



Bioassessment 2-Year Monitoring Strategy for the North Branch Chicago River Watershed

March 19, 2018 (Revised April 2, 2019)

FAA#3191812

Purpose

The North Branch Watershed Workgroup (NBWW) will undertake a comprehensive monitoring program to document the existing water quality status of the rivers and streams in the sub-watersheds of the North Branch Chicago River watershed within Lake County and Cook County, Illinois. The monitoring program will emphasize the direct assessment of biological assemblages by sampling fish and macroinvertebrates using standardized sampling and assessment methodologies. In addition to determining aquatic life status, the monitoring program will also ascertain the related causes and sources associated with biological impairments by using paired chemical, physical and other stressor data and information within a systematic analytical process detailed in a comprehensive plan of study, specifically monitoring habitat and water and sediment chemistry.

The Monitoring Strategy is considered a living document. The NBWW Monitoring & Water Quality Impairment Abatement Committee will use adaptive management to review the results of the monitoring program and will revise and update the Monitoring Strategy if changes are needed. After the first two years, all of the sites will have been sampled for biological attributes and water chemistry. At that time, the Monitoring Strategy will be reviewed before the next full assessment begins.

Introduction and Background

The project area (see Figure 1) consists of the North Branch Chicago River watershed, covering approximately 50 square miles in Lake County, Illinois and 44 square miles in Cook County, Illinois. Three tributary subwatersheds made up of 55 miles of rivers and streams make up the watershed: West Fork North Branch Chicago River (West Fork, HUC 12: 071200030103), Middle Fork North Branch Chicago River (Middle Fork, HUC 12: 071200030102 and upper portions of 071200030105) and Skokie River (HUC 12: 071200030101). Each of the three subwatersheds originate in Lake County and flow south into Cook County where they converge in Morton Grove to form the mainstem of the North Branch of the Chicago River. The North Branch Chicago River flows south through the Chicago River, South Branch and Sanitary and Ship Canal to join with the Des Plaines River, which is a tributary of the Illinois and Mississippi Rivers.

Portions of the North Branch Chicago River, tributaries and lakes within the watershed in Lake County and Cook County are listed as impaired by the Illinois EPA and do not meet their designated uses under the Clean Water Act. Segments are listed as impaired for pollutants including aldrin, cadmium, chromium, hexachlorobenzene, nickel, barium, chloride, copper, endrin, lead, mercury, silver, sediment/siltation, total phosphorus, bottom deposits, chlordane, Dichlorodiphenyltrichloroethane (DDT), fecal coliform, total suspended solids, dissolved oxygen (DO), and temperature. Most of the impairments are being directly monitored (see Tables 2 & 3). However, E. coli is being monitored for the fecal coliform impairment and Total Suspended Solids is being monitored for the sediment/siltation and bottom deposits impairment, as well as including a robust sediment chemistry analysis in the program. The parameter "pesticides" includes analysis of aldrin, endrin, chlordane and DDT.

A North Branch Chicago River Watershed Stage 3 Total Maximum Daily Load (TMDL) Report is under development for some stream segments within the watershed for fecal coliform, DO and chloride. However, it is unclear as to whether implementation of the TMDL recommendations and the existing regulatory mechanisms will ultimately allow for the impaired waterbodies to meet Clean Water Act standards. The NBWW brings together local stakeholders to better determine stressors to the aquatic system through a long-term water quality monitoring program to work together to preserve and enhance water quality in the North Branch Chicago River and its tributaries. The preliminary monitoring strategy was developed by the NBWW Monitoring & Water Quality Impairment Abatement Committee.

NBWW Program Goals

The NBWW will undertake a comprehensive monitoring program to fulfill the following goals:

- Develop and implement a comprehensive monitoring program that will include chemical, physical and biological components that will more accurately identify the quality of stream and river ecosystems as well as stressors associated with non-attainment of water quality standards and designated uses. The NBWW monitoring program will establish baseline conditions, and then measure progress towards meeting water quality standards.
- Provide a secondary benefit to NPDES permittees by meeting certain monitoring permit requirements, including monitoring requirements for upstream and downstream of Publicly Owned Treatment Works (POTWs) and Municipal Separate Storm Sewer Systems (MS4s).

