Biological and Water Quality Assessment of the North Branch Chicago River: 2020-21

West Fork Downstream Willow Rd. (WF23)

Skokie River Downstream I-94 (SR18)

Skokie River Upstream Half Day Rd. (SR4)

Middle Fork Upstream E. Lake Rd. (MF16)

Trent A. Dougherty, Executive Director
James B. Lane, Board President

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Biological and Water Quality Assessment of the North Branch Chicago River 2020-21

Cook and Lake Counties, IL

Technical Report MBI/2023-1-1

March 31, 2023

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FOREWORD

What is a Biological and Water Quality Survey?

A biological and water quality survey, or “bioassessment”, is an interdisciplinary monitoring effort coordinated on a waterbody specific or a watershed scale. This may involve a relatively simple survey that focuses on one or two small streams, one or two principle stressors and a handful of sampling sites or a much more complex effort including entire watersheds, multiple and overlapping stressors and tens of sites. The 2020-21 NBWW survey included the Skokie River, Middle and West Forks of the North Branch Chicago River, and the upper North Branch Chicago River. The principle focus of the biological and water quality assessment is on the status of the Illinois General Use for aquatic life and recreation and causes of impairments.

Scope of the 2020-21 NBWW Biological and Water Quality Assessment

The Midwest Biodiversity Institute (MBI) was contracted by the North Branch Chicago River Watershed Workgroup (NBWW) to develop a biological and water quality monitoring and assessment plan for the North Branch Chicago River and tributaries in Cook and Lake Counties, IL in 2018. The plan was incorporated into a Quality Assurance Project Plan (QAPP; NBWW 2019) that was submitted to and approved by Illinois EPA. The spatial sampling design consisted of an intensive pollution survey and geometric allocation of sites that was carried out during the first survey in 2018-19 and second survey in 2020-21. This design was employed to fulfill multiple purposes and goals in addition to the determination of the existing status of the biological assemblages and their relationship to chemical, physical and biological stressors. Targeted sites were positioned upstream and downstream of major discharges, other sources of potential releases and contamination, and major tributaries to provide a “pollution profile” of the major streams and rivers. The major objectives included:

1. Determine the aquatic life status of each sampling location in quantitative terms, i.e., not only if a waterbody is impaired, but the spatial extent and severity of the impairment and the respective departures from established criteria;

2. Determine the proximate stressors that correspond to observed impairments for the purpose of targeting appropriate management actions to those stressors; and,

3. Screen for any potential issues with use attainability.

To meet these objectives data was collected with methods that provide high quality results and are in conformance with the practices of Illinois EPA (Illinois EPA 2010a,b; 2011a-g; 2014a,b) and Illinois DNR (2010a,b) and under a project QAPP approved by Illinois EPA (NBWW 2019). The second survey of 2020-21 and trends between then and 2018-19 are the principal subjects of this report.

EXECUTIVE SUMMARY

Aquatic Life Condition Assessment

The primary indicators of the status of the Illinois General Use for aquatic life are the Illinois fish and macroinvertebrate Indices of Biotic Integrity and generally following the guidance in the 2020 Integrated Report (Illinois EPA 2022) with certain exceptions. The status of aquatic life is reported in an attainment table and expressed as full, partial or non-support and based on the most limiting of either the fish or macroinvertebrate results. Non-support is further subdivided into non-support fair and non-support poor. The partial support category was added to better highlight instances where one of the two assemblages attained the General Use biological criteria for fish or macroinvertebrates. Of the 25 sites assessed for the General Use for aquatic life (Figure 1) all were impaired and with one or both of the fish or macroinvertebrate IBI values in non-support poor, except for one non-support fair site with fair values for both IBIs (Table 1).

Causes and Sources of Non-attainment

IPS thresholds derived for water and sediment chemistry and physical habitat attributes (MBI 2022a) were used to assess causes of impairment and their comparative severity. The approach for deriving these thresholds includes a more refined stratification of biological effect threshold values for parameters that showed valid relationships with biological responses based on species and taxa level analyses and then correlated with the corresponding fish and macroinvertebrate IBI attainment thresholds and narrative ratings (MBI 2022a). This produced thresholds across four or five narrative categories of quality (excellent, good, fair, poor, and very poor). This replaces the formerly used binary (i.e., “pass/fail”) approach to evaluating exceedances of chemical and physical effect thresholds and criteria by providing for a more graded approach to the assignment of causes and sources of Illinois General Use biological impairments. This approach has been incorporated into IPS outputs to support local restoration and protection efforts by the respective watershed groups and stakeholders. The findings herein are updates to the 2018-19 survey (MBI 2020a) and based on the 2020-21 survey results.

Causes and Sources were determined for each impaired site and included categorical or parameter level associations and their sources if known. With the recent availability of the more comprehensive and regionally relevant analyses of stressors via the Integrated Prioritization System (NE IL IPS; MBI 2020a), causes were weighted by exceedances of very poor, poor, and fair IPS threshold values. This approach uses a lines of evidence approach where threshold exceedances generated by the IPS is related to a biological impairment. This goes beyond the association of a coincidental exceedance of a chemical criterion or other threshold with a biological impairment. Knowing about relationships that are supported by prior empirical observations in other studies and our own experiences continues to boost the confidence in such causal assignments. This process varies from that used by IEPA in that regionally developed effect thresholds for a broad array of chemical, habitat, and land use variables were used to derive causes that could be different from those derived by IEPA (2022).

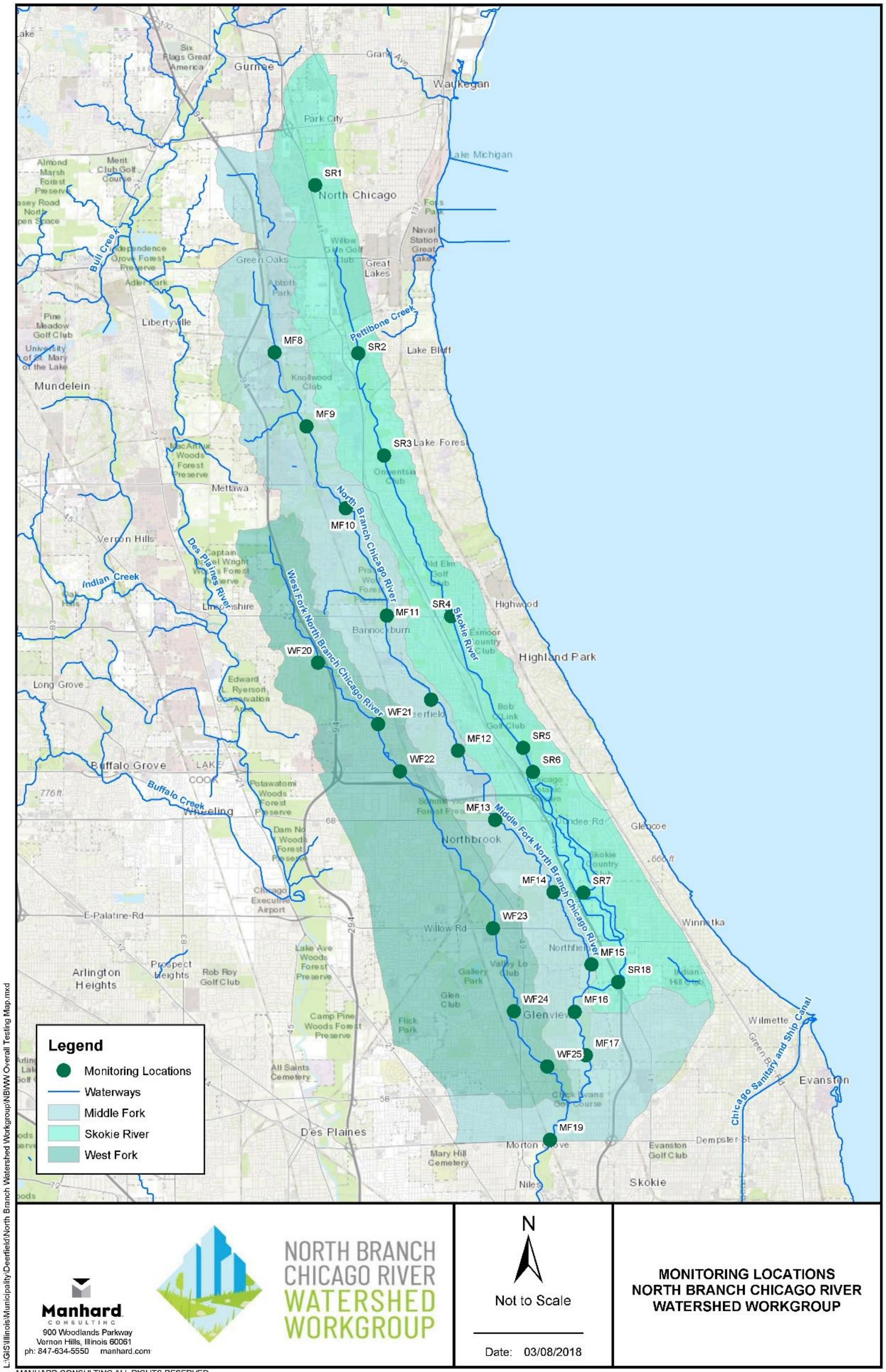


***Figure 1**. Location of 25 biological, chemical, and habitat sampling sites in the NBWW survey area in 2018-2021. Site codes correspond to sites listed in Table 1.*

***Table 1**. Aquatic life use attainment status at 25 sites in the NBWW 2020-21 survey area with associated causes by narrative rank, restorability rankings, and IEPA causes.*

Site ID	Fish RM/ Macro RM	Drain-age Area (sq. mi.)	fIBI	mIBI	QHEI	Aq. Life Status	Very Poor	Poor	Fair	IPS Restora-bility Ranking	IEPA Causes
Skokie River - 2020											
SR1	21.10/21.10	2.78	5.0	17.2	37.0	Non - Poor	Dev-WS; Substr; Chloride; Conduct; QHEI Ratio; Sed. PAH	Low D.O.; QHEI; Chan; Conduct; High Mod. Attr.; QHEI Ratio	TKN; Secd. PAHs; Sed. Metals	7.9	Chloride, DO, TP, TSS
SR2	17.40/17.40	7.87	16.5	23.8	38.0	Non - Poor	Dev-WS; Chloride; Conduct; Sed. PAH	QHEI; Substr; Chan; Org. Enrich.; High Poor Attr.	Low D.O.; Max D.O.; Conduct; Sed. Metals;	24.0	
SR3	14.80/14.80	11.56	23.0	24.6	48.0	Non - Fair	Sed. PAH; D.O. Swing	Dev-WS; QHEI; Substr; Chloride; Conduct; Low D.O.; Poor Attr.; Org. Enrich,	Low D.O.; Max D.O.; Chan; Conduct; Sed. PAH; Sed. Metals; QHEI Ratio	27.2	
SR4	11.30/11.30	15.07	17.5	22.8	52.5	Non - Poor	Dev-WS; Sed. PAH	Conduct.; Sed. Metals; Poor Attr.	Max D.O.; QHEI; Substr; Chan; Chloride; Sed. PAH;	35.1	
SR5	8.00/8.00	20.67	23.5	21.2	46.8	Non - Poor	Dev-WS; Substr; Sed. PAH	QHEI; Chan; High Poor Attr.; QHEI Ratio; D.O. Swing	Low D.O.; TKN; Max D.O.; Conduct; Chloride; Sed. PAH; Sed. Metals;	20.1	
SR6	7.40/7.40	21.51	18.0	21.3	39.5	Non - Poor	Dev-WS; Substr; Sed. PAH	Low D.O.; QHEI; Chan; High Poor Attr.; QHEI Ratio	Imperv-30C; Max D.O.; Conduct; Chloride; Sed. PAH;	20.4	
SR7	3.00/0.00	23.73	15.0	NA	38.0	Non - Poor	Dev-WS; Substr;Low D.O.	QHEI; Chan; D.O. Swing	Low D.O.; TKN; Max D.O.; Chloride; Sed. Metals; QHEI Ratio	29.2	TSS, Mercury
SR18	0.50/0.50	30.90	34.5	40.8	62.6	Non - Fair	Dev-WS; Sed. PAH	Substr; Sed. Metals; High Poor Attr.; QHEI Ratio; Nitrate	TP; TKN; Nitrate; Max D.O.; QHEI; Chan; Chloride; Sed. PAH;	51.4	Algae, Chlordane, Cover Loss, Flow Mod.,
Middle Fork North Branch Chicago River - 2021											
MF8	21.10/21.10	5.81	13.0	17.5	29.0	Non - Poor	Substr; Conduct; Chloride; Sed. PAH; Poor Attr.; Low D.O.; D.O. Swing	Dev-WS; QHEI; Chan; Org. Enrich.; QHEI Ratio	TKN; Low D.O.; TKN; Sed. Metals	19.2	Chloride, DDT, D.O., Hab.Alt., Cause Unknown, Hexachlorobenzene, Sed./Silt, TSS
MF9	18.90/18.90	8.91	14.0	24.0	31.5	Non - Poor	Substr; Conduct; Chloride; Sed. PAH; Low D.O.; D.O. Swing	QHEI; Chan; Poor Attr.	Dev-WS; Org. Enrich.; TKN; QHEI Ratio	12.5	
MF10	16.70/16.70	11.99	12.0	41.1	41.0	Non - Poor	Conduct; Chloride; Low D.O.; QHEI Ratio; D.O. Swing	Dev-WS; Sed. PAH; QHEI; Substr; Chan; QHEI Ratio; Poor Attr.	TKN; Max D.O.; Org. Enrich.; Low D.O.	19.3	
MF11	14.10/14.10	16.13	20.0	21.5	44.0	Non - Poor	Conduct; Chloride; Sed. PAH; D.O. Swing	Dev-WS; Low D.O.; QHEI; Substr; Chan; Sed. Metals; Sed. PAH; High Poor Attr.; Org.	TKN; Low D.O.	21.8	
MF12	10.80/10.80	19.23	15.0	34.0	45.5	Non - Poor	Chloride; Sed. PAH; Low D.O.; D.O. Swing	Dev-WS; QHEI; Substr; Chan; Conduct; Org. Enrich.	Low D.O.; Sed. Metals; QHEI Ratio	23.6	
MF13	8.60/8.60	20.97	13.0	15.7	60.0	Non - Poor	Conduct; Chloride; Sed. PAH; Org. Enrich.; Low D.O.; D.O. Swing	Dev-WS; Substr; Poor Attr. Sed. Metals	Max D.O.; QHEI; Chan; Low D.O.; Ammonia; QHEI Ratio	25.5	
MF14	6.00/6.00	22.48	15.0	39.5	64.5	Non - Poor	Conduct; Chloride; Sed. PAH	Dev-WS; High Poor Attr.	Low D.O.; TKN; Max D.O.; QHEI; Substr; Sed. Metals; QHEI Ratio; D.O. Swing	38.7	
MF15	4.00/4.00	24.29	17.0	21.4	55.5	Non - Poor	Conduct; Chloride; Sed. PAH; D.O. Swing	Dev-WS; Substr; Org. Enrich.; Sed. Metals	Max D.O.; Low D.O.; QHEI; Chan; Ammonia	34.6	
MF16	3.00/3.00	56.15	21.0	24.7	38.5	Non - Poor	Substr; Sed. PAH; Nitrate	Dev-WS; TKN; Conduct.; QHEI; Org. Enrich.; Sed. Metals	TP; Low D.O.; Nitrate; Max D.O.; Chan; Chloride; PAHs; Sed. Metals; TKN	20.0	Cr, DDT, Endrin, Hexachlorobenzene, Merury, Phosphorus, TSS
MF17	1.80/1.80	57.31	16.5	25.2	45.8	Non - Poor	Sed. PAH; Nitrate	Dev-WS; QHEI; Substr; Chan; Org. Enrich.; Sed. Metals; Conduct.; TKN; Ammonia; Poor Attr.	TP; Low D.O.; Nitrate; Max D.O.; Chloride; Sed. PAH; Sed. Metals; Low D.O.; QHEI Ratio	21.9	
	Narrative Thresholds	**Excellent**	≥50	>73	≥84.5	FULL				Very High	IEPA 2022 Integrated Report
		Good	>41-49	41.8-72.9	75.9-84.0	FULL				High	
		Fair	30-<41	30-41.7	50.1-75.0	PARTIAL/Non-Fair				Moderate	
		Poor	>15-29	>15-29	25-50	NON-Fair				Low	
		Very Poor	≤15	≤15	<25	NON-Poor				Very Low	
	Source(s)	IPS	IEPA/IPS	IEPA/IPS	IPS	IPS				IPS	

