quality of Sub-Branch N1 before confluence with North Branch of Flint Creek
FCLC9	Middle of Honey Lake	42.2004	-88.1301	Determines the quality of Honey Lake
FCNB7	Flint Creek North Branch Sub-Branch N2 Biltmore Drive 215" S of Beachview Lane east side of bridge	42.2018	-88.1344	Determines the quality of Honey Lake outflow
FCNB4	Flint Creek North Branch 0.2 miles S of Miller Road on RT 59 east side of bridge	42.2092	-88.1440	Determines the quality of Flint Creek North Branch before confluence with Grassy Lake
FCLC10	East End of Grassy Lake	42.2053	-88.1472	Determines the quality of Grassy Lake
FCLB4Q	Flint Creek North Branch confluence with Flint Lake NE corner of property located at 27346 W. Woodland Drive	42.2007	-88.1660	Determines the quality of Flint Creek North Branch before entering Flint Lake
SCSB1	Spring Creek Main Branch 110' N of Regency Boulevard on RT 59 west of the bridge	42.0779	-88.1899	Determines the quality of the head waters of Spring Creek
SCSB2	Spring Creek second branch making up the headwaters of Spring Creek on RT 59 0.28 miles S of Penny Road east side of bridge	42.0918	-88.1896	Determines the quality of the head waters of Spring Creek
SCBH1Q	Spring Creek Main Branch on RT 68 500' E of Healy Road north side of bridge	42.1105	-88.2116	Determines the quality of Spring Creek down stream of Penny Pond

SCBH2Q	Spring Creek Main Branch on County Line Road 0.27 miles W of Old Sutton Road north of bridge	42.1543	-88.2116	Determines the quality of Spring Creek down stream of Spring and Mud Lakes
SCFRG3Q	Spring Creek Main Branch 120' from Keystone Court on Lincoln Avenue 120' NW on right bank	42.1913	-88.2367	Determines the quality of Spring Creek before the confluence with the Fox River

Table 6 ANALYTES AND FIELD MEASUREMENTS

Group	Test	Frequency		
		Annually	Storm Events	Every 5 Years
Field Measurements	pH	X	X	
	Specific Conductivity	X	X	
	Dissolved Oxygen	X	X	
	Clarity	X	X	
	Temperature	X	X	
	Stream Discharge	X	X	
	Oxidation Reduction Potential			X
Standard Water Quality Analytes	Ammonia	X		
	Chloride	X		
	Fluoride	X		
	Total Suspended Solids	X	X	
	Total Dissolved Solids	X	X	
	Fecal Coliform/E-coli Enumeration	X	X	
	BioChemical Oxygen Demand	X	X	
	Chemical Oxygen Demand	X	X	
	Total Kjeldahl Nitrogen	X	X	
	Total Nitrate/Nitrite	X	X	
	Total Phosphorous	X	X	
	Dissolved Phosphorous	X	X	
	Cadmium	X		
	Copper	X		
	Lead	X		
	Potassium	X		
	Zinc	X		
	Phenolics	X		
	Oil & Grease	X	X	
Geochemical Characterization Analytes	Alkalinity			X
	Orthophosphate			X
	Sulfate			X
	Aluminum			X
	Barium			X
	Calcium			X
	Iron			X
	Magnesium			X
	Manganese			X
	Sodium			X
Biological Assessment	Trophic State Index	X		
	Index of Biotic Integrity	X		
	Macroinvertebrate Biotic Index	X		

Table 7 SAMPLE CONTAINER, METHODS AND HOLDING TIMES, EMT

Analysis	SpecificMethod	Container	Preservation	(days)	Needed
[Group Analysis] in Water					
300_IC-NO2_NO3_SUM	varies		No Preservative, Store at <6 C	7	
On Site Analysis in Water					
180.1_FIELD_TURBIDITY	E180.1	No container- field tested	No Preservative, Store at <6 C	2	448
2550_FIELD_TEMP-F	SM2550-B	No container- field tested	No Preservative, Store at <6 C	1	
2580B_FIELD_REDOX	SM4500-H	No container- field tested	No Preservative, Store at <6 C	0.01	
4500_FIELD_PH	SM4500-H	No container- field tested	No Preservative, Store at <6 C	0.01	
4500_FIELD_DO	SM4500-O G	No container- field tested	None	1	
Metals by ICP-MS in Water					
200.8_Al	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Ba	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Ca	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Cd	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Cu	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Fe	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_K	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Mg	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Mn	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Na	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Pb	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448
200.8_Zn	E200.8	8 oz HDPE, 1:1 HNO3 to pH <2	Nitric acid (HNO3) pH <2	180	448

TABLE 7 cont.,– METHODS AND HOLDING TIMES, EMT, Inc.

Anions by Ion Chromatography in Water					
300_IC_CL	E300	250 ml HDPE	No Preservative, Store at <6 C	28	50
300_IC_F	E300	250 ml HDPE	No Preservative, Store at <6 C	28	50
300_IC_NO2	E300	250 ml HDPE	No Preservative, Store at <6 C	2	50
300_IC_NO2	E300	250 ml HDPE	No Preservative, Store at <6 C	2	50
300_IC_NO3	E300	250 ml HDPE	No Preservative, Store at <6 C	2	50
300_IC_NO3	E300	250 ml HDPE	No Preservative, Store at <6 C	2	50
300_IC_SO4	E300	250 ml HDPE	No Preservative, Store at <6 C	28	50
Wet Chemistry in Water					
1664_FOG_HEM	E1664B	32 oz FOG, glass, 1:1 HCL to pH <2	Hydrochloric acid (HCl) pH <2 Store at <6 C	28	1000
8000_COD	HACH 8000	250 ml HDPE, 1:1 H2SO4 to pH <2	Sulfuric acid (H2SO4) pH <2 Store at <6 C	28	10
2320_ALKALINITY	SM2320 B	250 ml HDPE	No Preservative, Store at <6 C	14	50
2540C_TDS	SM2540C	500 ml HDPE	No Preservative, Store at <6 C	7	100
2540D_TSS	SM2540D	500 ml HDPE	No Preservative, Store at <6 C	7	500
4500_NH3	SM4500-NH3-B-C	16 oz HDPE, 1:1 H2SO4 to pH <2	Sulfuric acid (H2SO4) pH <2 Store at <6 C	28	200
4500_TKN	SM4500-Norg B / SM4500-NH3 BC	250 ml HDPE, 1:1 H2SO4 to pH <2	Sulfuric acid (H2SO4) pH <2 Store at <6 C	28	100
4500_PHOS-E	SM4500-P E	250 ml amber glass, 1:1 H2SO4 to pH <2	Sulfuric acid (H2SO4) pH <2 Store at <6 C	28	50
4500_PHOS-E_DISSOLVED*	SM4500-P E	250 ml amber glass, 1:1 H2SO4 to pH <2	Sulfuric acid (H2SO4) pH <2 Store at <6 C	28	50
4500_PO4-E	SM4500-P E	250 ml HDPE, Filtered	No Preservative, Store at <6 C	2	25
5210_BOD	SM5210 B	250 ml HDPE	No Preservative, Store at <6 C	2	200
9065_PHENOL	SW9065	250 ml amber glass, 1:1 H2SO4 to pH <2	Sulfuric acid (H2SO4) pH <2 Store at <6 C	28	50
*filtered in the field					
Subcontracted Analyses in Water					
9213D_Fecal Coliform/E-Coli-_SUBBED	SM9213D	100 ml HDPE sterile, Na2S2O3 tablet (Coliforms)	Sodium thiosulfate (Na2S2O3) Store at <6 C	6 hours	100