Budget and Timeline

The NBWW will use annual membership dues to support the comprehensive monitoring program. Qualified contractors will be thoroughly screened. Preliminary annual budget (based on 2019 budget):

- Annual dues: \$122,478
 - \$6,000 Technical Support
 - \$19,000 Administration/Management
 - \$87,964 Monitoring Program
 - Monitoring Compilation and Statistics
 - Water column Chemistry Monitoring
 - Sediment Chemistry Analysis
 - Bioassessment Monitoring/Sediment Collection
 - Benthic chlorophyll a Analysis

Monitoring Program

Monitoring of the North Branch Chicago River Watershed will consist of a bioassessment program (sampling of fish, macroinvertebrates and habitat), continuous dissolved oxygen (DO) monitoring, benthic periphyton sampling, and water column and sediment sampling to evaluate ecosystem quality and stressors. The monitoring program will be conducted at 25 sites throughout the North Branch Chicago River watershed within Lake County and Cook County, Illinois as shown in Figure 1 and listed in Table 1. The water column chemistry monitoring will be completed six times annually throughout the watershed with a tiered site design, as shown in Table 2. Tier 1 and 2 sites (all 25 sites) are sampled 4 (four) times per year and stay the same year after year. Tier 3 sites are a subset of the Tier 1 and 2 sites and receive an additional 2 (two) sampling events each year to complement the bioassessment. The Tier 3 sites change each year to follow the bioassessment locations. The bioassessment program, consisting of monitoring of fish, macroinvertebrates and habitat will be completed on a two-year

rotating basis. Water column and sediment sampling, sediment chemistry, continuous DO monitoring, benthic periphyton sampling and two additional nutrient water chemistry sample events will be completed on a two-year rotating basis concurrent with the bioassessment program.

Training and Certification

The methods and protocols used in the proposed study require implementation by adequately trained and skilled biologists, field technicians, and laboratory staff. For the bioassessment, the lead biologist(s) must be well trained and experienced in all aspects of conducting the sampling, making decisions that affect quality in the field, being familiar with the study area, and knowing how to identify all species of fish and taxa of macroinvertebrates that will be encountered. Biological crew leaders must also be knowledgeable about safety procedures for boat electrofishing and boat and water safety. All crew leaders will be certified as Level 3 Qualified Data Collectors under the Ohio Credible Data Law (OCDL) or equivalent.

Field personnel assigned to this project will be directly supervised by the principal investigator and will have been trained by the principal investigator in an apprenticeship format (training documentation provided upon request). Of particular importance will be training in the electrofishing procedure, use of the modified QHEI, and the identification of external anomalies on fish. Each will follow the procedures outlined in Ohio EPA (1989) and Rankin (1989). Bioassessment laboratory personnel will adhere to the laboratory's internal protocols.

For the water column and sediment investigation, all laboratory staff utilizing the methods and protocols addressed in this study meet or exceed the educational requirements outlined in the NSWRD Quality Assurance Project Plan (QAPP). For each analysis, the chemist must demonstrate proficiency for each individual analysis. The proficiency requirements are typically defined in the specific method, within the U.S. EPA program for which the work is performed, within the National Environmental Laboratory Accreditation Program (NELAP) requirements and NSWRD's QAPP. The NSWRD Laboratory and its sub-contractors are NELAP accredited.

Field technicians assigned to this project, for the purpose of collecting samples and performing the analyses that are required to be completed in the field, have received adequate training from trained and experienced personnel. Field technicians will operate under the guidance and supervision of the Laboratory Supervisor. The field technicians are trained to be compliant with the requirements set forth by NELAP, U.S. EPA, and NSWRD's QAPP where applicable.