***Table 1**. continued.*

Site ID	Fish RM/ Macro RM	Drain-age Area (sq. mi.)	fIBI	mIBI	QHEI	Aq. Life Status	Very Poor	Poor	Fair	IPS Restora-bility Ranking	IEPA Causes
West Fork North Branch Chicago River - 2021											
WF20	12.50/12.50	3.90	7.0	10.6	30.5	Non - Poor	Substr; Conduct.; Chloride; Sed. PAH; Org. Enrich.	Dev-WS; QHEI; Chan; Conduct; TSS; TKN: Poor Attr.; QHEI Ratio	TP; TKN; Ammonia	1.9	Aldrin, Cause Unknown, DDT, Endrin, Hexachlorobenzene, Phosphorus, TSS
WF21	10.40/10.40	7.02	11.0	18.7	42.0	Non - Poor	Chloride; Conduct.; Sed. PAH; Org. Enrich.; Low D.O.; Ammonia; Poor Attr.	Dev-WS; QHEI; Chan; Conduct; Sed. Metals; QHEI Ratio; Nitrate; D.O. Swing	TKN; Substr; Sed. PAH; Low D.O.; TKN	14.6	
WF22	9.20/9.20	9.41	9.0	15.8	46.5	Non - Poor	Dev-WS;TP; Chloride; Sed. PAH; Org. Enrich.; Ammonia; Low D.O.; D.O. Swing	TKN; QHEI; Substr; Chan; Conduct; Sed. Metals; Poor Attr.	Imperv-30C; Low D.O.; Nitrate; Sed. PAH; Sed. Metals; QHEI Ratio	1.4	
WF23	4.90/4.90	17.86	9.0	13.8	41.0	Non - Poor	Dev-WS; Substr; Chloride; Sed. PAH; Org. Enrich.; TSS; Low D.O.; D.O. Swing	Imperv-30C; QHEI; Chan; Conduct; Chloride; TSS; TKN; Poor Attr.; QHEI Ratio	TP; TKN; Max D.O.; Low D.O.	7.8	
WF24	2.90/2.90	24.52	10.0	21.0	66.0	Non - Poor	Dev-WS; Conduct; Sed. PAH; Ammonia; D.O. Swing	Low D.O.; Conduct; Org. Enrich.; Sed. Metals; Poor Attr.	Imperv-30C;TP; TKN; QHEI; Substr; Chan; Low D.O.	18.6	
WF25	1.30/1.30	27.97	12.0	21.9	48.0	Non - Poor	Dev-WS; Chloride; Conduct.; Sed. PAH: Ammonia; Low D.O.	QHEI; Substr; Conduct; Org. Enrich.; Sed. Metals; Poor Attr.; D.O. Swing	TP; TKN; Chan; Low D.O.; QHEI Ratio	16.6	
North Branch Chicago River - 2020											
MF19	18.60/18.60	93.41	13.0	21.4	48.5	Non - Poor	Dev-WS; Sed. PAH	Imperv-30C; QHEI; Substr; Toxicity	TP; Low D.O.; TKN; Nitrate; Max D.O.; Chan; Conduct; Chloride; Sed. Metals;	28.3	Aldrin, Cause Unknown, DDT, Flow Mod., Hexachlorobenzene, Phosphorus, N, TSS
	Narrative Thresholds	**Excellent**	≥50	>73	≥84.5	FULL				Very High	IEPA 2022 Integrated Report
		Good	>41-49	41.8-72.9	75.9-84.0	FULL				High	
		Fair	30-<41	30-41.7	50.1-75.0	PARTIAL/Non-Fair				Moderate	
		Poor	>15-29	>15-29	25-50	NON-Fair				Low	
		Very Poor	≤15	≤15	<25	NON-Poor				Very Low	
	Source(s)	**IPS**	**IEPA/IPS**	**IEPA/IPS**	**IPS**	**IPS**				**IPS**	

Glossary of terms used in Table 1

Acronym	Description	Acronym	Description	Acronym	Description
Urban-WS	Urban land use HUC12	High Mod. Attr.	NumberHigh Influence Modified QHEI Attributes	D.O. Swing	Width of Diel D.O. Variation in 24 Hrs.
Dev-WS	Developed land HUC12	Substr	Substrate condition from QHEI	Conduct	Specific conductivity
Imperv-30C	Imprevious surface 30 m buffer clipped	Chloride	Chloride concentration in mg/L	Toxicity	Exceedance of Toxic Biological Signature
QHEI	Qualitative Habitat Evaluation Index (QHEI)	Sed. PAH	Polycyclic aromatic hydrocarbons in Sediment	Org. Enrich.	Exceedance of Organic Enrichment Biological Signature
QHEI Ratio	Ratio of Modified:Good QHEI attributes	Sed. Metals	Metals concentration in Sediment	TSS	Total suspended solids
Chan	Channel condition from QHEI	Low D.O.	Minium Dissolved Oxygen in mg/L	TKN	Total Kjeldahl nitrogen
Poor Attr.	Number of Poor QHEI Attributes	Max. D.O.	Maximum Dissolved Oxygen in mg/L	TP	Total phosphorus

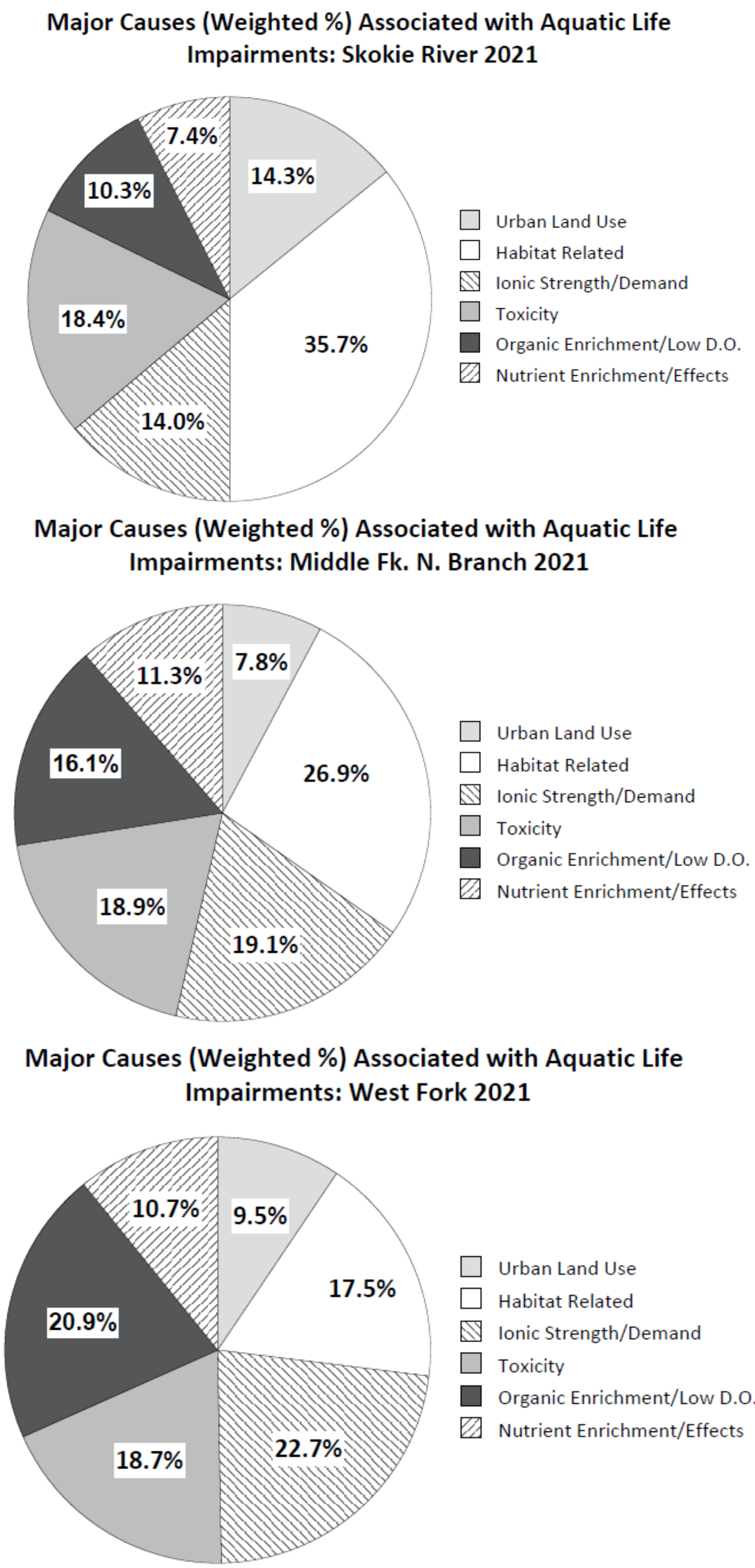


Figure 2*. Categorical causes associated with aquatic life impairments in the NBWW survey area in 2020 and 2021 based on the weighted observations of exceedance thresholds (very poor = 5, poor = 3, and fair = 1).*

Twenty-two (22) causes across six (6) major categories were identified for the North Branch Chicago River survey are in 2020-21 (Figure 2). Of these causes, two were land use related (developed watershed, impervious cover 30 meter buffer), six (6) were habitat related (QHEI score, substrate score, QHEI ratio, poor attributes, channel score, and high influence poor attributes), three (3) were ionic strength/ conventional parameters (chloride, conductance, totals suspended solids), four were toxic parameters /compounds in sediment (PAH compounds, metals) and water (ammonia-N, toxic biological response signatures), three (3) were organic enrichment/D.O. related (low dissolved oxygen [D.O.], organic enrichment response signatures, and TKN), and four (4) nutrient enrichment/effect related (total phosphorus, nitrate-N, maximum D.O., and diel D.O. swing). The proportion of causes was assessed based on the number of observations and weighted observations (Figure 2; Appendix D), the latter being based on the severity of the expression of the cause in chemical water column, sediment chemistry, or habitat measures. A higher weighting was assigned based on the narrative rating of an exceedance with 5 for very poor, 3 for poor and 1 for fair. Habitat causes were the most frequent limiting factor (100 total observations; 27.2% weighted) to aquatic life with very poor substrate scores, poor QHEI scores, poor channel scores, and an accumulation of poor attributes as the primary factors perpetuating these deficiencies. Poor habitat persists throughout the North Branch Chicago River watershed, containing primarily poor habitat at 20 sites, with only five (5) fair QHEI scores located in the Middle Fork of the North Branch and single fair scores in the Skokie River and West Fork. Organic Enrichment/Low D.O. had 70 observations (19.3% weighted) with very poor to fair low D.O. levels, a high frequency of organic enrichment response signatures, and elevated TKN levels in each subwatershed. Indicators of Toxics and Toxicity included 64 observations (17.4% weighted) of exceedances of IPS thresholds for sediment metals, and PAH compounds, and ammonia-N. The majority were PAH compounds followed by metals and then ammonia-N, the latter of which did not include any exceedances of the Illinois standard. The origin of the majority of this category was urban stormwater. There were 56 observations of Ionic Strength/Demand parameters (15.4% weighted) that included mostly exceedances of conductance and chloride thresholds that latter of which included exceedances of the Illinois standard. There were only two exceedances of TSS which were also related to urban stormwater runoff. Nutrient Enrichment/Effects had 47 observations (12.8% weighted) with the diel D.O. swing being the most severe indicator with 11 very poor and four (4) poor exceedances and the remainder being mostly fair exceedances of maximum D.O., total P, and nitrate-N. Urban Land Use had the fewest observations (30; 8.2% weighted) and only two factors, developed land use in a HUC12 watershed (DevWS) with 24 very poor and poor threshold exceedances and impervious cover in the 30 meter buffer (Imperv30C) with 5 total observations. The predominant causal categories varied somewhat between the three branches with habitat causes dominating in the Skokie River (35.7% weighted) and Middle Fork (26.9% weighted) and ionic strength/conventional dominant in the West Fork (22.7%; Appendix D). The listing of a wider variety causes of impairment by MBI compared to Illinois EPA in Table 1 is due to the use of a wider array of IPS derived effect thresholds, differences in the interpretation of impairments, and most of all to differences in the spatial survey designs employed by each.

Synthesis of Results

The 2020-21 results yielded mostly poor and very poor results for both the macroinvertebrate and fish assemblages in each of the subwatersheds and the mainstem of the North Branch Chicago River. Urban runoff is the major contributor of pollution within the watershed including dissolved substances, heavy metals, and polycyclic aromatic hydrocarbons. It also plays a major role in habitat alterations and heavy siltation that are ubiquitous throughout the survey area. High diel D.O. swings and low D.O. concentrations can likely be attributed to the high organic matter content of the sediments and abundant filamentous algae. Chlorophyll a concentrations for both sestonic and benthic algal biomass were mostly in the good or excellent IPS threshold ranges at all sites. Fish IBIs (fIBI) were primarily in the very poor to low poor range. The General Use fIBI biocriterion of 41 was not met at any site in 2020-21. In the Skokie River, poor scores were recorded at five sites, very poor at two sites, and fair at the downstream most site SR18 (RM 0.50). The Middle Fork N. Branch fIBI was poor at four (4) sites and very poor at six (6) sites. The West Fork fIBIs were uniformly very poor at all sites. The percent tolerant fish exceeded the good threshold at all but three sites. DELT anomalies were generally very low, with good and excellent values recorded at all except one site that was fair. Zero intolerant species or mineral substrate spawners were collected which is very poor performance for these fIBI metrics.

The macroinvertebrate assemblage condition in the NBWW 2020-21 survey area ranged mostly from poor to fair and all values in non-support of the IEPA mIBI biological criterion. As a result no sites met the mIBI General Use for aquatic life. In terms of any trends between 2020-21 and 2018-19, one site improved in the lower Skokie River nearly meeting the mIBI biocriterion for General Use at SR18 (RM 0.50) and along with a fair fIBI resulted in the only Non-Fair attainment rating in the survey area. The Middle Fork site at MF14 (RM 6.00) missed the General Use biocriterion by only 1.3 mIBI units and the 2020 results were somewhat better than 2018 at selected sites. Values in the West Fork were consistently poor to very poor. The second highest mIBI of 39.5 at MF14 coincides with the best habitat in the NBWW survey area with a QHEI score of 64.5. This site and SR18 had 47.0% and 36.7% EPT taxa and were the only results in the good range for that metric whereas 19 sites were in the poor range with 11 at 0%.