Table 8 Analytical Method Details – EMT, Inc

Analyte	Minimum Measurement Criteira	Minimum Measurement Objectives	MDL[1]	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
Turbidity	NA*		0.180	1.00	NTU	-	10	-	-	85-115	10	
Temperature	NA*	0.1 degree C°	0.00		°F	-	-	-	-	0-0	-	
pH	NA*	0.1 pH unit[3]	0.0362	0.0500	pH Units	-	10	-	-	99.27-100.73	10	
Dissolved Oxygen	NA*	0.100[4]	0.100[5]	2.00	mg/L	-	20	80-120	-	90-110	-	7782-44-7
Aluminum	No Standard		0.0200	0.125	mg/L	-	20	70-130	20	88.5-115	20	7429-90-5
Barium	No Standard		0.00150	0.0250	mg/L	-	20	70-130	20	90.2-108	20	7440-39-3
Cadmium	No Standard		0.000200	0.00250	mg/L	-	20	70-130	20	85-115	20	7440-43-9
Calcium	No Standard		0.0500	0.125	mg/L	-	20	70-130	20	85-115	20	7440-70-2
Copper	No Standard		0.00250	0.0250	mg/L	-	20	70-130	20	85.7-108	20	7440-50-8
Iron	No Standard		0.0500	0.125	mg/L	-	20	70-130	20	90.9-110	20	7439-89-6
Lead	No Standard		0.000400	0.0250	mg/L	-	20	70-130	20	85.9-110	20	7439-92-1
Magnesium	No Standard		0.0200	0.125	mg/L	-	20	70-130	20	85-115	20	7439-95-4
Manganese	No Standard		0.00100	0.0250	mg/L	-	20	70-130	20	87.7-111	20	7439-96-5
Potassium	No Standard		0.0500	0.125	mg/L	-	20	70-130	20	85-115	20	7440-09-7
Sodium	No Standard		0.0500	0.125	mg/L	-	20	70-130	20	85-115	20	7440-23-5
Zinc	No Standard		0.0100	0.0250	mg/L	-	20	70-130	20	85-98.5	20	7440-66-6
Chloride*	500 mg/L[D]	100 mg/L*	0.0200	0.0500	mg/L	-	20	90-110	20	96.9-107	-	16887-00-6
Fluoride	No Standard*		0.0100	0.0250	mg/L	-	20	90-110	20	91.6-110	-	16984-48-8
Nitrogen, Nitrate	No Standard*		0.0100	0.0250	mg/L	-	20	90-110	20	96.7-110	-	14797-55-8
Nitrogen, Nitrite	No Standard*		0.0100	0.0250	mg/L	-	20	90-110	20	92.9-103	-	14797-65-0
Sulfate	No Standard		0.0500	0.150	mg/L	-	20	90-110	20	96.4-106	-	14808-79-8
Oil and Grease (HEM)	No Standard		1.40	4.00	mg/L	-	18	78-114	18	78-105	18	
(COD)*	No Standard*		2.10	15.0	mg/L	-	10	80-120	10	91.9-110	10	
Alkalinity, Bicarbonate (As CaCO3)	No Standard		0.540	10.0	mg CaCO3/L	-	10	-	-	96.6-109	10	71-52-3
Alkalinity, Carbonate (As CaCO3)	No Standard		0.540	10.0	mg CaCO3/L	-	10	-	-	96.6-109	10	3812-32-6
Alkalinity, Total (As CaCO3)	No Standard		0.540	10.0	mg CaCO3/L	-	10	-	-	96.6-109	10	10001
Total Dissolved Solids (Residue, Filterable)	100 mg/L[G]		1.00	10.0	mg/L	-	5	-	-	91.4-103	5	
Suspended Solids (Residue, Non-filterable)	No Standard		1.40	10.0	mg/L	-	5	-	-	92.9-102	10	
pH*	NA*	0.1 pH unit[5]	0.0362	0.0500	pH Units	-	10	-	-	98.1-102	10	
Ammonia	15.0 mg/L[D]	3.0 mg/L*	0.0210	0.980	mg/L	-	20	88-108	10	95-105	20	7664-41-7
Nitrogen, Kjeldahl, Total	No Standard		0.0504	1.05	mg/L	-	20	80-120	7.15	98-102	7.15	7727-37-9
Phosphorus, Dissolved (as P)	No Standard		0.0170	0.100	mg/L	-	20	80-120	10	90-110	10	7723-14-0
Phosphorus, Total (As P	No Standard		0.0180	0.100	mg/L	-	20	80-120	10	88.3-114	10	7723-14-0
Phosphorus, Total Orthophosphate (As P)	No Standard		0.0150	0.100	mg/L	-	5.56	80-120	5.56	85-115	20	7723-14-0
BOD[5]	No Standard*		2.00	15.0	mg/L	-	20	80-120	20	84.6-115.4	20	
Phenolics	No Standard		0.00500	0.0500	mg/L	-	20	80-120	20	85-115	10	
Fecal Coliform/E. coli	200 ct/100mL[D]	40 ct/100mL*	1.00	1.00	cfu/100 ml	-	-	-	-	-	-	

Table 8 cont., Analytical Method Details – EMT, Inc

Key to Abbreviations

NA = Not Applicable
ct = count
* Limits are current and subject to change
^{s} = Required sensitivity
^{1} = Method Detection Limit (MDL) from the contract laboratory
^{G} = State of Illinois General Use Water Quality Standard

Table 9 Parameters and SOP Numbers, Environmental Monitoring and Technologies, Inc.

Parameter	SOP#
Acidity/Alkalinity	001
Subsampling of Non Homogenous Waste	003
Ammonia (Titrimetric with Distillation)	004
Total Kjeldahl Nitrogen (TKN)	006
BTU	007
BOD	008
Flash Point Closed Cup	009
Flash Point Open Cup	010
Chloride (Titrimetric)	011
COD	012
Nitrate (NO3/NO2) by HACH 8171, Modified Cadmium Reduction	013
Conductivity	014
Cyanide by Midi-CN Distillation	016
Formaldehyde in Textiles	017
Cyanide Reactive	019
Thiocyanate Colorimetric Determination	020
Fluoride by ISE	024
Hexchromium (Colorimetric)	027
Anions by IC	029
Oxidizers Screen	033
Phosphorus (Total & Ortho)	034
Phenol by distillation	036
pH in Water	038
Paint filter	039
Physical description	040
FOG 1664	044
Surfactants (MBA)	046
Residue non-filterable (TSS-VSS)	047
Residue Total	049
Total Dissolved Solids (TDS)	050
Compost Stability	051
Sulfide Reactive by Distillation	052
Sulfide Total by distillation	055
Sulfite	057
Specific Gravity and Density	058
TCLP	059
Chlorophyll A	060
TOC	063
Turbidity-Nephelometric Method	064

Parameter	SOP#
Formaldehyde	069
ZHE	070
Compatibility Screening	072
Water Content by Karl Fisher	073
Residual Chlorine DPD	076
pH in Soil	082
Sulfide by Methylene Blue	083
Hexavalent chromium by 3060-Alk Dig.	084
SPLP (Non-Volatile)	085
SPLP-ZHE (Volatile)	086
SESW	087
Bomb Prep.by Method 5050	088
FOG 1664 using Discs	090
Nitrite (NO2) by Konelab	094
Cr6 by IC	095
n-Hexane Extractable Material (HEM) for Sludge, Sediment, and Solid Samples	096
Method 1030, Ignitability of Solids	097
Method 3015 MW for WW	101
Method 245.1/7470A Hg for Liquid	102
Method 7471BA Hg for Solid	103
Method 3051 MW for Solid	104
Method 6010C ICP-AES	109
Method 200.7 ICP-AES	111
Method 3050B HB for Solid	116
Method 3005A Dissolved	117
Method 200.8 ICP-MS	118
Method 6020A ICP-MS	119
Method 3052	120
Manual Integration Policy	262
Pesticides (and PCBs) by Method 508 in DW and GW	508
VOC in DW by Method 524.2, Rev.4	524
Carbamates Pesticides by Method 531.1 in DW and Other Waters	531
Extraction of Endothall in DW by Ion Exchange Extraction and Acidic Methanol Methylation	548.1
Extraction of Dalapon Using Solid Phase Extraction Disks	552/3535
Separatory Funnel Liquid-Liquid Extraction by Method 3510C	3510C
Soxlet Extraction by Method 3540C	3540C
Soxlet Extraction by Method 3540C for Diesel Range Organics (DRO) by the WDNR	3540C/DRO/WDNR
Ultrasonic Extraction by Method 3550 B	3550B
Florisil, Sulfuric Acid and Sulfur Cleanup	3600
Gasoline Range Organics (GROs) and Diesel Range Organics (DROs), Alcohols and	8015B