Monitoring Site

Monitoring sites are located on the North Branch of the Chicago River and the three branches that flow into and form the North Branch Chicago River. The Skokie River, the Middle Fork of the Chicago River and the West Fork of the Chicago River. The two POTWs located in the watershed (Village of Deerfield POTW and North Shore Water Reclamation District POTW) are bracketed to determine to what effect effluent impacts the receiving waters. Sites are also located to determine the influences of tributary streams.

Water Column Chemistry Monitoring

The sampling will consist of on-site field measurements and water samples which will be analyzed within the laboratory. On-site monitoring will be conducted using water quality instruments to measure dissolved oxygen, pH, specific conductance, and temperature. Detection and measurement of additional parameters for water and sediment testing will be conducted in the laboratory. The sampling parameters are listed in the Quality Assurance Project Plan (QAPP). Water chemistry will be monitored 6 (six) times

January through October. A tiered site design will allow for more frequent monitoring of sites while keeping within budget and allowing for comprehensive coverage of the watershed. Samples will be collected using grab samples at the monitoring station unless otherwise noted in site description maps. If high pollutant loads are detected, follow up sampling at a refined scale may be undertaken to further determine the cause. Table 2 shows the parameters and summarizes the frequency of sampling described below for water column chemistry monitoring.

- **Tier 1:** 8 (eight) sites monitored 4 (four) times per year for common water quality parameters including nutrients and bacteria; and once annually under low flow conditions for metals and water organics.
- **Tier 2:** 17 (seventeen) sites monitored 4 (four) times per year for the majority of common water quality parameters including nutrients and bacteria.
- **Tier 3:** 2 (two) additional monitoring events per year at each bioassessment site for common water quality parameters including nutrients and bacteria concurrent with the bioassessment sampling period.

Equipment necessary to complete the water column chemistry monitoring will be provided by the contractor and may include buckets, collection bottles and gloves. Water column chemistry monitoring began in 2018 at eleven (11) Tier 1 and 2 sites on the Skokie River. Any monitoring completed prior to approval of the QAPP is not eligible to receive 319 grant funds or be used as match for a 319 grant.

Bioassessment and Sediment Chemistry Monitoring

The bioassessment and sediment chemistry monitoring will be conducted on all of the sites, with approximately half of the sites being monitored each year on an every other year rotating basis. Biological sampling for fish and macroinvertebrate assemblage data, habitat and sediment chemistry shall follow established protocols of the Illinois Department of Natural Resources (Illinois DNR; 2001) and Illinois EPA (1997, 2005) and be capable of producing comparable data and assessments. Sampling methods will be determined based on whether the stream is non-wadeable or wadeable. Ultimately, methods will be determined by the contractor and documented in the QAPP. Equipment necessary to complete the bioassessment will be provided by the contractor and may include electrofishing equipment, nets and an analytical field meter. Table 3 shows the parameters and summarizes the frequency of sampling for sediment chemistry monitoring. Bioassessment and sediment chemistry monitoring began in 2018 at 11 (eleven) sites on the Skokie River and will begin at 14 (fourteen) sites on the Middle Fork and West Fork in 2019.

Continuous DO Monitoring

Datasondes will be used in the North Branch Chicago River watershed to record continuous water quality data for dissolved oxygen (DO) over 3-5 day consecutive periods. Approximately 7 (seven) datasondes will be deployed in late summer each year under low flow conditions. The location of the datasondes will be concurrent with the biological sample locations for any given year. In 2018, 7 (seven) datasondes were deployed on the Skokie River branch where the biological monitoring occurred. In 2019, 7 (seven) datasondes will be deployed in the Middle Fork and West Fork.