Neither of the two major point sources (NSWRD Clavey Rd. and Deerfield WRFs) played a dominant role in the observed results with the exception of increases in some chemical constituents associated with municipal wastewater downstream from each. No distinguishable signatures of excessive nutrient enrichment were apparent in the modified SNAP analysis even though the two WRFs dominate the low flows of their respective receiving streams. The Risk of Exceedance analysis showed the second highest sestonic chlorophyll a value and supersaturated D.O. levels at two West Fork sites downstream from the Deerfield WRF in 2021. Total P and nitrate-N levels were also elevated at these sites.

Perhaps the most important observation from the 2020-2021 bioassessment is that the overall habitat in each of the subwatersheds and in the mainstem North Branch Chicago River site is mostly poor. Heavy silt coverage and muck substrates coupled with the lingering effects of legacy channel and hydrological modifications and current day maintenance activities not only reduce the habitat available for macroinvertebrates and fish, but also hamper the assimilation of organic pollution and nutrients in particular. Urban runoff contributes to highly elevated levels of PAHs and metals in sediments that are prevalent throughout the survey area. The biological results are associated with numerous exceedances of IPS thresholds with no sites meeting the Illinois EPA General Use designation for aquatic life.

Reinforcing these observations are the low and very low Restorability scores generated by the NE Illinois IPS (Table 1) which means that the challenges with restoring the streams of the NBWW study area to attaining the Illinois General Use for aquatic life are greater and dependent on restoration actions that address the most limiting chemical and physical factors as is demonstrated by the consistent repetition of very poor and poor causes of impairment related to urban land uses coupled with flow and habitat alterations. The highest Restorability factors were in the Middle Fork and lowest rankings occurred throughout the West Fork, with the Skokie River intermediate between those two forks. The only moderate Restorability score occurred in the lower Skokie River at site SR18 (RM 0.50).

Recreational Use Assessment

Levels of fecal bacteria in the form of *Escherichia coli* (*E. coli*) cfu[2]/100 mL were used to assess the status of recreation in and on the water for the 2020-21 study area. The Illinois EPA General Use criteria are expressed as counts of fecal coliform bacteria, which were not measured here, hence the U.S. EPA national criteria for *E. coli* were used instead. The U.S. EPA *E. coli* criteria are expressed in terms of a 90-day geometric mean and a statistical threshold value (STV) which is the 90th percentile of the data distribution that is not be exceeded by more than 10% of the samples. Given the small sample size limitations, mean values were used as an approximation of the 90-day geometric mean and maximum values as the STV. The U.S. EPA recommended 90-day geometric mean criteria value is 126 cfu/100 ml and the STV criteria value is 410 cfu/100 ml (U.S. EPA 2012).

E. coli results for the North Branch Chicago River and tributaries were available from all 25 locations in each of the 2020 and 2021 sampling years. The frequency of exceedances of the U.S. EPA recommended geometric mean and STV criteria was frequent in the 2020-21 survey area. Among the 25 sites sampled for *E. coli* in 2020, twenty (20) exceeded the geometric mean and twenty-two (22) exceeded the maximum STV (Table 2). In 2021, twenty-three (23) exceeded the geometric mean and twenty-one (21) exceeded the maximum STV. Twenty (20) exceeded for both geometric mean and maximum STV in 2020 and 2021 (Table 2). This is close to the same frequency of exceedances observed in 2018 and 2019. Twelve (12) sites had minimum values exceeding the geometric mean criterion, five (5) in the West Fork, four (4) in the Middle Fork, and two (2) each in the Skokie River and North Branch.

The sites that did not exceed the geometric mean and maximum STV included SR7 (RM 3.0 in the Skokie Lagoons) in both 2020 and 2021, MF8 and MF 12 (RMs 21.1 and 10.8 in the Middle Fork North Branch Chicago River), and WF20 (RM 12.5 in the West Fork) two of which are the upstream most sites in their respective branches (Table 2). Three consecutive sites in the upper Middle Fork had means below that criterion, but with maximums that exceeded the STV. The Skokie Lagoons appear to aid in the reduction of *E. coli* in the Skokie River with declines occurring at SR7 (RM 3.0) during both 2020 and 2021 (Table 2). The confluence of the Skokie River with the Middle Fork North Branch did not reduce *E. coli* colonies at MF16 as was observed in 2018 and 2019. The magnitude of the exceedances seemed to be greater in the West Fork in 2020 and 2021 especially, but less so in the Middle Fork especially compared to the 2019 maximums. The analysis of the maximum values was inhibited by the 2420 cfu/100 ml maximum that was listed for numerous sites which precludes knowing the true values. A few Middle Fork sites in 2020 reported maximums above this value with 13,000 cfu/100 mL reported for site MF15 (RM 4.0). Knowing the true maximum values would enhance the diagnosis of maximum values as originating from the mosaic of fecal sources in urban runoff vs. raw or poorly treated sewage which frequently results in *E. coli* counts in the five to six figure range.

***Table 2**. E.coli values (cfu/100 ml) for samples collected in the North Branch Chicago River study area during May-October 2020 and 2021. Yellow shaded cells exceed the recommended U.S. EPA (2012) 90-day geometric mean (126 cfu/100 ml); red shaded cells exceed the maximum statistical threshold value (STV; 410 cfu/100ml). Grey shading is a histogram of the relative values at each site.*

Site ID	River Mile	Drainage Area (sq. mi.)	Samples	Minimum	Geometric Mean	Maximum STV
Skokie River - 2020						
SR1	21.1	2.70	6	9	193	1550
SR2	17.4	7.80	6	59	203	512
SR3	14.8	11.50	6	65	158	361
SR4	11.3	15.00	6	228	591	2420
SR5	8.0	20.60	6	125	297	548
SR6	7.4	21.50	6	150	386	980
SR7	3.0	23.70	6	3	34	210
SR18	0.5	30.90	6	26	301	816
Skokie River - 2021						
SR1	21.1	2.70	4	16	102	649
SR2	17.4	7.80	4	66	265	2420
SR3	14.8	11.50	4	62	133	488
SR4	11.3	15.00	4	91	154	265
SR5	8.0	20.60	4	52	120	613
SR6	7.4	21.50	4	41	153	613
SR7	3.0	23.70	4	13	84	365
SR18	0.5	30.90	4	116	447	1990
Middle Fork North Branch Chicago River - 2020						
MF8	21.1	5.81	4	4	56	457
MF9	18.9	8.91	4	33	95	1130
MF10	16.7	11.90	4	23	124	4350
MF11	14.1	16.11	4	49	265	4610
MF12	10.8	19.23	4	56	265	5480
MF13	8.6	20.96	4	49	221	2610
MF14	6.0	22.48	4	60	335	5170
MF15	4.0	24.29	4	308	881	13000
MF16	3.0	56.10	6	62	349	2420
MF17	1.8	57.30	6	88	285	2420
Middle Fork North Branch Chicago River: 2021						
MF8	21.1	5.81	6	11	50	236
MF9	18.9	8.91	6	36	153	770
MF10	16.7	11.90	6	36	204	980
MF11	14.1	16.11	6	116	379	1050
MF12	10.8	19.23	6	77	116	361
MF13	8.6	20.96	6	88	158	411
MF14	6.0	22.48	6	162	295	770
MF15	4.0	24.29	6	42	276	1120
MF16	3.0	56.10	4	137	600	2420
MF17	1.8	57.30	4	361	790	2420
(yellow)	exccedance of Primary Contact Recreation (PCR) geometric mean criterion of 126 cfu/mL.					
(red)	exccedance of PCR Statistical Maximum Value (STN) criterion of 410 cfu/mL.					

***Table 2**. continued.*

Site ID	River Mile	Drainage Area (sq. mi.)	Samples	Minimum	Geometric Mean	Maximum STV
West Fork North Branch Chicago River - 2020						
WF20	12.5	3.87	4	22	70	238
WF21	10.4	7.02	4	125	424	2420
WF22	9.2	9.41	4	130	453	2420
WF23	4.9	17.86	4	35	317	2420
WF24	2.9	24.52	4	140	314	980
WF25	1.3	27.97	4	201	465	1050
West Fork North Branch Chicago River - 2021						
WF20	12.5	3.87	6	28	303	1110
WF21	10.4	7.02	6	126	604	2420
WF22	9.2	9.41	6	155	729	2420
WF23	4.9	17.86	6	5	134	2420
WF24	2.9	24.52	6	151	438	2420
WF25	1.3	27.97	6	108	653	2420
North Branch Chicago River - 2020						
MF19	18.6	93.41	6	122	464	1990
North Branch Chicago River - 2021						
MF19	18.6	93.41	4	144	650	2420
(yellow)	exccedance of Primary Contact Recreation (PCR) geometric mean criterion of 126 cfu/mL.					
(red)	exccedance of PCR Statistical Maximum Value (STN) criterion of 410 cfu/mL.					

BIOLOGICAL AND WATER QUALITY ASSESSMENT OF THE NORTH BRANCH CHICAGO RIVER WATERSHED: 2020-21

Study Area Description

Lake and Cook Counties are densely populated with 5.8 million residents comprising 46% of the Illinois population, according to the 2014 U.S. Census. The North Branch Chicago River basin consists of 25 municipalities and 10 townships (Lake Co. SMC 2020). The North Branch Chicago River originates in Glenview, IL where the West Fork and Middle Fork of the North Branch converge. The watershed drains 112 square miles of Cook and Lake Counties via the Skokie River and West and Middle Forks of the North Branch Chicago River. The NBWW study area included the North Branch Chicago River, the West Fork of the North Branch Chicago River, the Middle Fork of the North Branch Chicago River and the Skokie River. The Middle Fork of the North Branch (63.3 $mi.^2$) is the largest subwatershed in the NBWW study area, which includes the Skokie River. The Skokie River (31.1 $mi.^2$) is the second largest subwatershed, and flows a distance of 17 miles beginning in Gurnee, IL to its confluence with the Middle Fork in the Cook County Forest Preserve Watersmeet Woods. The West Fork of the North Branch (28.7 $mi.^2$) has the smallest drainage area and flows the shortest distance (14 mi.) from its headwaters near Mettawa, IL to its confluence with the North Branch mainstem near Morton Grove, IL (Lake Co. SMC 2020).

General Landscape Setting

The North Branch Chicago River basin lies entirely within the level III ecoregion Central Corn Belt Plains. The NBWW study area is primarily located in the level IV subregion of Valparaiso-Wheaton Morainal Complex with the exception of site MF19 which is located in the Chicago Lake Plain subregion (Table 3). The Valparaiso-Wheaton Morainal Complex is characterized by a hilly, hummocky rolling area containing moraines, kames, eskers and outwash plains with numerous small lakes and marshes. Soils are largely derived from thick late-Wisconsin glacial drift and thin loess deposits where they occur. Prior to modern urban development the subregion had natural oak-hickory forests and bluestem prairie on dry, well-drained moraines. In the poorly drained uplands swamp white oak forests were common with cattails, common reed, and bulrushes dominant in marshes. Prairies dominated the subregion, but through fire suppression and removal allowed for increased forest density. Current land uses are primarily residential (36.3%) followed by public/private open space (29.1%), transportation/utilities (16.3%) retail/commercial (5.3%), governmental/institutional (4.5%), industrial (3.8%), water (2.8%), office parks (1.1%), and agriculture (0.8%; Lake County SMC 2020).

Major Point Sources

Significant point sources of pollution were inventoried as part of the North Branch Chicago River Watershed bioassessment to understand the extent of their potential impact and for

Table 3. *Level IV subregions in the 2020-2021 North Branch Chicago River watershed study area and their key attributes (from Woods et al. 1995).*

Level IV Subregion	Physiography	Geology	Soils	Potential Natural Vegetation	Land Use/Land Cover
Chicago Lake Plain (54b)	Nearly level to flat, paleo-lake plain containing beach ridges, swales, sand dunes, paleo-spits, paleo-sand bars, bluffs, and both morainal and bedrock ridges	Quaternary lacustrine sediments, beach deposits, outwash deposits, and glacial till	Mollisols (Endoaquolls, Argiaquolls), Entisols (Udipsamments); Also Histosols (Medisaprists)	A mosaic of bluestem prairie and oak–hickory forest.	Mostly urbanized
Valparaiso-Wheaton Morainal Complex (54f)	Glaciated, hilly, hummocky to rolling area containing moraines, kames, eskers, rolling till plains, outwash plains, kettle holes, and ravines. Small lakes and marshes are common.	Wisconsinan-age glacial till and Quaternary lake deposits, thin loess (< 20") and alluvium. Ordovician and Silurian dolomite, limestone and shale	Alfisols (Epiaqualfs, Hapludalfs), Mollisols (Endoaquolls, Argiudolls), Inceptisols (Eutrudepts)	A mosaic of oak–hickory forest and bluestem prairie. Dry prairie and dry upland forest on dry soils. In marshes: cattails, bulrushes and common reed.	Mostly growing urban and suburban developments, but wooded areas, wetlands, and pastureland are common

developing the intensive pollution survey monitoring design. The NBWW 2020-21 survey area includes two major discharges, the Deerfield Water Reclamation Facility (WRF) that discharges into the West Fork of the North Branch Chicago River at river mile 10.0, and the Clavey Road WRF that discharges into the Skokie River at river mile 1.0 just downstream for the Skokie Lagoons dam (Table 4). The NSWRD Clavey Road WRF treats 17.8 MGD with any inflow in

Table 4*. Major wastewater treatment facilities that discharge directly (river miles are indicated) to 2020-2021 survey area streams (NSWRD– North Shore Water Reclamation District; WRF - Water Reclamation Facility). Treatment levels and nutrient information from U.S. EPA Discharge Monitoring Report (DMR) Pollutant Loading Tool.*

Facility	Receiving Water Body	River Mile	Latitude	Longitude	Avg. Flow 2018 (MGD)[1]	Avg. Flow 2019 (MGD)[1]	Design Avg. Flow (MGD)[2]	Treat-ment Type[3]	Nutrient Removal[4]
NSWRD Clavey Rd. WRF	Skokie River	1.0	42.10188	-87.75883	12.9	17.0	17.8	AWT	B
Deerfield WRF	West Fork North Branch Chicago R.	10.0	42.15944	-87.85472	2.3	2.9	3.5	AWT	M

[1] Effluent quality reported to MBI by DRWW and individual POTWs; [2] Design average flow from NPDES fact sheet; [3] AWT – Advanced Wastewater Treatment – generally 10-20 mg/L CBOD5, 1.5-3.0 NH3-N; 12-24 mg/L TSS; Secondary – generally 30 mg/L CBOD5/TSS, and no NH3-N removal; [4] B – biological phosphorus removal; M – nutrient (N and P) monitoring only; P – 1.0 mg/L limitation.

excess of the design flow being diverted into retention basins until flows reach 28 MGD; the stored sewage is then treated by the plant (CSWEA 2010). The Dundee Road lift station is located on the Skokie River just upstream from the Skokie Lagoons, but it has not been active for several years. The Deerfield WRF treats 2-3 million gallons of wastewater per day (MGD) while serving the Villages of Deerfield and Bannockburn, as well as portions of Highland Park (Village of Deerfield 2020). Advanced treatment is conducted at both WRFs. The Village of Glenview, which is served by the Metropolitan Water Reclamation District of Great Chicago (MWRD), has a lift station overflow that impacts the lower West Fork. These sources are depicted in the graphs of the key water quality parameters, habitat, and biological indicators in all three branches throughout the report.