Parameter	SOP#
DRO by the Wisconsin DNR Method	8015B/DRO/WDNR
GRO by the Wisconsin DNR Method	8015B/GRO/WDNR
Chlorinated Pesticides by GC/ECD	8081/608/508
PCBs by Method 8082 and 608	8082/608
VOC by Method 8260B and 624	8260B/624
SVOC by GC/MS	8270D/625
PNA by HPLC (Method 8310 and 610)	8310
Carbamates by Method 8318	8318
Extraction for N-Methylcarbamates by HPLC, Method 8318A	8318
Herbicides by Method 8321	8321B
Nitroaromatic and Nitroamine Explosive Compounds by Method 8330B	8330A/B
Extraction for Explosives	8330A/B Ext.
GRO by Method AK101	AK101
DRO by Method AK102	AK102
RRO by Method AK103	AK103
Method 3546A, microwave Extraction for Organic Soil Samples	3546A
PNA by GC/MS-SIM	SIM PNA
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Appendices

Appendix 1 – Sample Collection and Field Procedures

Appendix 2 – Standard Operating Procedures for Field Data Collection

Appendix 3 – Calibration of Stream Gages Standard Operating Procedures

Appendix 4 – Field Data Sheets

APPENDIX 1

Sample Collection and Field Procedures

COLLECTION OF IN-STREAM WATER SAMPLES

This section describes the methods used for collected water samples from the Flint and Spring Creek watersheds. These methods allow for the collection of grab samples utilizing a PVC plastic bucket and in-stream measurements. This standard operating procedures document (SOP) has been developed to maintain consistent data collection procedures and to ensure the quality of the data collected. Sample data sheet is available in Appendix 3.

1.0 FIELD EQUIPMENT

The following equipment listed is necessary for sampling procedures.

1. 1-gallon PVC bucket, nylon rope
2. Distilled or reagent-grade deionized water
3. YSI (or equivalent) field probe or pH, conductivity, temperature meter(s)
4. 1 liter amberglass jar
5. Latex free gloves
6. Sample bottles (provided by the contract laboratory):

- 250 ml. plastic bottle (w/ 1+1 H_2SO_4 to $pH < 2$)
- 250 ml. plastic bottle (NP)
- 1 Liter plastic bottle (NP)
- 500 ml. amber glass (H_2SO_4 to $pH<2$)
- 250 ml. plastic bottle (HNO_3 to $pH < 2$)
- 1 Liter plastic bottle, (H_2SO_4 to $pH<2$)
- 150 ml. sterile glass bottle ($Na_2S_2O_3$) for E.coli or fecal coliform numeration
-

The contract laboratory analyses will be run upon receipt. If that is not possible then the samples will be split and preserved at the laboratory. (ex. Copper-HNO_3, NH_3-N-H_2SO_4.)

7. Cooler and ice

8. Antibacterial soap

9. Sharpie markers and labels

10. Field books

2.0 PREPARATION

Before samples are collected, sample bottles should be labeled correctly with sampling point, sampling I.D. number, analysis required, the sampler's initials, and a space for the date and time to be filled in later. Sample bottle lids should also be labeled to prevent contamination between samples.

Coolers and samples bottles should be inspected before samples are collected. If dirt, residual chemicals, or any other types of contaminants are present, the sample bottle should be discarded. The coolers should be washed with mild soap and wiped down if any contaminants are present.

Sampling buckets, PVC plastic shall be scrubbed with a solution of soap and water. Make sure the cleaning detergent is free of phosphates (orthophosphate sample).

The sampler's hands should be washed with antibacterial soap prior to sampling events. Latex free gloves will be worn during sample collection, and special care should be taken to avoid touching the inner surface of sample lids or bottles.

3.1 PROCEDURE

Field measurements for pH, conductivity and temperature must be collected prior to sampling. Triple rinse the grab cut in the sample water prior to taking a final grab of the sample. Allow readings to stabilize before documenting any readings.
Sample bottles should be kept closed until they are filled. At each sample collection site, the sampler will wear a new pair of gloves for decontamination and a new pair for sample collection.

If samples are taken from a bridge, collect the sample from the upstream side of the structure.

When sample during precipitation events, the sample bucket shall be covered at all times with a lid.

The following information will be logged in the field log book:

a. Date of sample
b. Signature of collector

c. Signature of transporter
d. Signature of person who relinquished the sample
e. Signature of the laboratory analytical staff member who received the sample
f. Weather conditions during sampling (i.e., air temperature; cloudy, rain, snow)
g. Sampling time
h. DO, Specific conductivity, pH, and temperature measured with the YSI (or equivalent) field probe
i. Sample storage temperature
j. Visual observation of sample

3.1 Sample Collection PVC Bucket

The PVC bucket shall be inspected to ensure that it is in good condition. The nylon rope attached should not be frayed or torn.

3.1.1 Decontamination

The PVC bucket must be cleaned before samples are collected and between sampling sites. The equipment shall be cleaned with phosphate-free detergent and blank water. Blank water should be deionized water. The equipment should be scrubbed with detergent and deionized water before the rinsing steps below are followed.

Step 1 – Blank Water Rinse

- Rinse the inside of the PVC bucket by swirling with blank water.
- Discard the remaining blank water.
- Repeat Step 1.

3.2 Sample Collection Procedure

Step 1a – River Rinse and Field Measurements from Stainless Steel Bucket

- Lower the bucket into the stream and fill.
- Discard the contents.
- Lower the bucket into the stream at center and fill for field measurements (pH, temperature, dissolved oxygen, specific conductivity, and oxidation reduction potential). Alternately, take field measurements directly in-stream.
- Discard the contents

Step 2 – Sample Collection

- Lower the stainless steel bucket to mid-depth.
- Collect subsamples from left bank, center, and right bank.

Step 3 – Homogenizing Subsamples

3.3 Field Measurements

Sample pH, temperature, dissolved oxygen, specific conductivity and oxidation reduction potential are measured with a YSI (or equivalent) field probe. Field measurements should be taken from a second stream water filling of the bucket at the center of the stream. Alternately, the field measurements can be taken directly in-stream. The water is then discarded, and the bucket is filled from the stream at the three cross section locations for sample collection.

4.1 Specific Procedures, Containers, and Field Preservation for Parameters

4.2 Fecal Coliform or E.coli enumeration

The sample bottle should be kept closed until it is filled. The sampler should wear a new pair of gloves for each bacteria sample collected.

The sample bottle used is a sterile container. The lid of the bottle has a locking mechanism and a sodium thiosulfate tablet already in the bottle. After sample collection, a plastic tie, which must be cut to reopen the bottle, is used to insure sample integrity.

Step 1 – Sample Collection

- The bottle will be filled to the fill line from a grab sample taken from the center of the stream. Do not overfill; airspace is needed for mixing.
- After filling, secure the lid and plastic tie. Shake to dissolve sodium thiosulfate tablet.

4.3 Others Water Chemistry

All other samples will be collected by filling the appropriate sample bottles. Over filling of the sample bottles with preservative should be avoided to prevent loss of preservative.