The instruments will consist of either YSI 6-Series V2 model or EXO2 model units and used in accordance with the manufacturer specifications (YSI 2017). Each monitoring crew is required to maintain a calibration and maintenance log for each Datasonde Unit. The log will have consecutively numbered pages and include the following information at a minimum: date, Datasonde Model, Datasonde I.D. Number, description of monitoring (survey name), calibration comments, maintenance performed, and

crew leader name. Each instrument will be clearly identified (*e.g.*, the make, model, serial and/or I.D. number) to differentiate among multiple units. The appropriate calibration procedure must be followed and if the instrumentation does not have an electronic program that maintains a running calibration log, the results will be recorded in the logbook each time that unit is used, along with the date and name/initials of the person performing the calibration. If any difficulties are encountered during calibration or if the instrument will not hold calibration, this information will also be recorded. Malfunctioning equipment will not be used to collect data and will be scheduled for maintenance and/or repair and recorded in the log indicating what was done to correct the problem, along with the date and initials of the person that identified the problem. Continuous DO monitoring began in 2018 on the Skokie River and will begin on the Middle Fork and West Fork in 2019.

Benthic Periphyton Sampling

Benthic periphyton is collected to provide data on chlorophyll a content in support of the determination of the effect of nutrients as part of a combined nutrient approach that includes the diel DO flux as measured by a datasonde continuous monitor deployed at the same location. Benthic periphyton samples will be collected during a representative low flow period between early July and late August and to coincide with datasonde deployment and bioassessment. The results of the biological assemblage assessment (fish and macroinvertebrates) and concentrations of total phosphorus and nitrogen are also part of the combined assessment.

Benthic periphyton sampling began in 2018 on the Skokie River and will begin on the Middle Fork and West Fork in 2019.

Quality Assurance Project Plan (QAPP)

All monitoring will be conducted under an Illinois EPA approved QAPP. Illinois EPA requires the development of a QAPP for any grant activity involving the collection and analysis of environmental data. A QAPP presents the policies and procedures, organization, objectives, quality assurance requirements and quality control activities designed to achieve the type and quality of environmental data necessary to support project or program objectives. It is the policy of Illinois EPA that no data collection or analyses will occur without an approved QAPP. All in-house and external environmental data collection activities are subject to this requirement. All contracts must address quality assurance requirements (*e.g.*, data quality and reporting requirements) when those contracts pertain to, or have an impact on, data collection or analysis activities. Additionally, all grants and contracts need to address quality assurance requirements specified in applicable state acquisition or procurement regulations. The NBWW QAPP will follow U.S. and Illinois EPA guidance for the development of a project specific QAPP.

Data and Reporting

Following analysis, the laboratory contractor will send all data via email to the NBWW in one final report in .pdf format. In addition, the laboratory will send an Excel spreadsheet summarizing all sites and parameters after each sampling event. NBWW staff will take this data and format it to fit the STORage and RETrieval Data Warehouse (STORET) preferred by the Illinois EPA.

The Bioassessment contractor will send a monthly status report on bioassessment activities to the NBWW. This report will be provided electronically and as a hard copy, with chain-of-custody forms and laboratory reports attached. The consultant will use the datasonde DO data, water column and benthic chlorophyll a data along with the fish and macroinvertebrate data to perform the Stream Nutrient Assessment Procedure (SNAP).

The bioassessment contractor will also complete a final report, analyzing the results of the water column and sediment chemistry as well as the fish, macroinvertebrate, habitat and field water chemistry data. Interpretative statistics, such as long-term central tendencies, will be based on all available data within the database, developed over time, including past data collection efforts. This final report will be due on October 31, 2020. Data will be submitted annually to Illinois EPA.

References

Illinois DNR. 2001. IDNR stream fisheries sampling guidelines. Watershed Protection Section, Springfield, IL. 9 pp.

Illinois EPA. 2005. Methods of collecting macroinvertebrates in streams (July 11, 2005 draft). Bureau of Water, Springfield IL.

Illinois EPA. 1997. Quality assurance methods manual. Section G: Procedures for fish sampling, electrofishing safety, and fish contaminant methods. Bureau of Water, Springfield, IL. 39 pp.