NPDES Permit Special Conditions

The two major permitted WWTPs in the NBWW study area are subject to Special Conditions related to the discharge of nutrients. The first special condition states:

"The Permittee shall, within eighteen (18) months of the permit effective date, prepare and submit to the Agency a feasibility study that identifies the method, timeframe, and costs of reducing phosphorus levels in its discharge to a level meeting a potential future effluent standard of 0.5 and 0.1 mg/L. The study shall evaluate the costs of the application of these limits on a monthly, seasonal, and annual average basis."

Special condition 23 (using the Clavey Rd. WRF NPDES permit as an example) states:

"The Agency has determined that the Permitee's treatment plant effluent is located upstream of a waterbody or stream segment that has been determined to have a phosphorus related impairment. This determination was made upon reviewing available information concerning the characteristics of the relevant waterbody/segment and the relevant facility (such as quantity of discharge flow and nutrient load relative to the stream flow).

A phosphorus related impairment means that the downstream waterbody or segment is listed by the Agency as impaired due to dissolved oxygen and/or offensive condition (algae and/or other aquatic plant growth) impairments that is related to excessive phosphorus levels.

The permittee shall develop, or be part of a watershed group that develops, a Nutrient Assessment Reduction Plan (NARP) that will meet the following requirements:

A. The NARP shall be developed and submitted to the Agency by December 31, 2024. This can be accomplished by the Permittee, by participation in an existing watershed group, or by creating a new group. The NARP shall be supported by data and sound scientific rationale.

B. The permittee shall cooperate with and work with other stakeholders in the watershed to determine the most cost-effective means to address the phosphorus related impairment. If other stakeholders in the watershed will not cooperate in developing the NARP, the *permittee shall develop its own NARP for submittal to the Agency to comply with this condition.*

C. In determining target levels of various parameters necessary to address the phosphorus related impairment, the NARP shall either utilize the recommendations of the Nutrient Science Advisory Committee or develop its own watershed-specific target levels.

D. The NARP shall identify phosphorus input reductions by point source discharges and non-point source discharges in addition to other measures necessary to remove phosphorus related impairments in the watershed. The NARP may determine, based on an assessment of relevant data, that the watershed does not have an impairment related to phosphorus, in which case phosphorus input reductions or other measures would not be necessary. Alternatively, the NARP could determine that phosphorus input reductions from point sources are not necessary, or that phosphorus input reductions from both point and nonpoint sources are necessary, or that phosphorus input reductions are not necessary and that other measures, besides phosphorus input reductions, are not necessary.

E. The NARP shall include a schedule for the implementation of the phosphorus input reductions by point sources, non-point sources and any other measures necessary to remove phosphorus related impairments. The NARP schedule shall be implemented as soon as possible and shall identify specific timelines applicable to the Permittee.

F. The NARP can include provisions for water quality trading to address the phosphorus related impairments in the watershed. Phosphorus/Nutrient trading cannot result in violations of water quality standards or applicable antidegradation requirements.

G. The Permittee shall request modification of the permit within 90 days after the NARP has been completed to include necessary phosphorus input reductions identified within the NARP. The Agency will modify the NPDES permit if necessary.

H. If the permittee does not develop or assist in developing the NARP, and such a NARP is developed for the watershed, the Permittee will become subject to effluent limitations necessary to address the phosphorus related impairments. The Agency shall calculate these effluent limits by using the NARP and any applicable data. If no NARP has been developed, the effluent limits shall be determined for the Permittee on a case-by-case basis, so as to ensure that the Permittee's discharge will not cause or contribute to violations of the dissolved oxygen or narrative water quality standards."

In addition all of the WWTPs that are members of the NBWW are subject to Special Condition 24 in their respective NPDES permits as follows:

"The Permittee shall participate in the North Branch Chicago River Watershed Workgroup (NBWW). The Permittee shall work with other watershed members of the NBWW to determine

the most cost effective means to remove dissolved oxygen (DO) and offensive condition impairments in the North Branch Chicago River Watershed to the extent feasible."

A. *The NBWW will conduct the following activities in accordance with the Plan during the term of this permit:*

   1. *Develop and Integrated Prioritization System (IPS) and supporting tools consisting of in-depth analysis of all chemical, physical and biological data collected in past watershed assessments to develop a library of data analysis tools and prioritization mechanisms related to future impairment restoration activities.*

   2. *Develop a Nutrient Assessment Reduction Plan (NARP) sequenced as follows:*

      a. *Develop a preliminary NARP Workplan to be utilized to plan and budget the multiyear development and completion of a NBWW NARP. The preliminary NARP Workplan shall be completed by December 31, 2021.*
      b. *Develop NBWW NARP in accordance with the requirements in Special Condition 24.*

   3. *Continue comprehensive water quality monitoring program consisting of bioassessment monitoring, flow monitoring, and water column and sediment chemistry sampling and analysis; modify these programs as necessary to meet NARP objectives.*

B. *The Permittee shall submit an annual progress report on the activities identified in (A) above, which includes the monitoring data from the previous year, to the Agency by March 31st of each year. The Permittee may work cooperatively with the NBWW to prepare a single annual progress report that is common among NBWW members.*

C. *In its application for renewal of this permit, the Permittee shall consider and incorporate recommended NBWW activities listed in any annual progress report or Nutrient Assessment Reduction Plan that the Permittee will implement during the next permit term."*

Nutrient Assessment Reduction Plan (NARP)

The State of Illinois developed the Illinois Nutrient Loss Reduction Strategy (NLRS; State of Illinois 2018) to deal with the enrichment of Illinois surface waters by primary nutrients (N and P). As part of the NLRS Illinois EPA developed a process termed the Nutrient Assessment Reduction Plan (NARP) which is to be developed for major wastewater treatment facilities by December 31, 2023. The two major WWTPs that are members of the NBWW have recently initiated planning for meeting the NARP requirements as specific in their NPDES permits. Depending on the findings of the NBWW NARP process, additional controls on discharges of N and P could be forthcoming.

Nonpoint Sources

Nonpoint sources in the NBWW study area primarily include runoff from urban sources of varying intensities that range from light suburban to heavy urban and industrial. Hydromodification of stream and river flows and habitat modifications occur throughout the survey area with the latter primarily in the form of prior channelization and riparian encroachment by urban and suburban development. A dam located upstream of Willow Rd. on the lower Skokie River that creates the Skokie Lagoons impounds four (4) miles of the river.

Spatial Survey Design

The spatial monitoring design employed a combined geometric (stratified-random) and targeted-intensive pollution surveys that evaluates pollution from all sources and in keeping with its definition in the Clean Water Act (CWA). This design was employed primarily to determine the status of aquatic life and recreational use attainment at the same scale at which pollution sources are being managed and regulated within NE Illinois watersheds. Given that there are hundreds of point sources, numerous stormwater structures, varying degrees of urban and suburban development, legacy pollutants, and habitat and hydrologic alterations, an intensive pollution survey design is needed to capture and characterize the numerous and overlapping pollution gradients that result from these sources. This requires more sites than a condition survey which relies on a comparatively greater extrapolation of data from fewer sampled sites to many more unsampled sites and reaches. This design can result in overlooking local impairments that can evade less spatially intensive condition assessments. The pollution survey design is intended to make quantitative indicators and tools available to guide and support restoration and protection efforts undertaken by NBWW, other watershed groups, and their respective stakeholders. The data and assessments provided by these periodic watershed assessments and by the Northeastern Illinois Integrated Prioritization System (IPS) framework (MBI 2022a), that provides supporting analyses and information on a regional basis to support the restoration of impaired streams and rivers and the protection of high quality sites, reaches, and watersheds from further degradation.

A tiered design was adopted by the NBWW for monitoring water chemistry at varying frequencies throughout the watershed on an annual basis. This consists of sampling 25 sites located throughout the three North Branch Chicago River mainstem tributaries (Figure 3). These same sites were sampled biennially for biological assemblages and habitat, sediment chemistry, water chemistry via grab samples. Datasondes were deployed for 4-5 day periods during the summer under low flows at seven (7) sites. Continuous data for D.O., temperature, conductance, and pH were recorded and benthic chlorophyll a was collected at each site in conjunction with the deployment of the Datasondes. Each site was assigned a unique NBWW numeric site code, a river mile, and UTM coordinates (Table 5).

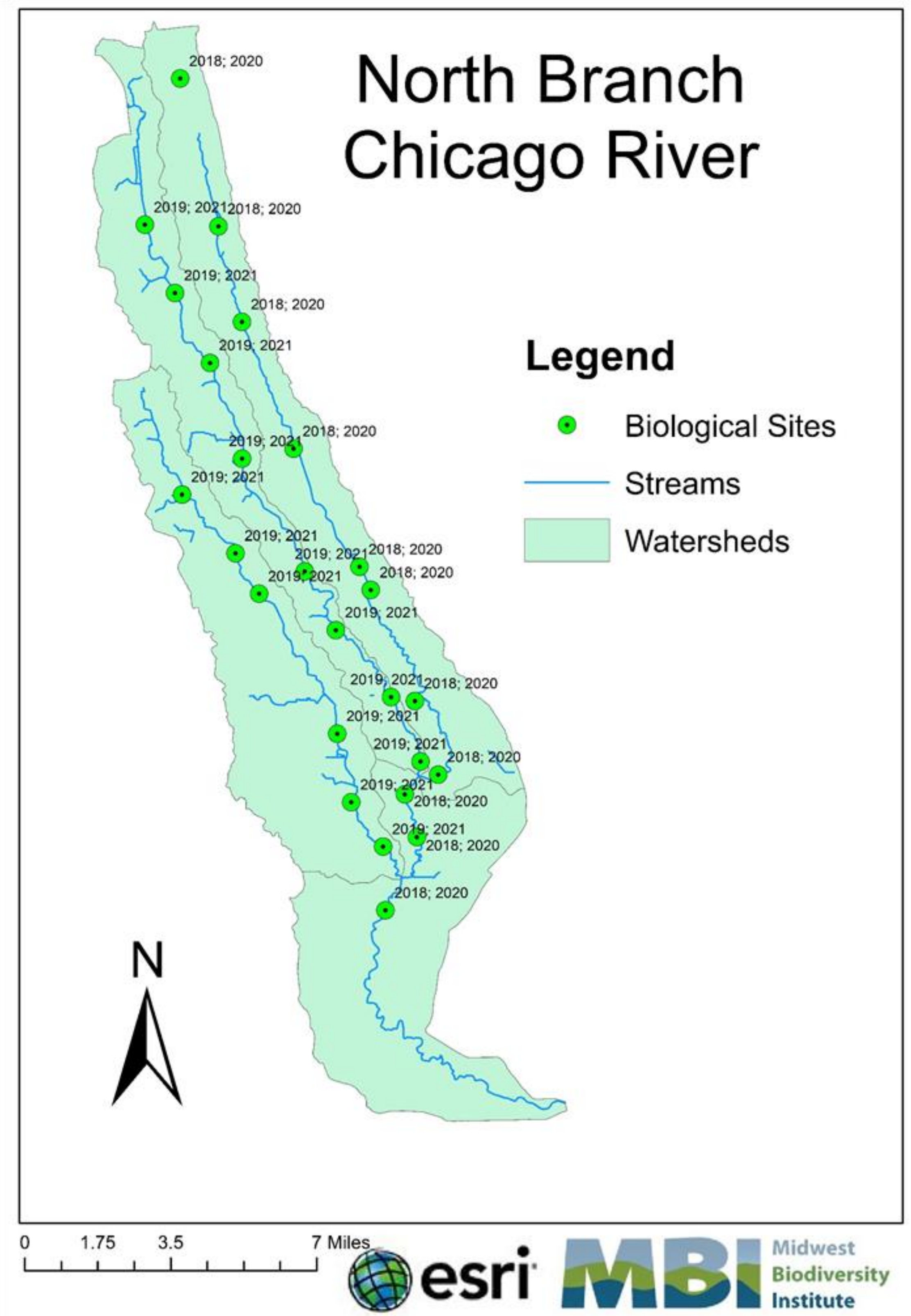


Figure 3. *Location of 25 biological and habitat sampling sites in the NBWW survey area during 2018-2021. Site codes correspond to the sites listed in Table 5.*

***Table 5**. Locations of sampling sites in the NBWW survey area in 2020-21 showing the site ID, river, river mile and what sampling was performed at each site (F - Fish; MH - multihabitat macroinvertebrate; QHEI - Qualitative Habitat Evaluation Index; Datasonde; Benthic Chlorophyll a, and water chemistry in accordance with Tier 1-3 designation). Corresponding IEPA sites are listed alongside NBWW sites or site clusters to illustrate the differences in site density.*

NBWW Site ID	River Stream Name	Drainage Area (mi.^{2})	River Mile	Year	Latitude	Longitude	Location	Biota	Habitat	Data-sonde/ Benthic Chla	Water Chemistry Tier 1	Tier 2	Tier 3	IEPA Location
Skokie River														
SR1	Skokie River	2.78	21.1	2020	42.33089	-87.88161	adj. Gillett Plant	MH, F	QHEI		1		3	HCCD01 (RM 8.0)
SR2	Skokie River	7.87	17.4	2020	42.27941	-87.86409	ust. IL 176	MH, F	QHEI			2	3	
SR3	Skokie River	11.56	14.8	2020	42.24616	-87.85333	dst. Deerpath Rd.	MH, F	QHEI	X		2	3	
SR4	Skokie River	15.07	11.3	2020	42.20196	-87.82955	ust. Half Day Rd.	MH, F	QHEI			2	3	
SR5	Skokie River	20.67	8.0	2020	42.16077	-87.79907	ust. Clavey Rd.	MH, F	QHEI	X		2	3	
SR6	Skokie River	21.51	7.4	2020	42.15268	-87.79392	ust. Lake Cook Rd.	MH, F	QHEI			2	3	
SR7	Skokie River	23.73	3.0	2020	42.11398	-87.77361	Skokie Lagoon	F	QHEI	X		2	3	None
SR18	Skokie River	30.90	0.5	2020	42.08834	-87.76299	dst. I-94	MH, F	QHEI	X	1		3	HCCD09 (RM 1.70)
Middle Fork North Branch Chicago River														
MF08	Middle Fork North Branch Chicago River	5.80	21.1	2021	42.28013	-87.89854	ust. Rockland Rd.	MH, F	QHEI	X	1		3	HCCC06 (RM 13.3)
MF09	Middle Fork North Branch Chicago River	8.90	18.9	2021	42.25635	-87.88459	dst. Footbridge	MH, F	QHEI	X		2	3	
MF10	Middle Fork North Branch Chicago River	11.90	16.7	2021	42.23196	-87.86841	dst. Westleigh St.	MH, F	QHEI	X		2	3	
MF11	Middle Fork North Branch Chicago River	16.10	14.1	2021	42.19861	-87.85362	dst. IL 22	MH, F	QHEI	X		2	3	
MF12	Middle Fork North Branch Chicago River	19.20	10.8	2021	42.15927	-87.82470	ust. Carriage Way	MH, F	QHEI	X		2	3	
MF13	Middle Fork North Branch Chicago River	20.90	8.6	2021	42.13879	-87.81029	ust. IL 68	MH, F	QHEI	X		2	3	
MF14	Middle Fork North Branch Chicago River	22.40	6.0	2021	42.11541	-87.78472	dst. Sunset Dr.	MH, F	QHEI	X		2	3	
MF15	Middle Fork North Branch Chicago River	24.20	4.0	2021	42.09294	-87.77116	dst. Winnetka Ave.	MH, F	QHEI	X	1		3	HCCC04 (RM 0.8)
MF16	Middle Fork North Branch Chicago River	56.15	3.0	2020	42.08152	-87.77860	ust. E. Lake Rd.	MH, F	QHEI			2	3	
MF17	Middle Fork North Branch Chicago River	57.31	1.8	2020	42.06667	-87.77310	dst. Glenview Rd.	MH, F	QHEI	X		2	3	
West Fork North Branch Chicago River														
WF20	West Fork North Branch Chicago River	3.80	12.5	2021	42.18624	-87.88178	adj. Saunders Rd.	MH, F	QHEI	X	1		3	HCCB13 (RM 7.0)
WF21	West Fork North Branch Chicago River	7.00	10.4	2021	42.16572	-87.85696	dst. Deerfield Rd.	MH, F	QHEI	X		2	3	
WF22	West Fork North Branch Chicago River	9.40	9.2	2021	42.15161	-87.84602	dst. Lake Cook Rd.	MH, F	QHEI	X	1		3	
WF23	West Fork North Branch Chicago River	17.80	4.9	2021	42.10279	-87.80994	dst. Willow Rd.	MH, F	QHEI	X		2	3	
WF24	West Fork North Branch Chicago River	24.50	1.9	2021	42.07891	-87.80765	dst. Lake Ave.	MH, F	QHEI	X		2	3	
WF25	West Fork North Branch Chicago River	27.90	1.3	2021	42.06345	-87.78887	ust. Walking bridge	MH, F	QHEI	X	1		3	
North Branch Chicago River														
MF19	North Branch Chicago River	93.41	18.6	2020	42.04128	-87.78799	ust. Dempster St.	MH, F	QHEI	X	1		3	HCC07 (RM 16.0)