5.1 SAMPLE HANDLING, TRANSPORTATION, QUALITY ASSURANCE, AND BLANKS

All samples are placed in a cooler with ice after labeling. Samples are to be transported to the laboratory within the prescribed holding times. All samples will be taken to the contract laboratory by the sampling team. The team will deliver the E.coli enumeration samples to the laboratory within the 6-hour hold time for E.coli enumeration samples. The sampling team will be responsible for contacting the laboratory and coordinating E.coli sample delivery.

5.1 Quality Assurance

Samples collected for Quality Control should make up approximately 10 percent of the total samples collected.

5.2 Duplicate Samples

Duplicate samples are to be filled from the same grab sample. Duplicate samples should be taken at three sites. Duplicate samples will be taken for all parameters at one of the sample collection intervals.

5.2.1 Field Blank

Sample bottles should be filled with blank water from unopened blank water containers. Field blanks should be performed at three sites for each sampling event.

5.2.2 Equipment Blanks

Equipment blanks should be performed at three sites for each sampling event. The equipment blanks should be performed for all parameters.

PVC Bucket

- Decontaminate bucket with blank water according to decontamination procedures.
- Fill bucket with blank water, and then fill sample bottles.

6.1 CHAIN OF CUSTODY

Chain of Custody forms (Appendix 3c) must be filled out and accompany all samples to the laboratory.

COLLECTION OF POTW EFFLUENT SAMPLES

This section describes the sampling of the plant effluent from the Barrington water treatment plant. Samples will be taken from the plant effluent. Plant effluent samples for E.coli enumeration, pH, temperature, conductivity, DO and oxidation reduction potential will be performed as a one-time grab sample directly from the effluent. A grab sample will be transported to the contract laboratory within the prescribed sample holding times for analysis. Field measurements, sample containers, field preservation for parameters, sample handling, and transportation will be similar to the methods listed above in the Collection of In-Stream Water Samples section of Appendix 1.

APPENDIX 2
Standard Operating Procedures for Field Data Collection

SOP No.	**1.10**
Revision:	**2**
Implementation Date:	**April 22, 2011**
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Approval:	

SOP 1.10 Temperature

All monitoring instruments must be calibrated before they are used to measure environmental samples. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against the thermometer that is traceable to the National Institute of Standards and Technology (NIST).

Frequency of Calibration

At a minimum, the instruments are calibrated prior to use on the day of the measurements are to be performed. A post-calibration check at the end of the day is performed to determine if the instrument drifted out of calibration. Some projects may require more frequent calibration checks throughout the day in addition to the check at the end of the day. For these checks, instrument can be recalibrated during the day if the instrument drifted out of calibration then only the data measured prior to the check would need to be qualified. The calibration/post calibration data information is recorded.

Some instruments lose their calibration criteria when they are turned off. These instruments can either be left on all day (battery dependent) are calibrated at each sampling location if they are calibrated at each sampling location a post-calibration check is not needed.

Ideally, the temperature of the standard should be close to the temperature of the ambient water that is being measured.

Temperature

Most instrument manuals state that there is no calibration of the temperature sensor, but the temperature sensor must be checked to determine its accuracy. This accuracy check is performed at least once per year and the accuracy check date/information is kept with the instrument. If the accuracy check date/information is not included with the instrument or the last check was over a year ago, the temperature sensor accuracy needs to be checked at the beginning of the sampling event. The instrument contains multiple temperature sensors, each sensor must be checked. This procedure is not normally performed in the field. If the instrument is obtained from a rental company the rental company should perform the calibration check and include with the instrument documentation that it was performed.

Calibration

1. Fill a container with water and adjust the water temperature to below the water body's temperature to be measured. Use ice or warm water to adjust the temperature.
2. Place a thermometer that is traceable to the National Institute of Standards and Technology (NIST) and the instruments temperature sensor into the water wait for both temperature readings to stabilize.
3. Compare the two measurements. The instruments temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (e.g., + or - 0.2 degrees centigrade). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.
4. Adjust the water temperature to a temperature higher than the water body to be measured.
5. Comparing the two measurements, temperature sensors must agree within the reference thermometer measurement within the accuracy of the sensor (e.g., + or - 0.2 degrees centigrade). If the measurements do not agree, then the instrument may not be working properly and the manufacturer needs to be consulted.
6. If agreement has been reached in both cases, the temperature sensors are ready for field measurements.

SOP No.	**1.20**
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SOP 1.20 pH

All monitoring instruments must be calibrated before they are used to measure environmental samples. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against the thermometer that is traceable to the National Institute of Standards and Technology (NIST).

Frequency of Calibration

At a minimum, the instruments are calibrated prior to use on the day of the measurements are to be performed. A post-calibration check at the end of the day is performed to determine if the instrument drifted out of calibration. Some projects may require more frequent calibration checks throughout the day in addition to the check at the end of the day. For these checks, instrument can be recalibrated during the day if the instrument drifted out of calibration then only the data measured prior to the check would need to be qualified. The calibration/post calibration data information is recorded.

Some instruments lose their calibration criteria when they are turned off. These instruments can either be left on all day (battery dependent) are calibrated at each sampling location if they are calibrated at each sampling location a post-calibration check is not needed.

Ideally, the temperature of the standard should be close to the temperature of the ambient water that is being assessed.

Before calibrating an instrument that has temperature sensors, make sure that the temperature sensors have been calibrated as outlined in SOP 1.10.

The pH of a sample is determined electrometrically using a glass electrode.

Choose the appropriate buffer standards that will bracket the expected values at the sampling locations. If the water body's pH is unknown, then three standards are needed for the calibration one close to seven, one at least two pH units below seven, and the other at least two pH units above seven. Instruments that will not accept these standards will need to be re-calibrated if the water samples pH is outside the initial calibration range described by the two standards.

Calibration Procedure

1. Allow the buffered standards to equilibrate to the ambient temperature.
2. Fill calibration containers with the buffered standards so that each standard will cover the pH control and temperature sensor.
3. Remove probe from its storage container, rinse with deionized water and remove excess water.
4. Select measurement mode. Immerse probe into the initial standard (e.g., pH 7).
5. Wait until the reading stabilizes. If the reading does not change within 30 seconds, and select calibration mode and the select "pH." Enter a buffered standard value into the instrument.
6. Remove probe from initial standard, rinse with the deionized water, and remove excess water.
7. Immerse probe into the second standard (e.g., pH 4). Repeat step five.
8. Remove probe from the second standard, rinse with the deionized water, and remove excess water. If instrument only accepts two standards, the combat calibration is complete. Go to step 11. Otherwise continue.
9. Immerse probe in third buffered standard (e.g., pH 10) and repeat step five.
10. Remove probe from third standard, rinse with deionized water, and remove excess water.
11. To ensure that the initial calibration standard (e.g., pH 7) is not changed, immersed the probe into the initial standard. Wait for the readings to stabilize. The reading should read the initial standard value within the manufacturer's specifications. If not, re-calibrate the instrument. If re-calibration does not help, the calibration range may be too great. Reduce calibration range by using standards that are closer together.
12. The calibration is complete. Rinse the probe with deionized water and store the probe according to manufacturer's instructions.

SOP No.	**1.30**
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SOP 1.30 Dissolved Oxygen

All monitoring instruments must be calibrated before they are used to measure environmental samples. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against the thermometer that is traceable to the National Institute of Standards and Technology (NIST).

Frequency of Calibration

At a minimum, the instruments are calibrated prior to use on the day of the measurements are to be performed. A post-calibration check at the end of the day is performed to determine if the instrument drifted out of calibration. Some projects may require more frequent calibration checks throughout the day in addition to the check at the end of the day. For these checks, instrument can be recalibrated during the day if the instrument drifted out of calibration then only the data measured prior to the check would need to be qualified. The calibration/post calibration data information is recorded.