Tables

Table 1: Sampling Locations

North Branch Sample Locations	Street	NBWW Station IDs	Illinois EPA Station IDs	Illinois EPA AUIDs	Tier Designation		
					1	2	3
Skokie River	Northern Boundary of the Foss Park Golf Course	SR1	HCCD-12	IL_HCCD	1		3
Skokie River	Rockland Road, Lake Bluff	SR2	HCCD-07	IL_HCCD-01		2	3
Skokie River	W. Deerpath Road, Lake Forest	SR3	HCCD-11	IL_HCCD-01		2	3
Skokie River	Half Day Road, Highland Park	SR4	HCCD-06	IL_HCCD-01		2	3
Skokie River	Clavey Road, Highland Park	SR5	HCCD-02	IL_HCCD-01		2	3
Skokie River	Lake Cook Road, north of Skokie Lagoons	SR6	HCCD-01	IL_HCCD-01		2	3
Skokie River	Tower Road, crosses the Skokie Lagoons, Winnetka	SR7	HCCD-04	IL_RHJ		2	3
Middle Fork	Route 176, Green Oaks	MF8	HCCC-16	IL_HCCC-02	1		3
Middle Fork	Middlefork Savanna Forest Preserve	MF9	HCCC-15	IL_HCCC-02		2	3
Middle Fork	Middlefork Trail & Greenway, W. Westleigh Road	MF10	HCCC-14	IL_HCCC-02		2	3
Middle Fork	Half Day Road, near Del Mar Woods	MF11	HCCC-13	IL_HCCC-02		2	3
Middle Fork	Carriage Way, south of Tea Tree Park, north of Briarwood Nature Area	MF12	HCCC-12	IL_HCCC-02		2	3
Middle Fork	Dundee Road, South of Somme Woods Forest Preserve	MF13	HCCC-11	IL_HCCC-02		2	3
Middle Fork	Sunset Drive, Northfield	MF14	HCCC-10	IL_HCCC-02		2	3
Middle Fork	Winnetka Road, Northfield	MF15	HCCC-03	IL_HCCC-02	1		3
Middle Fork	E. Lake Ave., Glenview/North of Blue Star Memorial Woods	MF16	HCCC-08	IL_HCCC-04		2	3
Middle Fork	South of Glenview Road, on the Forest Preserve Trail	MF17	HCCC-09	IL_HCCC-02		2	3
Skokie River	W. Frontage, west of I-94	SR18	HCCD-10	IL_RHJ	1		3
North Branch Chicago River	Dempster St., southernmost point of the watershed	MF19	HCC-10	IL_HCC-07	1		3
West Fork	South of Duffy Lane Bridge, off Saunders	WF20	HCCB-07	IL_HCCB-05	1		3
West Fork	South of Deerfield Road - Central Ave. in Deerfield	WF21	HCCB-06	IL_HCCB-05		2	3
West Fork	Lake Cook Road, Deerfield	WF22	HCCB-03	IL_HCCB-05	1		3
West Fork	Willow Road, southern end of Willow Hill Golf Course	WF23	HCCB – 12	IL_HCCB-05		2	3
West Fork	E. Lake Ave., Glenview	WF24	HCCB-11	IL_HCCB-05		2	3
West Fork	Long Valley Road, North of Glen View Club	WF25	HCCB-01	IL_HCCB-05	1		3

**All sites will be included in Tier 3 sampling. Sites SR1-7, 18 and MF16, 17 and 19 were sampled in 2018 twice during the summer concurrent with the biological sampling. The remaining sites in the Middle and West Fork will be sampled twice in 2019 concurrent with biological sampling.*