METHODS

All methods followed Illinois EPA and DNR procedures, except as modified to meet the needs of the NBWW, but with the goal of providing comparable data to evaluate aquatic life and recreational use attainment. This includes fish, macroinvertebrates, habitat, bacteria, chemical parameters (water and sediment), continuous data for selected parameters, and benthic and sestonic chlorophyll a. Recreational use attainment was evaluated with *Escherichia coli* and using the U.S. EPA national criteria since none were available from Illinois EPA for *E. coli*.

Chemical/Physical Water Quality

Water Sampling

The specific methods of data collection followed Illinois EPA (2012a) and chemical laboratory analyses were provided by the North Shore Water Reclamation District laboratory. The chemical/physical parameter categories (demand, nutrients, ionic strength, metals, and organics) and the frequency of sample collection are summarized in the Monitoring Strategy for the North Branch Chicago River (2018). NBWW assigned tiers to each the 25 sampling sites as follows:

- **Tier 1**: Eight (8) sites, three (3) in the West Fork North Branch Chicago River, three (3) in the Middle Fork North Branch Chicago River, and two (2) in the Skokie River, were sampled four times for demand, nutrient, and bacteria parameters, and once annually for metals and organics.
- **Tier 2**: Seventeen (17) sites divided into each of the three subwatersheds are monitored four times for the majority of the demand parameters, all nutrients, and bacteria parameters.
- **Tier 3**: Two additional monitoring events for demand, nutrients, and bacteria parameters at bioassessment sites during the bioassessment seasonal index period of mid-June through mid-October.

While NBWW collects water samples in February along with more frequently collected samples during the May-October seasonal index period, only the latter period data is included as it coincides with the bioassessment seasonal index period of mid-June to mid-October. Chemical data is collected on an annual basis at all 25 sites thus the results from 2018 through 2021 are presented and analyzed herein for trends. The first round of biological and water quality assessment analyzed the 2018-19 results (MBI 2020a) while this report focuses on the 2020-21 results.

Sediment Sampling

Surficial sediments were sampled for bulk chemical analysis once at all 25 locations in early October following Illinois EPA methods (Illinois EPA 2011b). Eleven (11) samples were collected in the Skokie River, the lower Middle Fork, and the North Branch in 2020 and 14 samples were collected in the remaining Middle and West Fork sites of the North Branch Chicago River in 2021 and analyzed by Eurofins/Test America.

Nutrient Effect Assessment Procedure

A methodology to assess the effects of nutrient enrichment modeled after the Stream Nutrient Assessment Procedure (SNAP) developed by Ohio EPA (2015b) was used in the NBWW bioassessment for 2020-21. It includes the width of the diel swing, maximum, and minimum values in continuously measured D.O., the biomass of chlorophyll a in benthic algae analyzed by the University of Washington Marine Sciences Laboratory, sestonic chlorophyll a, and the concentration of total phosphorus and dissolved inorganic nitrogen (nitrate + nitrite-N). Other related parameters such as volatile suspend solids (VSS), turbidity, and total Kjeldahl nitrogen (TKN) are included when they were collected at the 20 Datasonde and benthic chlorophyll a locations (Table 5). Datasondes were deployed for consecutive 5-7 day periods during times of low stream flow and elevated summer ambient temperatures (YSI 2012, 2017). The 2020-21 assessment follows modifications made for the upper Des Plaines River in 2020 (MBI 2022b) by the addition of a scoring system that is weighted by the role of each indicator as a direct response (primary), indirect response (secondary), or as a tertiary algal stimulatory indicator (Mazor et al. 2022). Together these results were used to determine five narrative ratings of Enrichment Status that results from the degree to which each of the nutrient related parameters and SNAP indicators exceeded their respective primary, secondary, and tertiary thresholds.

A summary of the number of water and sediment parameters and samples collected in 2018-2021 is found in Table 6. The parameters analyzed and frequencies of collection varied by NBWW tier assignment as was previously described.

***Table 6**. Summary of the number of water chemistry parameters and samples collected by parameter category for water column (left) and surficial sediment (right) in the North Branch Chicago River study area during 2018-21.*

	Water		Sediment	
Parameter Type	**Parameters**	**Samples**	**Parameters**	**Samples**
All	123	10,426	110	7,076
Field pH & Temp.	2	1,120	0	0
Demand	2	1,104	0	0
Ammonia	1	426	0	0
Nutrient	7	1,972	2	122
Ionic Strength	6	1,144	0	0
Metals	18	448	20	1,220
Suspended Materials	2	840	0	0
Organic Compounds	100	2,856	110	5,791
Benthic Chlorophyll	1	39	0	0
Sestonic Chlorophyll	1	423	0	0

Biological Assemblage Methods

Biological assemblages in the 2020-21 North Branch study area included fish and macroinvertebrates at the same 25 instream locations as in 2018-19 (Table 5). Biological and habitat sampling adhered to a summer-early fall index period of June 16-October 15 for fish and July 1-September 30 for macroinvertebrates. All sites were sampled for fish twice, while macroinvertebrates were sampled once with a 10% resample. A habitat evaluation was performed at all fish sites using the QHEI (Ohio EPA 2006) and a site description accompanied the Illinois EPA multihabitat macroinvertebrate sample. All sampling occurred during periods of summer-fall base flows; periods of high flows and runoff were avoided.

Fish Assemblage Methods

Fish were collected once in 2021 and twice in 2020 at each site with pulsed D.C. electrofishing units including a Wisconsin AbP-3 battery powered backpack, a 2500 Watt generator controlled by a Smith-Root 2.5 GPP pulse box, or a 5000 Watt generator controlled by a Smith-Root 5.0 GPP pulse box. Deference was given to the most effective method based on the prevailing site and water characteristics. The upper boundary for using the battery-powered backpack electrofishing unit was two times the depth and five times the width of the net ring (anode). Wider and deeper sites were sampled with the 2500 Watt generator and Smith-Root 2.5 GPP pulse box unit as either a bank set longline or floated on a roller barge. The primary net ring served as the anode and a woven steel cable cathode trailed from the backpack unit, the longline or the roller barge. A long-handled dip net was used to assist in the collection of stunned fish. The 5000 Watt generator and Smith-Root 5.0 GPP pulse box were mounted on an inflatable 16 foot Wing raft with an electrode array, which was used solely at site SR7 in the Skokie Lagoons. Woven steel droppers extended in front of the raft on a telescoping boom and served as the anodes and steel dishwasher hoses extending off the side of the frame served as the cathodes. A two or three person crew consisting of a fish crew leader and one or two field technicians conducted the sampling under summer normal base flow conditions. Sampling effort was standardized by distance and included a 150-200 meter reach for wadeable sites and 500 meters for the single raft site.

Captured fish were placed in a live well for later processing. Water was regularly replaced and/or aerated to maintain adequate oxygen levels to minimize fish mortality. Samples from each site were processed by enumerating weights by species and by life stage (young-of-the-year, juvenile, and adult) on a field data sheet. The incidence of external anomalies was recorded following the procedures outlined by Ohio EPA (1996, 2015a) and refinements made by Sanders et al. (1999). Fish were released back into the stream after they were identified to species, examined for any external anomalies and weighed either individually or in batches. Larval fish were not included in the sample and fish measuring less than 15-25 mm in length were generally excluded as a matter of practice (excepting adults of small species). All sites were marked with GPS coordinates (beginning, middle and end of the sampling reach) and site data was recorded on a standard field form.

Any fish collected that were not identifiable in the field were vouchered for identification in the laboratory. Vouchered specimens were preserved in borax buffered 10% formalin solution and labeled by site, date, and geographic identifier (e.g. river mile and site number). Regional ichthyology keys were used including the Fishes of Illinois (Smith, 1979) and updates by the Illinois Natural History Survey (INHS). Identification was made to species level at a minimum. Scientific nomenclature followed Page et al. (2012). Vouchers were deposited at Midwest Biodiversity Institute in Hilliard, OH. The data were used to calculate the Illinois Fish Index of Biotic Integrity (fIBI; Smogor 2000, 2005) as the primary assessment of fish assemblage quality.

Macroinvertebrate Methods

Macroinvertebrate methods followed the Illinois EPA multihabitat method (Illinois EPA 2011 c,d) at all sites. The Illinois EPA multihabitat method requires the selection of a sampling area that is representative of the instream and riparian habitat conditions of the assessment reach. Sampling requirements included flow conditions characteristic of typical summer normal base flows, the absence of highly influential tributary streams, the presence of one riffle/pool sequence or run/bend meander or alternate point-bar sequence, if present, and a minimum length of 300 feet. Collection methods included using a D-frame dip-net to sample all bottom- and bank-zone habitat types within a site. All sites were marked with GPS coordinates (beginning and end of sampling reach) and site data was recorded on a standard field form.

Multihabitat macroinvertebrate samples were field preserved in borax buffered 10% formalin solution. Once samples were delivered to the lab in Hilliard, Ohio the samples were transferred to 70% ethyl alcohol. Laboratory procedures followed the Illinois EPA (2011e) methodology which requires the field sample to be subsampled to a 300-organism count following a pre-pick of large and/or rare taxa. Taxonomic resolution was to the lowest practicable taxonomic level for the common macroinvertebrate assemblage groups (mayflies, stoneflies, midges, and crustaceans), which goes beyond the genus level requirement of Illinois EPA (2011g), but which is needed for other data analyses (MBI 2022a). Calculation of the Macroinvertebrate IBI (mIBI) adhered to Illinois EPA methods by using genus as the benchmark level of taxonomic resolution.

Habitat Assessment Methods

The QHEI (Rankin 1989, 1995; Ohio EPA 2006) was the principle aquatic habitat assessment method used at each site. The habitat assessments were completed as a part of the fish assemblage sampling by the fish crew leader who is trained and experienced in using the QHEI. The QHEI measures six categories of attributes that are important to supporting healthy assemblages of aquatic biota with a scoring range of 0-100. QHEI scoring thresholds for excellent, good, fair, poor, and very poor were derived a part of the NE Illinois IPS (MBI 2022a). Excellent and good scores are regarded as sufficient to support the General Use for aquatic life. Scores below good and in the fair, poor, and very poor ranges indicate the accumulation of deficiencies in the habitat that can preclude attainment of the General Use for aquatic life. A QHEI matrix (after Rankin 1995 attenuated for NE Illinois) showing the occurrence of good and modified attributes was also examined to evaluate the overall capacity of the stream habitat to support the General Use at each site. It also provides insights to which attributes of habitat would require remediation to attain General Use of better conditions.

Data Management

All data was managed by MBI in internal databases that permit ready access and analysis. Biological and habitat data is stored in a routine based on the Ohio ECOS format that MBI uses for all biological data management tasks. Biological data analysis included the calculation of Illinois fish and macroinvertebrate IBIs for determining General Use aquatic life status and the accompanying data attributes to enhance the diagnosis of impairments. Habitat data was analyzed using the QHEI and also via a QHEI attributes matrix to aid in assessing habitat related impairments. Summaries of species/taxa relative abundance and QHEI metrics at each site and by sampling date are provided in Appendices A-C.

Determining Use Attainability

The Illinois WQS offers a single aquatic life use designation that applies to all rivers and streams through the General Use. An assessment of aquatic life use attainability was not conducted as the General Use designation was presumed to be attainable for all rivers and streams in the 2020-21 study area. However, the data collected is adequate to determine if habitat and/or other eligible factors are an irreversible limiting factor in any instances of General Use non-support.

Determining Use Attainment

The determination of the attainment status of the Illinois General Use for aquatic life generally followed the guidance in the Illinois EPA 2022 Integrated Report with some modifications as described below (Illinois EPA 2022). The General Use for aquatic life is applicable to all streams in the NBWW 2020-21 study area. Attainment of the fIBI and mIBI thresholds were expressed as fully supporting excellent, fully supporting good, partially supporting, non-supporting fair, non-supporting poor, and non-supporting very poor, with the most limiting result of either the fish or macroinvertebrates determining the narrative assignment of fair, poor or very poor. The addition of the fully supporting excellent, partial support, and non-support very poor categories are the principal modifications to the current Illinois EPA structure and was done to better highlight where only one assemblage attained their respective fIBI or mIBI biocriterion and to better highlight the full gradient of biological response. Narrative ratings for non-biological parameters are assigned based on the Integrated Prioritization System (NE Illinois IPS; MBI 2022a).

Determining Causal Associations

Using the results, conclusions, and recommendations of this assessment requires an understanding of the methodology used to determine biological status and assigning associated causes and sources of impairment utilizing the accompanying chemical/physical data and source information (e.g., point source loadings, land use). The availability of outputs from the Northeastern Illinois Integrated Prioritization System (NE Illinois IPS; MBI 2022a) enhances causal analysis by conveying the severity of the exceedance in terms of expressing very poor, poor, and fair conditions. These outputs included regionally derived stressor thresholds for more than 80 chemical and habitat variables, Restorability rankings for impaired sites, and Susceptibility and Threat rankings for sites that attained the Illinois General Use biological criteria.