Some instruments lose their calibration criteria when they are turned off. These instruments can either be left on all day (battery dependent) are calibrated at each sampling location if they are calibrated at each sampling location a post-calibration check is not needed.

Ideally, the temperature of the standard should be close to the temperature of the ambient water that is being assessed.

Before calibrating an instrument that has temperature sensors, make sure that the temperature sensors have been calibrated as outlined in SOP 1.10.

Dissolved oxygen (DO) content in water is measured using a membrane electrode. To ensure proper operation, the DO probes membrane and electrolyte should be replaced prior to calibration for the sampling event. The new membrane may need to be conditioned before it is used; consult manufacturer's manual on how the conditioning is to be performed. Failure to perform this step may lead to erratic measurements. Before performing the calibration/measurements, inspect the membrane for air bubbles and nicks.

Note: some manufacturers require an altitude correction instead of a barometric correction. In that case, enter the altitude correction according to the manufacturer's directions in step five and

Note : some instruments have a built-in barometer. Follow the manufacturer's instructions for entering the barometric value in step 5.

Calibration

1. Gently dry the temperature sensor and remove any water droplets from the DO probe's sensor membrane according to the manufacturer's instructions. Note that the evaporation of moisture on the temperature sensor or DO probe may influence the readings during calibration.

2. Create a 100% water-saturated air environment by placing a wet sponge or a wet paper towel on the bottom of the DO calibration container. The probe is loosely fitted into the calibration container to prevent the escape of moisture evaporating from the sponge or paper towel while maintaining ambient pressure (see manufacturer's instructions). Note that the probe and the temperature sensor must not come in contact with these wet items.

3. Allow the confined air to become saturated with water vapor (saturation occurs in approximately 10 to 15 minutes). During this time turn on the instrument to allow the DO probe to warm-up.. Select measurement mode. Check the temperature readings. Readings must stabilize before continuing to the next step.

4. Select calibration mode; then select "DO%."

5. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument. This measurement must be determined from on-site barometer. Do not use barometric pressure obtained from the local weather services unless the pressure is corrected for the elevation of the sampling location. [Note: inches of mercury times 25.4 mm/inch equals mm of mercury or consult Oxygen Solubility at Indicated Pressure Chart.

6. The instrument should indicate that the calibration is in progress. After calibration, the instrument should display percent saturated DO.

7. Select measurement mode and set the display to read DO mg/L and temperature. Compare the DO mg/L reading to Oxygen Solubility at Indicated Pressure chart. The numbers should agree. If they do not agree within the accuracy of the instrument (usually + or - 0.2 mg/L), repeat calibration. If this does not work, change the membrane and electrolyte solution.

8. Remove the probe from the container and place it into a 0.0 mg/L DO solution (see footnote). Check temperature readings. They must stabilize before continuing.

9. Wait until the "mg/L DO readings have stabilized. The instrument should read less than 0.5 mg/L (assuming inaccuracy of + or - 0.2 mg/L. If the instrument reads above 0.5 mg/L or reads negative, it will be necessary to clean the probe, and change the membrane and electrolyte solution. If this does not work, try a new 0.0 mg/L DO solution. If these changes do not work, contact the manufacturer. Note: some projects

and instruments may have different accuracy requirements. The 0.5 mg/L value may need to be adjusted based on the accuracy requirements of the project or instrument.

10. After the calibration has been completed, rinse the probe with tap or deionized water and store the probe according to manufacturer's instructions. It is important that all of the 0.0 mg/L DO solution be rinsed off the probe so as not to affect the measurement of environmental samples.

Note: you can either purchase the 0.0 mg/L DO solution from a vendor or prepare the solution yourself. To prepare a 0.0 mg/L DO solution, follow the procedure stated in Standard Methods (Method 4500-O G). The method basically states to add excess sodium sulfite (until no more dissolves) and a trace amount of cobalt chloride (read warning on the label before use) to water. This solution is prepared prior to the sampling event. Note: this solution can be made without cobalt chloride, but the probe will take longer to respond to the low D.O. concentration.

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SOP 1.40 Specific Conductance

All monitoring instruments must be calibrated before they are used to measure environmental samples. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against the thermometer that is traceable to the National Institute of Standards and Technology (NIST).

Frequency of Calibration

At a minimum, the instruments are calibrated prior to use on the day of the measurements are to be performed. A post-calibration check at the end of the day is performed to determine if the instrument drifted out of calibration. Some projects may require more frequent calibration checks throughout the day in addition to the check at the end of the day. For these checks, instrument can be recalibrated during the day if the instrument drifted out of calibration then only the data measured prior to the check would need to be qualified. The calibration/post calibration data information is recorded.

Some instruments lose their calibration criteria when they are turned off. These instruments can either be left on all day (battery dependent) are calibrated at each sampling location if they are calibrated at each sampling location a post-calibration check is not needed.

Ideally, the temperature of the standard should be close to the temperature of the ambient water that is being assessed.

Before calibrating an instrument that has temperature sensors, make sure that the temperature sensors have been calibrated as outlined in SOP 1.10.

Conductivity is used to measure the ability of an aqueous solution to carry electrical current. Specific conductance is the conductivity value corrected to 25 degrees centigrade.

Most instruments are calibrated against a single standard which is near the specific conductance of the environmental samples. The standard can be either below or above the specific conductance of the environmental samples. A second standard is used to check the linearity of the instrument in the range of measurements.

When performing specific conductance measurement on groundwater or surface water and the measurement is outside the initial calibration range defined by the two standards, the instrument will need to be re-calibrated using the appropriate standards.

Specific Conductance Calibration Procedure

1. Allow the calibration standards to equilibrate to the ambient temperature.
2. Fill calibration containers with the standards so each standard will cover the probe and temperature sensor. Remove probe from its storage container, rinse the probe with the deionized water or a small amount of the standard (discard the rinsate), and place the probe into the standard.
3. Select measurement mode. Wait until the probe temperature has stabilized.
4. Select calibration mode then specific conductance. Enter the specific conductance standard value. Make sure that the units on the standard are the same as the units used by the instrument. If not, convert the units on the standard to the units used by the instrument.
5. Select measurement mode. The reading should remain within manufacturer's specifications. If it does not, re-calibrate. If readings continue to change after recalibration, consult manufacturer or replace calibration solution.
6. Remove probe from the standard, rinse the probe with deionized water or a small amount of the second standard (discard the rinsate), and place the probe into the second standard. The second standard will serve the verified the linearity of the instrument. Read the specific conductance value from the instrument and compare the value to the specific conductance on the standard. The two values should agree within the specifications of the instrument. If they do not agree, re-calibrate. If readings do not compare, then the second standard may be outside the linear range of the instrument. Use a standard that is closer to the first standard and repeat the verification. If values still do not compare, try cleaning the probe or consulting the manufacturer.
7. After the calibration has been completed, rinse the probe with deionized water and stored to probe according to manufacturer's instructions.

Note: for projects were specific conductance is not a critical measurement it may be possible to calibrate with one standard in the range of the expected measurement.

SOP No.	**1.50**
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SOP 1.50 Oxidation Reduction Potential (ORP)

All monitoring instruments must be calibrated before they are used to measure environmental samples. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against the thermometer that is traceable to the National Institute of Standards and Technology (NIST).

Frequency of Calibration

At a minimum, the instruments are calibrated prior to use on the day of the measurements are to be performed. A post-calibration check at the end of the day is performed to determine if the instrument drifted out of calibration. Some projects may require more frequent calibration checks throughout the day in addition to the check at the end of the day. For these checks, instrument can be recalibrated during the day if the instrument drifted out of calibration ten only the data measured prior to the check would need to be qualified. The calibration/post calibration data information is recorded.