Table 2: Water Column Sampling Parameters and Frequency

Parameter	NBWW Frequency	Tier 1 (Four Times per Year)	Tier 2 (Four Times per Year)	Tier 3 (Two additional sampling events concurrently with bioassessment locations)
		Number of Sample Events*		
General Water Quality Parameters				
Chloride	six times a year	4	4	2
Conductivity	six times a year	4	4	2
pH	six times a year	4	4	2
TSS	four times a year	4	4	
Volatile Suspended Solids	four times a year	4	4	
DO	six times a year	4	4	2
Temperature	Six times a year	4	4	2
BOD5	Six times a year	4	4	2
Metals				
Arsenic	annually under low flow conditions	1	0	
Iron	annually under low flow conditions	1	0	
Calcium	annually under low flow conditions	1	0	
Magnesium	annually under low flow conditions	1	0	
Sodium	annually under low flow conditions	1	0	
Barium	annually under low flow conditions	1	0	
Cadmium	annually under low flow conditions	1	0	
Chromium	annually under low flow conditions	1	0	
Lead	annually under low flow conditions	1	0	
Mercury low level	annually under low flow conditions	1	0	
Copper	annually under low flow conditions	1	0	
Nickel	annually under low flow conditions	1	0	
Silver	annually under low flow conditions	1	0	
Zinc	annually under low flow conditions	1	0	
Nutrients				
Ammonia	four times a year	4	4	
Total Nitrates (NO ₂ +NO ₃)	six times a year	4	4	2
TKN	four times a year	4	4	
Total phosphorus	six times a year	4	4	2
Chlorophyll a	five times a year	3	3	2
Bacteria				
E. coli	six times a year	4	4	2
Water Organics				
PCBs	annually under low flow conditions	1	0	
Pesticides	annually under low flow conditions	1	0	
PNAs	annually under low flow conditions	1	0	
VOCs	annually under low flow conditions	1	0	

*Tier 1 and Tier 2 sites are sampled 4 times per year. The only difference between Tier 1 and Tier 2 sites is that Tier 1 sites get the additional organics and metals analysis during the low flow August sample event. Table 1 shows all of the Tier 1 and Tier 2 sites. Then any of the sites that are scheduled for the bioassessment (11 in 2018 and 14 in 2019) would be considered Tier 3 and they would be sampled in July and September. Therefore, all of the sites are considered Tier 3 but only sampled when the bioassessment scheduled.

Table 3: Sediment Sampling Parameters and Frequency

Parameter	NBWW Frequency	Tier 1	Tier 2
		Number of Sample Events (Annually)	
Sediment Metals			
Aluminum	Concurrent with bioassessment	1	1
Arsenic	Concurrent with bioassessment	1	1
Barium	Concurrent with bioassessment	1	1
Beryllium	Concurrent with bioassessment	1	1
Boron	Concurrent with bioassessment	1	1
Cadmium	Concurrent with bioassessment	1	1
Chromium	Concurrent with bioassessment	1	1
Cobalt	Concurrent with bioassessment	1	1
Copper	Concurrent with bioassessment	1	1
Iron	Concurrent with bioassessment	1	1
Lead	Concurrent with bioassessment	1	1
Manganese	Concurrent with bioassessment	1	1
Mercury	Concurrent with bioassessment	1	1
Nickel	Concurrent with bioassessment	1	1
Potassium	Concurrent with bioassessment	1	1
Silver	Concurrent with bioassessment	1	1
Sodium	Concurrent with bioassessment	1	1
Strontium	Concurrent with bioassessment	1	1
Vanadium	Concurrent with bioassessment	1	1
Zinc	Concurrent with bioassessment	1	1
Sediment Organics			
PCBs	Concurrent with bioassessment	1	1
Pesticides	Concurrent with bioassessment	1	1
VOCs/Hexachlorobenzene	Concurrent with bioassessment	1	1
PNAs	Concurrent with bioassessment	1	1
TKN	Concurrent with bioassessment	1	1
Phosphorus	Concurrent with bioassessment	1	1
Cyanide (low level)	Concurrent with bioassessment	1	1
Herbicide (2, 4, D, 2, 4, 5, TP)	Concurrent with bioassessment	1	1
Phenols	Concurrent with bioassessment	1	1

Please note: Sediment sampling does not include a Tier 3. Tier 3 for the water column sampling was included to conduct 2 additional monitoring events per year at bioassessment sites for general water quality parameters including nutrients and bacteria concurrent with the bioassessment sampling period.