Causal Diagnosis

Describing the causes and sources associated with observed biological impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment chemistry data, habitat data, effluent data, land use data, and biological response signatures (Yoder and Rankin 1995; Yoder and DeShon 2003). Thus the assignment of associated causes and sources of biological impairment in this report represents the association of impairments (based on response indicators) with stressor and exposure indicators using linkages to the bioassessment data based on previous experiences with analogous situations and impact types. This was done by relating exceedances of chemical thresholds such as chronic and acute water quality criteria and relevant biological effects thresholds for water and sediment chemistry from the NE Illinois IPS tool and dashboard to further refine the relative importance of categorical and/or parameter specific causes. The reliability of the identification of associated causes and sources is increased where other such prior associations have been observed. This process relies on multiple lines of evidence concerning the biological response which is the ultimate measure of success in water quality management. The NE Illinois IPS derived exceedance thresholds for chemical and habitat parameters were also used in the tabular and graphical presentation of the chemical water and sediment results as part of the causal analyses. When combined with the Restorability and Susceptibility/Threat rankings this improved the certainty of the assignment of causes and sources to an observed biological impairment.

Hierarchy of Water Indicators

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. A tiered approach that links the results of administrative actions with true environmental measures was employed in the analyses. The integrated approach is outlined in Figure 4 and includes a hierarchical continuum from administrative to true environmental indicators. The six “levels” of indicators include:

- Level 1 - actions taken by regulatory agencies (permitting, enforcement, grants);
- Level 2 - responses by the regulated entity (treatment works, pollution prevention);
- Level 3 - changes in discharged quantities (pollutant loadings);
- Level 4 - changes in ambient conditions (chemical/physical water quality, habitat);

- Level 5 - changes in uptake and/or assimilation (tissue contamination, biomarkers, assimilative capacity); and,
- Level 6 - changes in health, ecology, or other effects (ecological condition, human and wildlife health).

In this process the results of administrative activities (Levels 1 and 2) are linked to water quality (Levels 3, 4, and 5) which translates to a response (Level 6). An example is the aggregate effect of billions of dollars spent on water pollution control in the U.S. since the early 1970s that have been determined with quantifiable measures of environmental condition. In this case the hierarchy was applied to a specific stream reach that is impacted by multiple point and nonpoint sources. The administrative steps taken by Illinois EPA to issue NPDES permits (Level 1) and the steps taken by the permit holders (Level 2) are easily described and quantified. Quantifying changes in the loadings of pollutants (Level 3) can be affected by the quality and completeness of the effluent monitoring which includes the capture of stressors that actually affect the receiving streams. Likewise, documenting changes in ambient conditions (Level 4) can also be affected by the quality and completeness of the chemical/physical monitoring that not only includes the parameters but also the spatial design in relation to sources of pollution.

This in turn informs about how pollution sources tax the assimilative capacity (Level 5) of a receiving stream. The end result of all the above is portrayed by the response in the biological

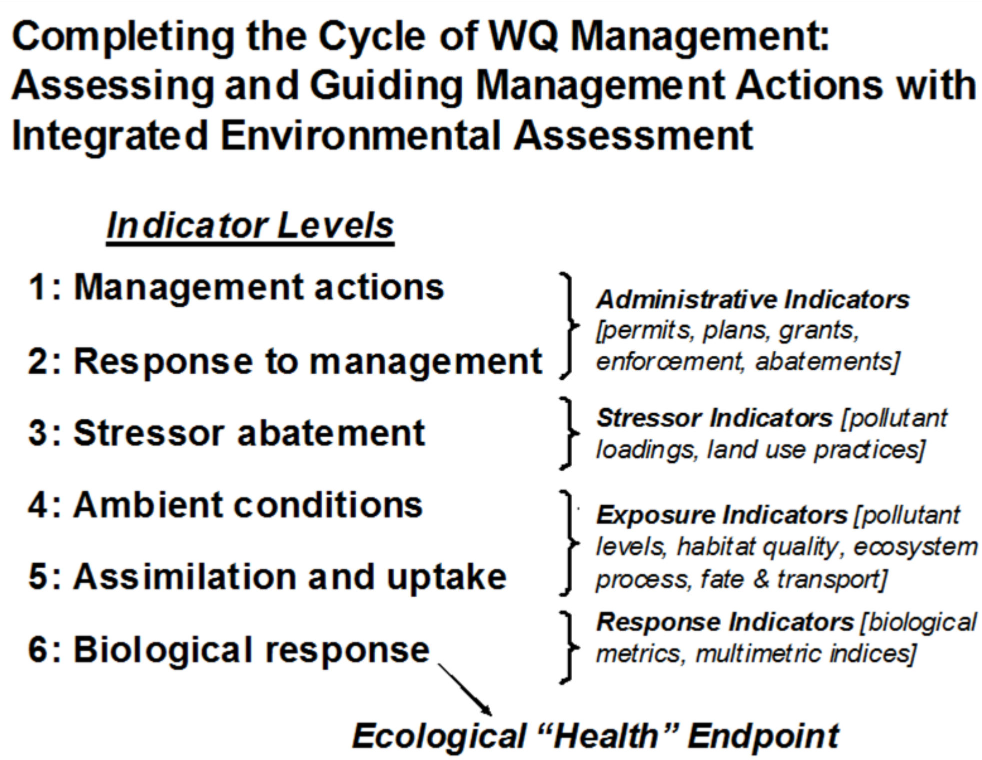


***Figure 4**. The hierarchy of administrative and environmental indicators which can be used to support monitoring and assessment, reporting, and an evaluation of the effectiveness of pollution controls on a receiving stream. This is patterned after a model developed by U.S. EPA (1995a,b) and enhanced by Karr and Yoder (2004).*

indicators which is expressed as attainment or non-attainment of the Illinois General Use aquatic life thresholds for the fish and macroinvertebrate IBIs (Illinois EPA 2016). Symptoms expressed by the biota beyond the index scores can be useful in aiding the causal diagnosis as a feedback loop in the hierarchy of indicators process. Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators.

- Stressor indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications.
- Exposure indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent.
- Response indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the IEPA biological indices as the biological endpoints.

This classification of indicators represents the essential technical elements for the pollution survey design that was employed in the North Branch bioassessments by using each indicator within its most appropriate role for each (Yoder and Rankin 1998).

Causal Associations

Describing the causes and sources associated with biological impairments in the study area involved the interpretation of multiple lines of evidence that included water chemistry, sediment chemistry, habitat, and effluent data, a general knowledge about upstream land uses, and biological response signatures within the biological data itself. The assignment of causes and sources of biological impairment result from the association of the impairment with exceedances of water quality criteria or other response-based thresholds and the proximity to sources of pollution. This process was strengthened by the availability of regionally derived stressor effect thresholds from the NE Illinois IPS (MBI 2022a) that classified stressor levels into excellent, good, fair, poor, and very poor categories.

RESULTS – CHEMICAL/PHYSICAL WATER QUALITY

Chemical/physical water quality in the NBWW study area was characterized by grab sample data collected from the water column three times at each Tier 1-2 sites with an additional two collections at Tier 3 sites during summer-fall base flows annually. Sediment chemistry was determined from samples collected at all 25 Tier 1-3 sites, 11 in October 2020 and 14 in October 2021. Commonly detected chemical parameters were compared either to the criteria in the Illinois WQS, Illinois EPA non-standard benchmarks, reference benchmarks, and most commonly to biologically derived thresholds of the NE Illinois IPS (MBI 2022a). As such, the chemical/physical data herein serves as an indicator of the degree of exposure and stress in support of using the biological data to assess the attainment of the aquatic life use and to assist in assigning associated causes and sources for impaired sites. Parameter groupings included field, demand, ionic strength, nutrients, heavy metals, and organic compounds. Bacteria data was collected by grab samples and were used primarily to determine the status of recreational uses in accordance with U.S. EPA National Water Quality Criteria (U.S. EPA 2012).

Flow Regime

The flow regime for the NBWW study area during the period of January 1 – December 31 for all years of NBWW monitoring 2018-21 is depicted in Figure 5 based on the gages operated by the U.S. Geological Survey on the West Fork North Branch Chicago River at Northbrook, IL (USGS 05535500), on the Middle Fork North Branch Chicago River at Deerfield, IL (USGS 05534500), on the Skokie River at Highland Park, IL (USGS 05535070) and on the N Br Chicago River at Niles, IL (USGS 05536000). Flows in 2018 were lower during the August and September months compared to 2019 when recurrent elevated flows occurred. Low flows were observed during the latter part of July into August during the 2018 sampling year, falling below the 90% duration value in the Middle Fork North Branch Chicago River, Skokie River, and the West Fork North Branch Chicago River (Figure 5). Higher flows in September 2018 and 2019 exceeded the flood stage in the Skokie River and Middle Fork North Branch Chicago River. These elevated flows and high flows in June and July prevented a second fish pass in 2019 at all sites and at MF19 in 2018. Flows were sufficiently “normal” in mid-July and August. Flows in 2020 were similar to 2018-19 in May, but were lower through the summer and fall and less than the 75th percentile of 203 cfs. The flows in 2021 were the lowest of the four years with sustained periods below the median of 92 cfs and reaching the $Q_{7,10}$ of 16.5 cfs on several days.

Point Source Effluent Quality

Point source discharges of treated wastewater are a major contribution of pollutant loadings in the West Fork North Branch Chicago River and the Skokie River with design average flows of 17.8 MGD and 3.0 MGD (27.5 cubic feet/second and 4.6 cubic feet/second) contributed by the Clavey Rd. WRF and the Deerfield WRF, respectively (see Table 4). The 2020 and 2021 discharges for the Clavey Rd. WRF averaged 11.3 MGD (17.48 cfs) and 13.7 MGD (21.20 cfs) and the Deerfield WRF averaged 1.9 MGD (2.94 cfs) and 1.8 MGD (2.79 cfs). These totals are 25-30.3 times the $Q_{7,10}$ flow of 0.7 cfs for the Skokie River at Highland Park, IL and 1.26-1.33 times the $Q_{7,10}$ flow of 2.2 cfs of the West Fork North Branch Chicago River at Northbrook, IL. As a result of these discharges, the Skokie River and the West Fork North Branch Chicago River are “effluent dominated” where the total flow consists primarily of treated wastewater (Onnis-Hayden et al. 2006). The Deerfield WRF and Clavey Rd. WRF are the only two WWTPs in the NBWW survey area and provide the major portion of the low flows of their respective receiving streams. Summaries of the 2018-21 effluent flow and loads from each facility appear in Table 4 and the table below Figure 6. Effluent flows at both facilities have declined albeit inconsistently between 2018-19 and 2020-21 as have loadings of $CBOD_5$ and total suspended solids (TSS). The other effluent parameters ammonia-N (NH_3-N), nitrate-N (NO_3-N), and total phosphorus (TP) showed no real consistency in increases or declines between the four years being more variable between each year.

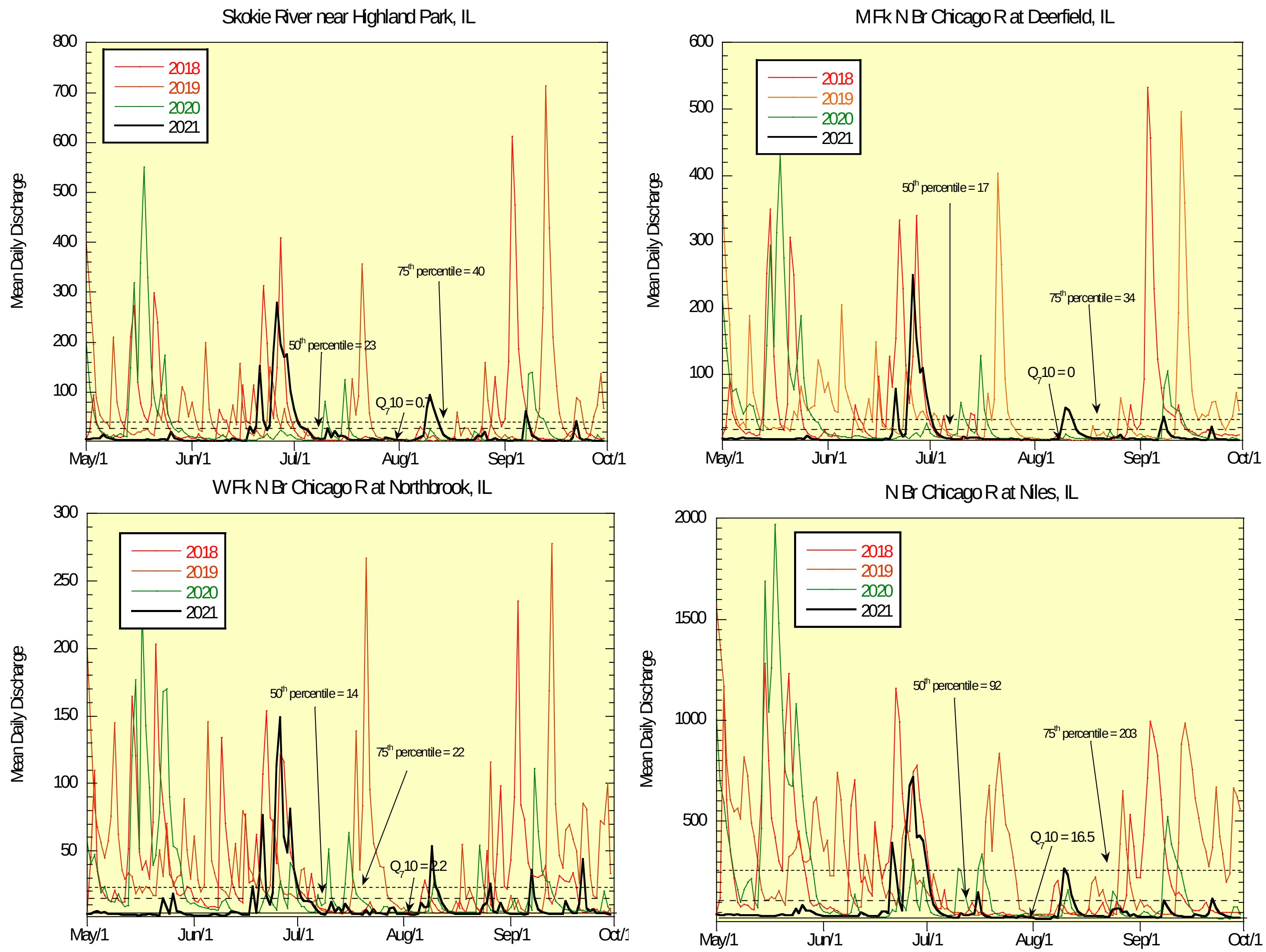


***Figure 5**. Daily flow in cfs measured at the USGS gages on the Skokie River (USGS 05535070, upper left) near Highland Park, the West Fork North Branch Chicago River (USGS 05535500, upper right) near Northbrook, the Middle Fork North Branch Chicago River (USGS 05534500, lower left) at Deerfield, and the North Branch Chicago River at Niles (USGS 05536000, lower right) for the years of 2018-21. The horizontal lines are the 75th percentile, 50th percentile, and the seven-day, ten year ($Q_{7,10}$) critical low flows.*