Some instruments lose their calibration criteria when they are turned off. These instruments can either be left on all day (battery dependent) are calibrated at each sampling location if they are calibrated at each sampling location a post-calibration check is not needed.

Ideally, the temperature of the standard should be close to the temperature of the ambient water that is being assessed.

Before calibrating an instrument that has temperature sensors, make sure that the temperature sensors have been calibrated as outlined in SOP 1.10.

The oxidation/reduction potential is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. This electrometric difference is measured in millivolts and is temperature dependent.

Calibration Procedure

1. Allow the calibration standard (a Zobell solution: read the warning on the label before use) to equilibrate to ambient temperature.

2. Remove the probe from its storage container and place it into the standard.

3. Select measurement mode.
4. Wait for the probe temperature to stabilize, and then read the temperature.
5. If the instrument is to be calibrated, do Steps 6 and 7. If the instrument calibration is to be verified, then go to Step 8.
6. Look up the millivolt (mv) value at this temperature from the millivolt versus temperature correction table usually found on the standard bottle or on the standard instruction sheet. You may need to interpolate millivolts value between temperatures. Select calibration mode", then "ORP." Enter the temperature-corrected ORP value into the instrument.
7. Select measurement mode. The readings should remain unchanged within manufacturer's specifications. If they change, re-calibrate. If readings continue to change after re-calibration, try a new Zobell solution or consult manufacturer. Go to Step 9.
8. If the instrument instruction manual states that the instrument is factory calibrated, then verify the factory calibration against the Zobell solution. If they do not agree within the specifications of the instrument, try a new Zobell solution. If it does not agree, the instrument will need to be re-calibrated by the manufacture.
9. After the calibration has been completed, rinse the probe with deionized water and store the probe according to manufacturer's instructions.

SOP No.	**5.22**
Revision:	**2**
Implementation Date:	**April 16, 2008**
Last Reviewed/Update Date:	**April 16. 2008**
Approval:	

SOP 5.22 Estimating Water Clarity Using A Secchi Disk

This SOP establishes a standardized method for performing semi-quantitative field measurements of water clarity and lakes, ponds, rivers, streams, and creeks using a Secchi disk. It sets a consistent protocol to ensure the quality of data collected resulting in improved uniformity, reproducibility, verifiability, and defensibility of the data, as well as increased credibility.

Materials

The following materials are necessary for this procedure:

- Secchi disk and attachment clip/structure (similar to Forestry Suppliers Item Number 77912)
- AquaVue^{TM} tube (similar to Wildco Item Number 79 – 015)
- Fiberglass Measuring tape (0.1 meter increments) (similar to Grainger Item Number 3VZJ 6)
- Data sheet or field notebook printed on waterproof paper (similar to Grainger Item Number 3XFR7).
- Clipboard.
- Pencil or Rite in the Rain Pen (similar to Forestry Suppliers Item Number 49237).
- Boat, canoe, kayak or waders.
- Paddles and motor.
- Anchors.
- Lifejackets.
- Depth finder.

Using the Secchi Disk in the Field

For most purposes, the Secchi disk is used specifically for in situ water clarity measurements taken directly in the field, in lakes, ponds, reservoirs, rivers, streams and creeks this method does not require sample containers or preservation.

Recording Parameter Units

The following units should be used when recording measurements taking with the Secchi disk:

Secchi depth.................................meters

Taking the Secchi Depth Measurement

Secchi depth measurements are conducted in the following manner regardless of whether you are in a boat or in waders standing in a stream.

The field analyst should remove sunglasses (prescription or non-prescription) but continue to wear any clear prescription glasses. Determine the position of the sun and position yourself so that the sun is at your back. This reduces the glare from the water. When taking a measurement the Secchi disk should remain in the water directly below your hand holding the measuring tape/line attached to the Secchi disk. If the current or wind causes the disk to drift, extra weight should be added to the disk to avoid skewed measurements when read at an angle.

- Unwind a measuring tape attached to the Secchi disk to equal the deepest spot or desired depth. Place your foot gently on the measuring tape wheel in case you drop the equipment.
- In one hand, hold the AquaVue™ tube by the handle and lower the end with the lens approximately 4 inches into the water. In your other hand, hold the measuring tape with the Secchi disk (securely attached) over the water.
- Look through the viewing end of the AquaVue™ tube.
- Using the measuring tape, slowly lower the Secchi disk in the water and watch through the AquaVue™ tube until it disappears from view or hits the bottom (if completely clear). If the Secchi disk hits the bottom and is still visible, record depth at the water surface and write "VOB" indicating the Secchi disk is visible on the bottom on the datasheet or appropriate field notebook. Do not continue with the steps listed below.
- Read aloud the depth that the water's surface to the nearest 10th of a meter to the second field analyst and then lower the Secchi disk deeper (another 0.3 meters). The second analyst should record this number on the datasheet or appropriate field notebook.
- Slowly begin to raise the Secchi disk. When you can make out the Secchi pattern stop raising the Secchi disk.
- Read and record the depth at the water surface.
- The second field analyst should determine the average of the two recorded depth and round to the nearest 10th of a meter the average value should be recorded on the datasheet.
- Remove all equipment from the water and repeat the entire measurement procedure as detailed above and record the second set of Secchi depth measurements on the datasheet. If the two average Secchi measurements are not within five percent repeat the measurement a third time. Calculate the five percent error by multiplying Secchi

- measurement one by 0.05 and rounding to the nearest 10th. Adding and subtracting the resulting value to the first reading will give the range of acceptable second readings. If the second reading falls in this range than the reading is accepted if the second reading does not fall in this range than a third Secchi measurement should be taken.

- Example: Secchi 1 = 6.5; Secchi 2 = 6.7
  6.5*0.05 = 0.325 (rounded 0.3)
  Acceptable range = 6.2 to 6.8

APPENDIX 3

SOP 9.13 Calibration of Stream Gages

The U.S. Geological Survey (USGS) Central Midwest Water Science Center (CM WSC) currently operates over 200 stream gages in Illinois that provide real-time discharge data. The data provided by these stream gages are used for many reasons including flood/drought monitoring, forecasting, recreation, water supply, streamflow studies, and water-quality. Stage data recorded at USGS stream gages are used to compute discharge based on an established relation between stage and discharge, called a stage-discharge rating. A unique stage-discharge rating is developed for each stream gage based on direct measurements of discharges made at various stages observed at the location.

The USGS CM WSC will provide streamflow discharge measurements for the purpose of stage-discharge rating development. These measurements will be provided to KOT Environmental Consulting INC to allow them to develop stage-discharge ratings. In order to accurately measure stage, the USGS will install a reference mark for use in determining the stage while discharge measurements are performed utilizing USGS Techniques and Methods 3-A7 (Sauer and Turnipseed, 2010). The reference gage will be surveyed according to USGS Techniques and Methods 3-A19 (Kenny, 2010) to ensure stability of the mark. All stage readings are referenced to a common datum, such as the National American Vertical Datum of 1988 (NAVD88). Establishment of the datum is completed according to USGS Techniques and Methods 11-D1 (Rydlund and Densmore, 2012). Discharge measurements will be event based and at the request of the cooperator. Up to six discharge measurements at five sites provided by the cooperator will be made during a six month period to cover the range of observed flows at each location. Discharge measurements will be made according to USGS Techniques and Methods 3-A8 (Turnipseed and Sauer, 2010). USGS data managers will set up site station numbers and develop formatting for archival of the measurements and other station details. Field crews will make discharge measurements upon request of the cooperator with at least 24 hours advanced notice by the cooperator. Measurements will not be made during the winter months when the stream is affected by ice as these types of measurements are not used in stage-discharge rating development. After discharge measurements have been made, measurements will be reviewed, archived, and provided to the cooperator.