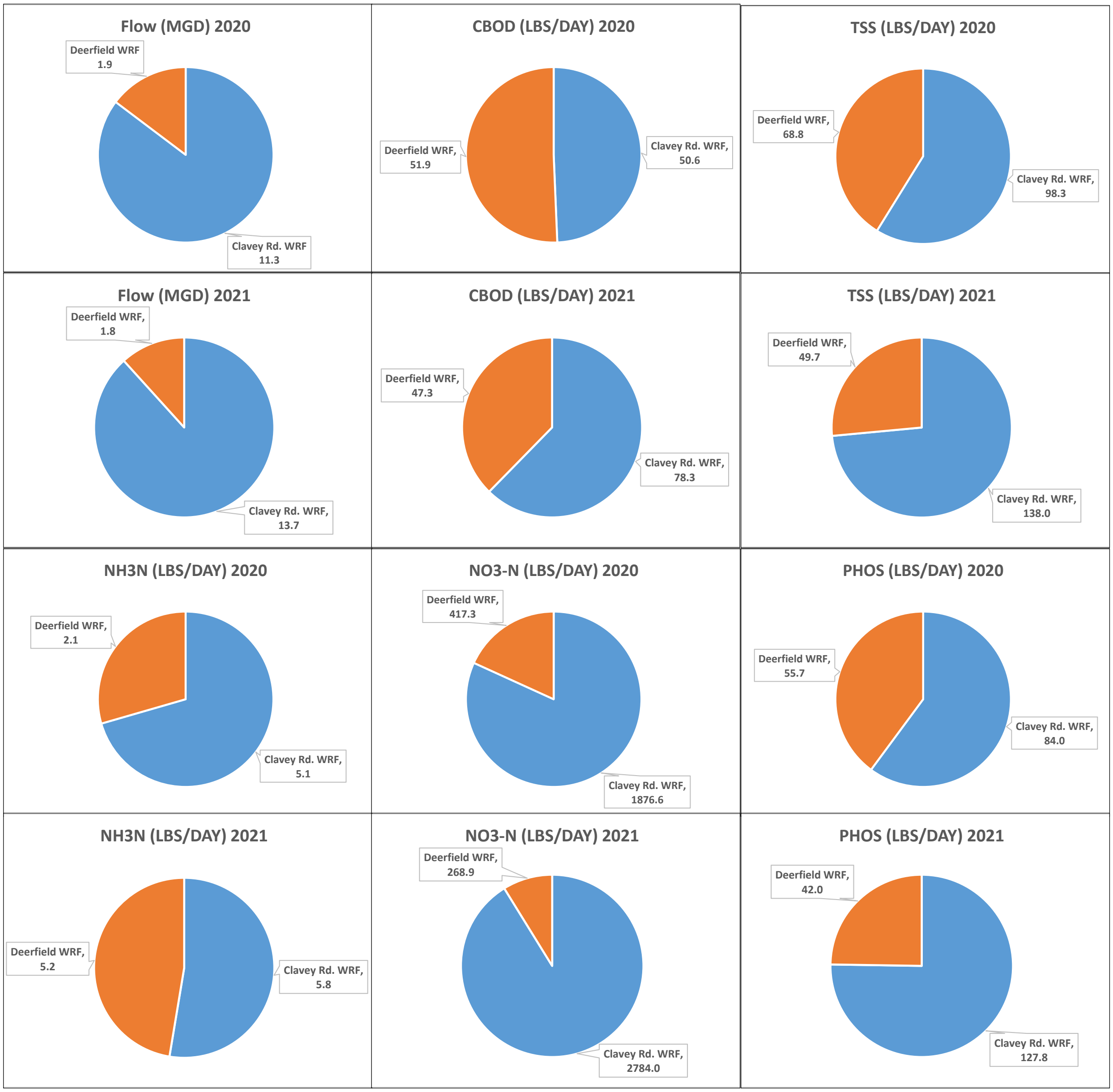


***Figure 6**. Proportions of effluent flow (MGD) and pollutant loadings (lbs./day) discharged by two major WWTPs to the NBWW survey area in 2020 and 2021. Proportions and loadings are based on the annual averages of each parameter. Discharges are listed in the table below with annual average loadings (lbs./day) between 2018 and 2021.*

Facility	Flow (MGD)	$CBOD_5$ (lbs/day)	TSS (lbs/day)	NH_3-N (lbs/day)	NO3 - N (lbs/day)	Total P (lbs/day)
			2018			
Clavey Rd. WRF	12.9	118.1	139.3	5.7	2082.5	69.1
Deerfield WRF	2.3	64.7	114.9	3.8	265.6	42.5
			2019			
Clavey Rd. WRF	17.0	138.5	232.9	7.4	1852.6	204.3
Deerfield WRF	2.9	55.1	121.4	2.6	193.4	32.0
			2020			
Clavey Rd. WRF	11.3	50.6	98.3	5.1	1876.6	84.0
Deerfield WRF	1.9	51.9	68.8	2.1	417.3	55.7
			2021			
Clavey Rd. WRF	13.7	78.3	138.0	5.8	2784.0	127.8
Deerfield WRF	1.8	47.3	49.7	5.2	268.9	42.0

Water Column Chemistry

The water column chemistry results were analyzed for spatial (longitudinal) patterns resulting from the pollution survey design in the North Branch Chicago River and its tributaries. The results were screened for exceedances of Illinois WQS, Illinois non-standard benchmarks, regional reference benchmarks, and most commonly for exceedances of the biological effect thresholds derived from the NE Illinois IPS (MBI 2022a). Exceedances of these benchmarks and thresholds are indicated on the plots and tables of the 2018-2021 chemical results.

Exceedances of Biological Effect and Reference Thresholds

The principal purpose of chemical sampling in a bioassessment is to provide data that supports the interpretation and the assignment of associated causes of biological impairments. Chemical exceedances of biological effect thresholds is essential to that process and has previously included the Illinois water quality criteria, regional reference benchmarks, and national and regional biological effects compendia. Some of these thresholds consist of correlations between concentrations of substances that correspond to biological quality gradients across wide geographical areas while others are toxicological endpoints derived from laboratory studies. Two regional studies that have been used include correlative effects levels of different chemicals by the DuPage River Salt Creek Workgroup (DRSCW; Miltner et al. 2010) in northeastern Illinois and the Metropolitan Sewer District of Greater Cincinnati (MSDGC; MBI 2015) in southwest Ohio. NOAA Screening Quick Reference Tables (SQRT; Buchman 2008) were also formerly used especially for chemicals that are not included in the Illinois WQS.

The NE Illinois IPS (MBI 2022a) thresholds for water column chemical parameters that are applicable to assessing the results in the NBWW study area appear in Table 7. Sediment chemical thresholds are provided in Table 8 and were also evaluated against threshold and probable effect levels (TEL and PEL) established by MacDonald et al. (2000) and elevation levels by Illinois EPA (Short 1998). Habitat and land use variables were also IPS derived and appear in Table 9. The severity of exceedances of these biological effect thresholds are offered by a gradient of narrative classes (i.e., fair, poor, and very poor) for impaired biological thresholds. These were used to support the assignment of causes of biological impairment provided that there was a logical linkage of a biological impairment with an exceedance of a threshold. The chemical results are also displayed graphically for selected parameters and in tables with exceedances of the IPS and other relevant effect thresholds for selected parameter groups for water column, sediment chemistry, and habitat results. Land use related causes are likewise listed in the synthesis and attainment tables. With the exception of D.O. and a single temperature value, both recorded by the short-term deployment of Datasondes, and a series of chloride values primarily in 2021, there were no other exceedances of the parameters that have Illinois EPA water quality criteria. One change from the 2018-19 analyses is that water column metal parameter exceedances are now based on Illinois WQS standard exceedances as opposed to IPS threshold exceedances. The IPS dataset does not include sufficient values that truly represent fair, poor, and very poor metals concentrations so until these conditions can be simulated or retrieved from historical data the Illinois standard values will be used.

***Table 7**. Biological effect thresholds derived from Northeast Illinois streams and rivers for selected water column parameters as part of the NE Illinois IPS model and used to assess chemical sample results from the NBWW study area. The most limiting of the fish or macroinvertebrate assemblages for each parameter are indicated along with thresholds for excellent, good, fair, poor, and very poor biological condition. The goodness of fit score (FIT) and reference site values are also provided. Illinois chronic and acute standards for heavy metals parameters are also provided in brackets in red alongside the good and poor IPS thresholds.*

Parameter Code	Variable Name	Units	Parameter Group	Limiting Assemblage	FIT Score	Sample N	Thresholds by Narrative Condition Category					Reference Site Values (Median-2X IQR)	Refer-ence Site N
							Excellent	Good	Fair	Poor	Very Poor		
P665	Total Phosphorus	mg/L	Nutrients	Fish	0.04	1464	≤0.106	>0.106	>0.277	>1.002	>1.726	0.088 (0.062-0.115)	35
P94	Conductivity	µS/cm	Ionic	Fish	0.05	1464	≤739	≥739	>1038	>1208	>1378	922 (705-1158)	40
P70300	Total Dissolved Solids	mg/L	Ionic	Fish	0.10	1464	≤453.8	>453.8	>558.0	>651.2	>744.5	614 (512-664)	28
DO_MIN	Minimum DO	mg/L	Demand	Macros	0.10	985	>8.0	≥6.5	>5.47	<4.44	<3.4	8.6 (6.5-9.6)	29
P625	Total Kjeldahl Nitrogen	mg/L	Demand	Macros	0.14	985	≤1.07	>1.07	>1.12	>1.63	>2.14	0.74 (0.30-0.99)	30
P940	Chloride, Total	mg/L	Ionic	Fish	0.17	1464	≤40.00	>40.00	>120.0	>184.9	>249.8	154 (80.3-171.3)	33
P299	Mean Dissolved Oxygen	mg/L	Demand	Macros	0.21	985	≥9.42	<9.42	<9.25	<6.11	<3.05	8.6 (7.9-9.0)	40
P310	BOD (5-Day)	mg/L	Demand	Macros	0.21	985	≤1.30	>1.30	>2.35	>3.45	>4.54	2 (2.0-2.2)	27
P610	Total Ammonia	mg/L	Nutrients	Macros	0.28	985	≤0.084	>0.084	>0.100	>0.190	>0.280	0.1 (0.10-0.10)	34
P630	Nitrate-N	mg/L	Nutrients	Fish	0.29	1464	≤3.767	>3.767	>5.045	>7.344	>9.643	0.39 (0.29-0.97)	32
P929	Sodium, Total	mg/L	Ionic	Fish	0.29	1464	≤16275	>16275	>45000	>79056	>113112	14200 (10375-22500	21
P530	Total Suspended Solids	mg/L	Demand	Fish	0.32	1464	≤17.50	>17.50	>31.60	>35.15	>38.69	9.2 (5.4-20.3)	33
P615	Nitrite-N	mg/L	Nutrients	Macros	0.41	985	≤0.014	>0.014	>0.040	>0.068	>0.096	0.01 (0.01-0.01)	27
DO_MAX	Maximum DO	mg/L	Demand	Macros	0.94	985	≤10.36	≥10.36	>12.21	>14.24	>16.28	8.74 (8.21-9.45)	29
P82078	Turbidity	NTU	Demand	Macros	2.61	985	--	≤19.3	>19.3	>25.9	>32.5	11.0 (4.5-24.5)	7
P549	Volatile Suspended Solids	mg/L	Demand	Fish	2.81	1464	≤5.000	>5.000	>7.769	>9.825	>11.88	6.0 (4.8-7.4)	5
P945	Sulfate, Total	mg/L	Ionic	Macros	6.49	985	≤58.27	>58.27	>73.10	>83.45	>93.81	74.6 (61.8-81.8)	4
P937	Potassium, Total	mg/L	Ionic	Macros	10.13	985	≤3158	>3158	>6300	>7718	>9129	2400 (1574-2817)	21
P916	Calcium, Total	mg/L	Ionic	Fish	Unimodal	1464	≤84425	>84425	>86067	>86313	>86559	54,000 (80-74,250)	21
Metals and Toxics													
P1092	Zinc, Total	µg/L	Metal_Tox	Fish	0.13	1464	≤7.47	>7.47 [55.5]	>9.78	>11.00	>12.22 [309.7]	2.0 (2.0-7.0)	23
P1027	Cadmium, Total	µg/L	Metal_Tox	Fish	0.93	1464	≤0.937	>0.937 [2.70]	>0.974	>0.983	>0.991 [33.63]	<MDL (0.17)	23
P1042	Copper, Total	µg/L	Metal_Tox	Fish	1.75	1464	--	≤4.480 [CS: 18.65]	>4.480	>4.969	>5.458 [AS: 30.1]	2.00 (1.96-4.15)	22
P1051	Lead, Total	µg/L	Metal_Tox	Macros	2.11	985	≤2.851	>2.851 [CS; 18.0]	>3.335	>3.884	>4.434 [AS: 343]	0.24 (0.20-0.57)	23
P1082	Strontium	µg/L	Metal_Tox	Fish	2.69	1464	≤169.1	>169.1	>190.8	>280.4	>370.1	150 (135-181)	21
P1055	Manganese, Total	µg/L	Metal_Tox	Macros	2.74	985	≤53.71	>53.71 [CS: 3319]	>77.03	>107.1	>137.2 [AS: 7808]	32.0 (24.1-38.2)	23
P1067	Nickel, Total	µg/L	Metal_Tox	Macros	3.26	985	--	≤3.470 [CS: 103.6]	>3.470	>9.585	>15.70 [AS: 932]	5.0 (1.5-21)	14
P1105	Aluminum, Total	µg/L	Metal_Tox	Fish	4.54	1464	≤310.0	>310.0	>393.3	>560.2	>727.0	200 (128-449)	21
P1007	Barium, Total	µg/L	Metal_Tox	Fish	4.77	1464	≤74.1	>74.09	>84.88	>101.8	>118.6	56.3 (44.3-64.7)	21
P720	Cyanide, Total	µg/L	Metal_Tox	Macros	5.17	985	≤8	>8 [CS: 5.2]	>10	>10	>10 [AS: 22]	3 (2-10)	6
P1002	Arsenic	µg/L	Metal_Tox	Macros	9.19	985	--	≤3.616 [CS: 190]	>3.455	>5.029	>6.603 [AS: 360]	Insufficient Data	
P1034	Chromium, Total	µg/L	Metal_Tox	Fish	10.17	1464	≤1.398	>1.398 [CS: 167]	>1.540	>2.682	>3.824 [AS: 3503]	1.73 (1.30-2.00)	6

CS - Illinois WQS chronic standard equated to Good; AS - Illinois WQS acute standard equated to Very Poor.