References:

Kenny T.A., 2010. *Levels at Gaging Stations: U.S. Geological Survey Techniques and Methods 3-A19*. Accessed at: https://pubs.usgs.gov/tm/tm3A19/tm3A19.pdf, on February 27th, 2020.

Rydlund P.H. Jr. and Densmore B.K., 2012. *Methods of Practice and Guidelines for Using Survey-Grade Global Navigation Satellite Systems (GNSS) to Establish Vertical Datum in The Unites States Geological Survey: U.S. Geological Survey Techniques and Methods 11-D1*. Accessed at: https://pubs.usgs.gov/tm/11d1/tm11-D1.pdf, on February 27th, 2020.

Sauer, V.B. and Turnipseed, D.P., 2010. *Stage Measurement at Gaging Stations: U.S. Geological Survey Techniques and Methods 3-A7*. Accessed at: https://pubs.usgs.gov/tm/tm3-a7/tm3a7.pdf, on February 27th, 2020.

Turnipseed D.P. and Sauer V.B. 2010. *Discharge Measurements at Gaging Stations: U.S. Geological Survey Techniques And Methods 3-A8*. Accessed at: https://pubs.usgs.gov/tm/tm3-a8/tm3a8.pdf, on February 27th, 2020.[JJ1]

APPENDIX 4 FIELD DATA SHEETS

APPENDIX 4a
ENVIRONMENTAL MONITORING AND TECHNOLOGIES, INC. FIELD DATA SHEET

ENVIRONMENTAL
MONITORING AND
TECHNOLOGIES, INC.

Field Information Form

Site/Sample ID: ______________ **LatDD:** ____________ **LongDD:** ____________

Stream Name and Location Description: ________________________________

Field Parameter Collection Time: __________ **Sample Collection Time:** ______________

Field Parameters

pH	Temperature (°C)	D.O. (mg/L)	D.O. (% Saturation)	Turbidity (ntu)	Conductance (µmhos/cm)	Alkalinity (mg/L as $CaCO_3$)	Acidity (mg/L as $CaCO_3$)

Total Discharge: __________(cfs) **Total Discharge:** ______________(gpm)
(Refer to corresponding Stream Discharge Measurement Form for additional flow information)

Weather Conditions

Direction/Speed: __________ Outlook: ____°C__________ Precipitation: Y or N

Stream Conditions

Flow:__________ Visual Turbidity:__________ Stream Bed Conditions: ______________

Additional Comments: ________________________________

Specific Comments: ________________________________

I certify that sampling procedures were in accordance with applicable federal, state, and EMT protocols:

__/__/__ Date	Name	Signature	Company
__/__/__ Date	Name	Signature	Company

APPENDIX 4b METER CALIBRATION LOG

ENVIRONMENTAL
MONITORING AND
TECHNOLOGIES, INC.

Meter Calibration Log

Project Name: ____________________ Date: ____________________

Technician(s): ____________________

Meter: ____________________ Serial No: ____________________

pH

Time	pH 10 Buffer Check	pH 7 Buffer Check	pH 4 Buffer Check	Temperature (°C)

Sp. Conductivity

Time	Corrected Cond. @ 25° C	Temperature (°C)

Dissolved Oxygen

Time	% Saturation	Temperature (°C)

Turbidity

Time	Standard (NTU)	Reading

Meter: ____________________ Serial No: ____________________

__/__/__ Date	Name	Signature	Company
__/__/__ Date	Name	Signature	Company

APPENDIX 4c STREAM DISCHARGE MEASUREMENT FORM

ENVIRONMENTAL
MONITORING AND
TECHNOLOGIES, INC.

Stream Discharge Measurement Form

Site ID: ______________

Measurement Time Start: ____________ Measurement Time Stop: __________

Total Width in Cross-Section: ______(ft) Cross-Section and Reach Depth:______________(ft)

Total Cross-Section Area: ________(ft²) Reach Length between Detection Stations: _______(ft)

Float-Velocity/area Method

Trial #	Time (seconds)	Trial #	Time (seconds)
B1		B4	
B2		B5	
B3		B6	

Average Time: _________(s)

$Q = AL/T$

Whereas:
Q = discharge in cfs
A = average cross-sectional area of reach length in square feet
L = reach length between detection stations in feet
T = recorded time required for float to travel between the detection stations at each end of the measurement reach in seconds

Total Discharge: _________(cfs) Total Discharge: ___________(gpm)

COMMENTS: ____

Appendix 4d STREAM DISCHARGE MEASUREMENT FORM

ENVIRONMENTAL
MONITORING AND
TECHNOLOGIES, INC.

Stream Discharge Measurement Form

Site ID: ______________

Measurement Time Start at REW: ____________ Measurement Time Stop at LEW: _________

Total Width: ________________ (ft) Total Area: ____________(ft^2)

Point	Distance From Initial Point (ft)	Angle coefficient	Width (ft)	Depth (ft)	Velocity (ft/s) At point	Velocity (ft/s) mean in Vertical	Adjusted for hor. angle	Area (ft^2)	Discharge (cfs)
B1									
B2									
B3									
B4									
B5									
B6									
B7									
B8									
B9									
B10									
B11									
B12									
B13									
B14									
B15									
B16									
B17									
B18									
B19									
B20									
B21									
B22									
B23									
B24									
B25									
B26									
B27									
B28									
B29									
B30									

Total Discharge: _________(cfs) Total Discharge: __________(gpm)

Methods Used:

☐ 0.6 Depth Method
Depths </= 2.5ft

☐ 2 - Point Method
Depths > 2.5ft

☐ 3 - Point Method
Depths > 2.5ft (Velocity at .2 depth 2x velocity at .8 depth)

☐ 3 - Point Method
Depths > 2.5ft (Velocity at .8 > velocity at .2 depth)

COMMENTS: ____

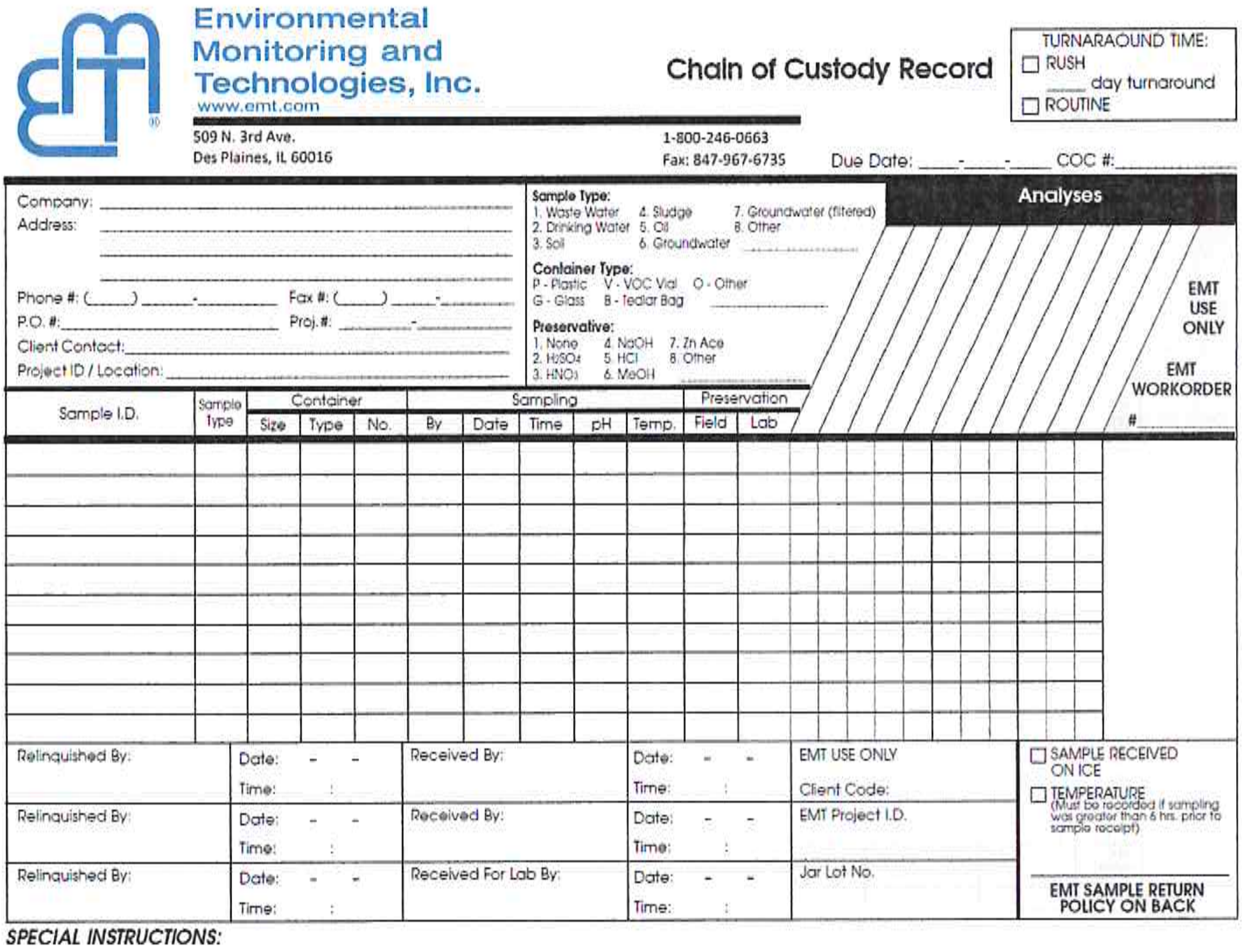
____

____

__/__/__ Date ________________ Name ________________ Signature ________________ Company

__/__/__ Date ________________ Name ________________ Signature ________________ Company

Appendix 4e CHAIN OF CUSTODY RECORD – page 1 of 2



Environmental Monitoring and Technologies, Inc.
www.emt.com
509 N. 3rd Ave.
Des Plaines, IL 60016

Chain of Custody Record

1-800-246-0663
Fax: 847-967-6735

TURNAROUND TIME:
☐ RUSH
____ day turnaround
☐ ROUTINE

Due Date: ____-____-____ COC #:__________

Company: ____________________
Address: ____________________
Phone #: (____) ____-______ Fax #: (____) ____-______
P.O. #:__________ Proj. #: _____-_____
Client Contact:____________________
Project ID / Location: ____________________

Sample Type:
1. Waste Water 4. Sludge 7. Groundwater (filtered)
2. Drinking Water 5. Oil 8. Other
3. Soil 6. Groundwater __________

Container Type:
P - Plastic V - VOC Vial O - Other
G - Glass B - Tedlar Bag __________

Preservative:
1. None 4. NaOH 7. Zn Ace
2. H_2SO_4 5. HCl 8. Other
3. HNO_3 6. MeOH __________

Analyses

EMT USE ONLY

EMT WORKORDER #________

Sample I.D.	Sample Type	Container			Sampling					Preservation												
		Size	Type	No.	By	Date	Time	pH	Temp.	Field	Lab											

Relinquished By:	Date: - - Time: :	Received By:	Date: - - Time: :	EMT USE ONLY Client Code:	☐ SAMPLE RECEIVED ON ICE ☐ TEMPERATURE (Must be recorded if sampling was greater than 6 hrs. prior to sample receipt)
Relinquished By:	Date: - - Time: :	Received By:	Date: - - Time: :	EMT Project I.D.	
Relinquished By:	Date: - - Time: :	Received For Lab By:	Date: - - Time: :	Jar Lot No.	**EMT SAMPLE RETURN POLICY ON BACK**

SPECIAL INSTRUCTIONS:

Page 1 of 2

Appendix 4e CHAIN OF CUSTODY RECORD – page 2 of 2

LIMITATIONS OF LIABILITY

Environmental Monitoring & Technologies, Inc. (EMT) performs analytical services with reasonable care and diligence standard to the analytical laboratory industry. In the event of an error or material deficiency in the performance of its duties, the sole and exclusive responsibility of EMT shall be to again perform the laboratory analysis at its expense. EMT shall have no other liability whatsoever.
Any claims of error or material deficiency in the performance of its duties are to be reported to EMT within thirty (30) days of discovery, but no later than one (1) year from the date of performance of the analytical services. In no event shall EMT be liable, whether in contract, in tort or otherwise, for any incidental, consequential or special damages, including but not limited to damages in any way connected with the use or interpretation of analyses and additional information provided by EMT.

DISCLAIMER AND ASSUMED CLIENT RESPONSIBILITY

EXCEPT AS PROVIDED ABOVE, ENVIRONMENTAL MONITORING & TECHNOLOGIES, INC. (EMT) HAS PROVIDED NO EXPRESSED OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE CONCERNING THE SERVICES AND RELATED REPORTS FURNISHED BY EMT.

STANDARD TERMS AND CONDITIONS

All work performed by EMT shall be in accordance with the Standard Terms and Conditions in effect as of the date of the performance of the work. EMT Standard Terms and Conditions are subject to change without notice.

SAMPLE ACCEPTANCE POLICY

All samples must be submitted with a completed and properly executed Chain-of-Custody (COC) record. The COC record should be filled out in ink. In addition to name, address and contact information, additional information that must be included on the COC form in order for it to be considered complete includes:

- ☐ Sample Identification
- ☐ Sample Type
- ☐ Sample Container Information (size, type, and number)
- ☐ Sampling Information (date, time, and sample collector's initials)
- ☐ Preservative (if any) added to sample in the field
- ☐ Analyses/Methods requested
- ☐ Special remarks regarding the sample, its collection, or specific reporting limits that are needed
- ☐ All individuals who handled or possessed the samples must sign the COC.

For all Samples:

1. Samples must be received in the appropriate containers required by the test methods and be in good condition without any visible signs of damage or contamination.
2. Sufficient sample volume must be received within the holding time defined by the regulatory agency, to perform the analyses/methods requested.
3. All samples and sample containers must be properly labeled with a unique identifier for each sample and sample container and be in agreement with the COC record.
4. Sample labeling must be completed using waterproof labels and permanent ink markings.
5. Environmental samples require thermal preservation. Temperature for sample shipment/storage should be 2-6°C. It is the responsibility of the person collecting and packaging the samples to make sure the temperature requirements are met.
6. Please note on the COC if samples may be hazardous or highly contaminated.

Please review the following checks for proper shipment of samples to EMT:

- ✓ Please reuse packing material sent with the bottle order to prevent bottle breakage. Completely fill cooler with packing materials to ensure bottles will not shift if cooler is placed on its side, or handled in a rough manner.
- ✓ Enclose completed COC form in plastic zip-lock provided.
- ✓ Seal cooler with sufficient packing tape to prevent opening during return shipment.
- ✓ Return shipment per instructions provided by EMT personnel.
- ✓ Please ice samples so that the samples are received at the desired temperature.

! IMPORTANT !: Sample containers provided by EMT may contain very small amounts of preservatives required by the requested test method; containers will be labeled accordingly. The preservatives are likely to be strong acids or bases, and can cause superficial burns to skin and/or damage clothing. Extra care should be exercised while handling and filling pre-preserved sample containers.

- ☐ **Please do not rinse the pre-preserved sample containers.**
- ☐ **Fill sample containers to approximately 1-inch of the bottle top (with the exception of volatile analysis).**
- ☐ **Cap bottles tightly.**

Samples not submitted in accordance with the above procedures are required to be "flagged" by detailing the discrepancy on the final report in accordance with National Environmental Laboratory Accreditation Program (NELAP) requirements.

(11/02)