***Table 8**. Biological effect thresholds derived from Northeast Illinois streams and rivers for selected sediment chemical parameters as part of NE Illinois IPS model and used to assess chemical sample results from the NBWW study area. The most limiting of the fish or macroinvertebrate assemblages for each parameter are indicated along with thresholds for excellent, good, fair, poor, and very poor biological condition. The goodness of fit score (FIT) and reference site values are also provided.*

Parameter Code	Variable Name	Units	Parameter Group	Limiting Assemblage	FIT Score	Sample N	Thresholds by Narrative Condition Category					Literature Thresholds			
							Excellent	Good	Fair	Poor	Very Poor	TEC/LEL	PEC/PEL	Short	Source
P1093	Zinc	mg/kg	Metal_Tox	Macros	2.22	985	≤75.00	>75.00	>100.0	>133.9	>167.8	121	459	170	MacDonald
P34524	Benzo(g,h,i)perylene	µg/kg	PAH	Macros	2.32	985	--	< 335.0	>335.0	>792.1	>1249	170	320		MacDonald
P34406	Indeno(1,2,3-cd)pyrene	µg/kg	PAH	Macros	2.41	985	--	< 260.5	>260.5	>623.3	>986.2	200	3200		MacDonald
P1043	Copper	mg/kg	Metal_Tox	Macros	2.42	985	≤19.00	>19.00	>29.78	>40.45	>51.12	31.6	149	37	MacDonald
P34233	Benzo(b)fluoranthene	µg/kg	PAH	Macros	2.51	985	--	<520.8	>520.8	>1437	>2354	240	13400		MacDonald
P1068	Nickel	mg/kg	Metal_Tox	Macros	2.67	985	--	<19.50	>19.50	>22.52	>25.53	22.7	48.6	26	MacDonald
P34250	Benzo(a)pyrene	µg/kg	PAH	Macros	2.85	985	--	<230.0	>230.0	>798.3	>1367	150	1450		MacDonald
P34472	Pyrene	µg/kg	PAH	Macros	2.85	985	--	< 393.0	>393.0	>1570	>2747	195	1520		MacDonald
P1052	Lead	mg/kg	Metal_Tox	Macros	3.01	985	≤15.50	>15.50	>24.80	>33.04	>41.27	35.8	128	60	MacDonald
P34529	Benzo[a]anthracene	µg/kg	PAH	Macros	3.48	985	--	< 239.0	>239.0	>699.4	>1160	108	1050		MacDonald
P34323	Chrysene	µg/kg	PAH	Macros	3.51	985	--	<266.0	>266.0	>958.3	>1651	166	1290		MacDonald
P34379	Fluoranthene	µg/kg	PAH	Macros	3.91	985	--	<774.0	>774.0	>2432	>4091	423	2230		MacDonald
P1083	Strontium	mg/kg	Metal_Tox	Macros	4.44	985	--	<81.80	>81.80	>106.8	>131.9	None	None		
P34559	Dibenz(a,h)anthracene	µg/kg	PAH	Macros	4.57	985	--	< 101.0	>101.0	>167.3	>233.7	33	135		MacDonald
P34223	Anthracene	µg/kg	PAH	Macros	5.10	985	--	<78.00	>78.00	>119.9	>161.8	46.9	245		CCME
P34464	Phenanthrene	µg/kg	PAH	Macros	5.10	985	--	< 243.5	>243.5	>803.3	>1363	204	1170		MacDonald
P1003	Arsenic	mg/kg	Metal_Tox	Macros	6.21	985	--	≤8.65	>8.65	>15.82	>23.67	9.79	33	7.2	MacDonald
P1029	Chromium	mg/kg	Metal_Tox	Macros	6.29	985	≤20.53	>20.53	>23.30	>26.22	>29.15	43.4	111	37	MacDonald
P1053	Manganese	mg/kg	Metal_Tox	Macros	7.08	985	≤841.0	>841.0	>845.5	>996.8	>1148	460	1100	1100	MacDonald
P1078	Silver	mg/kg	Metal_Tox	Macros	7.11	985	--	<0.483	>0.483	>1.261	>2.039	1.6	2.2		MacDonald
P1108	Aluminum	mg/kg	Metal_Tox	Macros	8.26	985	--	<6480	>6480	>8272	>10064				
P1008	Barium	mg/kg	Metal_Tox	Macros	8.88	985	--	≤141.0	>132.0	>150.3	>168.7			145	
P1028	Cadmium	mg/kg	Metal_Tox	Macros	11.00	985	--	≤0.933	>0.745	>1.354	>1.963	0.99	4.98	2	MacDonald
P1013	Beryllium	mg/kg	Metal_Tox	Macros	ND[a]	985	--	≤0.411	>0.411	>0.496	>0.581				
P1103	Tin	mg/kg	Metal_Tox	Macros	ND[a]	985	--	<8.86	>11.00	>16.73	>24.60				
P34203	Acenaphthylene	µg/kg	PAH	Macros	ND[a]	985	--	<86.38	>86.38	>103.6	>120.9	5.87	128		CCME
P34208	Acenaphthene	µg/kg	PAH	Macros	ND[a]	985	--	<84.25	>84.25	>104.8	>125.3	6.71	88.9		CCME
P34262	Delta-BHC	µg/kg	PAH	Macros	ND[a]	985	--	<2.098	>2.098	>6.19	>10.28				
P34384	Fluorene	µg/kg	PAH	Macros	ND[a]	985	--	<84.25	>84.25	>104.8	>125.3	77.4	536		MacDonald
P34445	Naphthalene	µg/kg	PAH	Macros	ND[a]	985	--	< 86.38	>86.38	>103.6	>120.9	34.6	391		CCME

[a] - Not determined (ND) due to a high number of non-detects

MacDonald - MacDonald, D. D., C. G. Ingersoll, and T. A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39, 20–31.

CCME - Canadian Council of Ministers of the Environment (CCME). 1999. Canadian sediment quality guidelines for the protection of aquatic life. Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB.

***Table 9**. Biological effect thresholds derived from Northeast Illinois streams and rivers for selected habitat and land use parameters as part of NE Illinois IPS model and used to assess chemical sample results from the NBWW study area. The most limiting of the fish or macroinvertebrate assemblages for each parameter are indicated along with thresholds for excellent, good, fair, poor, and very poor biological condition. The goodness of fit score (FIT) and reference site values are also provided.*

Parameter Code	Variable Name	Units	Parameter Group	Limiting Assemblage	FIT Score	Sample N	Thresholds by Narrative Condition Category					Reference Site Values (Median - 2X IQR)	Reference Site N
							Excellent	Good	Fair	Poor	Very Poor		
EMBEDDED	Embeddedness Score	QHEI Units	Habitat	Fish	0.03	1393	≤1.3	>1.3	>1.6	>2.4	>3.2	2 (2-2)	29
Urban	Urban (Ust. WS)	Wtd. %	Land Use	Fish	0.03	2657	≤8.8	>8.8	>45.0	>63.2	>81.3	8.7 (3.0-9.5)	48
QHEI	QHEI Score	QHEI Units	Habitat	Fish	0.04	1393	≥84.5	>75.9	<75.9	<50.1	<25.0	84 (76-90)	34
SUBSTRAT	Substrate Score	QHEI Units	Habitat	Fish	0.04	1393	≥16.0	<16.0	<15.0	<9.9	<5.0	8 (7-9)	33
WWH_ATTR	Good Habitat Attributes	Number	Habitat	Fish	0.04	1393	≥9	<9	<8	<5	<2	16 (15-17)	34
Imperv	Impervious (30 m)	Wtd. %	Land Use	Fish	0.04	2657	≤18.3	>18.3	>30.5	>53.4	>76.4	2.1 (0.0-14.7)	48
Imperv	Impervious (30 m Clipped)	Wtd. %	Land Use	Fish	0.04	2657	≤13.4	>13.4	>26.7	>50.9	>75.1	2.1 (0.0-6.1)	48
CHANNEL	Channel Score	QHEI Units	Habitat	Fish	0.07	1393	≥16.8	<16.8	<14.00	<9.2	<4.6	16 (13-19)	34
COVER	Cover Score	QHEI Units	Habitat	Fish	0.07	1393	≥16.0	<16.0	<14.0	<9.2	<4.6	16 (16-17)	34
SILTCOVE	Silt Cover Score	QHEI Units	Habitat	Fish	0.07	1393	≤2.0	<2.0	>2.0	>2.7	>3.33	2 (2-3)	29
Develop	Developed (Ust. WS)	Wtd. %	Land Use	Fish	0.07	2657	≤9.1	>9.1	>45.6	>63.6	>81.5	9.1 (2.9-9.6)	48
RIPARIAN	Riparian Score	QHEI Units	Habitat	Fish	0.10	1393	≥6.0	>6.0	<6.0	<4.0	<2.0	7.0 (6.0-9.5)	34
Imperv	Impervious (Ust. WS)	Wtd. %	Land Use	Macros	0.10	3096	≤5.6	>5.6	>13.2	>41.8	>70.5	5.2 (2.1-5.4)	48
DEPTH	Depth Score	QHEI Units	Habitat	Fish	0.11	1393	≥10.0	>10.0	<10.0	<6.6	<3.3	10 (9-11)	33
MWH_ATTR	Poor Habitat Attributes	Number	Habitat	Fish	0.12	1393	≤1	<1	>1	>3	>6	2 (1-5)	20
HYD_QHEI	Hydro-QHEI	QHEI Units	Habitat	Fish	0.13	1393	≥17.0	>17.0	<19.5	<12.9	<6.4	20 (14-22)	33
CURRENT	Current Score	QHEI Units	Habitat	Fish	0.14	1393	≥7.0	>7.0	<7.0	<4.6	<2.3	11 (5.8-11.0)	33
POOL	Pool Score	QHEI Units	Habitat	Fish	0.15	1393	≥11.3	<11.3	<10.0	<6.6	<3.3	11.5 (10-12)	34
Heavurb	Heavy Urban (Ust. WS)	Wtd. %	Land Use	Macros	0.17	3096	≤7.7	>7.7	>29.3	>52.6	>76.0	5.5 (1.1-6.0)	48
RIFFLE	Riff< Score	QHEI Units	Habitat	Fish	0.27	1393	≥5.8	≥5.8	<5.8	<3.9	<1.9	6 (5-7)	34
GRAD_S	Gradient Score	QHEI Units	Habitat	Fish	0.31	1393	≥10.0	>10.0	<10.0	<6.6	<3.3	10 (10-10)	34
Ag	Agricultural (Ust. WS)	Wtd. %	Land Use	Macros	4.82	3096	≤87.1	<87.1	>62.1	>74.6	>87.1	83.9 (11.7-85.4)	48
GRADIENT	Gradient (ft/mi)	feet/mile	Habitat	Fish	12.20	1393	≥8.8	<8.8	<4.3	<2.8	<1.4	8.6 (4.9-11.3)	34
Ag	Agricultural (30 m)	Wtd. %	Land Use	Macros	16.66	3096	≤87.2	<87.2	>43.2	>61.9	>80.7	0.0 (0.0-0.4)	48

Demand and Nutrient Related Parameters

Demand and nutrient parameters consist of those related to the discharges of treated and untreated sewage, organic enrichment from point and nonpoint sources, nutrient parameters and their effects, and physical parameters such as total suspended solids and temperature. For the 2018-21 surveys this consisted of nine parameters – dissolved oxygen (D.O.), temperature (°C), pH (S.U.), total suspended solids (TSS), volatile suspended solids (VSS), ammonia-N (NH_3-N), nitrate-N (NO_3-N), total phosphorus (TP), and total Kjeldahl nitrogen (TKN). With the exception of continuously measured D.O., temperature, and pH, most of the data is based on the collection of grab samples and expressed as mean and/or median values. The grab sample data are reported in tabular fashion across all three branches for 2020 and 2021 (Table 10) and graphically by individual branch for the four years of the 2018-2021 results.

The continuous measurement of D.O., temperature, and pH was done over 4-5 day periods in early August 2020 and late August 2021 during periods of extended low flows and elevated temperatures at 19 locations. The data at West Fork location at WF20 (RM 12.5) was affected by a beaver pond which physically affected the set and invalidated the results. The D.O. data was also used to support the Stream Nutrient Assessment Procedure and with pH, the IEPA Risk of Eutrophication procedure. These results are reported across all three branches for the 2020 and 2021 results with reference to the 2018 and 2019 results as necessary.

pH (S.U.)

pH is a measure of how acidic/basic water is with a measurement range of 0 to 14. It is the relative amount of free hydrogen (acidic) and hydroxyl (basic) ions in the water. pH is measured on a logarithmic scale where each successive whole number away from the neutral value of 7.0 represents a 10-fold change in the acidity (>7.0) or basicness (>7.0) of the water. For example, water with a pH of 5.0 is ten times more acidic than water having a pH of 6.0. It is an important factor in how chemicals affect aquatic life and other biological processes. It determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). For example, pH affects the amount of total ammonia-N that is present in the most toxic unionized form and along with temperature is part of the Illinois standard. At a temperature of 26°C, which is typical of summer ambient temperatures in the study area, a change in pH from 8.0 S.U. to 9.0 S.U. changes the equivalent ammonia-N criterion from 1.16 mg/L to 0.23 mg/L, a decrease of 80%. It also affects how much and what form of phosphorus is most abundant in the water, and therefore affects how aquatic plants and animals can utilize it. As a result pH is responsive to algal photosynthesis and respiration similar to D.O. with a diel cycle of pH being higher in daytime and lower at night. Along with hardness it affects the degree to which heavy metals are soluble which determines their toxicity. The Illinois standard is a range between 6.5-9.0 S.U. The short-term continuous results in 2020 and 2021 showed pH within the 6.5-9.0 range of the Illinois standard (Figure 7). Values were all below 8.0 S.U. at the three Skokie R. sites in 2020 and the North Branch site (MF19; RM 18.6) with a comparatively low range of between the

***Table 10**. Median values for 13 selected chemical/physical water quality parameters 25 sites in the NBWW survey area in 2020-21 based on samples collected May-October. NE Illinois IPS and other source thresholds are listed at the bottom of the table and the results are color coded accordingly.*

Site ID	River Mile	Drainage Area (sq. mi.)	Tempera-ture (°C)	pH (S.U.)	Conduct-ivity (µS/cm)	D.O. (mg/L)	Ammonia-N (mg/L)	Nitrate-N (mg/L)	TKN (mg/L)	Total Phos-phorus (mg/L)	Chloro-phyll a, Sestonic (ug/L)	Total Suspend-ed Solids (mg/L)	Volatile Suspend-ed Solids (mg/L)	Chloride (mg/L)	Specific Conduct-ance (µS/cm)
Skokie River - 2020															
SR1	21.1	2.7	22.6	7.09	1438	5.6	0.12	0.02	0.86	0.006	7.1	11	1.0	356	1438
SR2	17.4	7.8	21.9	7.48	1390	6.3	0.13	0.14	0.40	0.006	2.7	9	1.0	279	1390
SR3	14.8	11.5	21.8	7.54	1054	7.0	0.12	0.20	0.71	0.006	1.3	11	1.0	203	1054
SR4	11.3	15.0	22.0	7.76	1085	7.7	0.05	0.22	0.59	0.006	0.7	8	1.0	179	1085
SR5	8.0	20.6	22.3	7.65	1006	6.2	0.06	0.45	0.97	0.006	3.1	6	1.0	168	1006
SR6	7.4	21.5	22.9	7.67	983	6.3	0.12	0.49	0.88	0.006	1.5	7	1.0	167	983
SR7	3.0	23.7	25.1	7.85	844	7.5	0.06	0.64	1.46	0.120	25.0	14	4.5	149	844
SR18	0.5	30.9	23.5	7.70	868	7.1	0.06	6.18	1.33	0.320	18.0	14	3.5	140	868
Skokie River - 2021															
SR1	21.1	2.7	20.0	7.23	1030	8.1	0.11	0.19	0.64	0.006	1.0	11	2.0	222	1030
SR2	17.4	7.8	19.7	7.15	1661	8.1	0.06	0.30	0.82	0.006	0.4	8	1.0	452	1661
SR3	14.8	11.5	19.6	7.43	1499	9.0	0.08	0.30	0.76	0.006	0.4	5	1.0	406	1499
SR4	11.3	15.0	19.9	7.37	1505	9.1	0.08	0.29	0.95	0.006	0.2	5	1.0	395	1505
SR5	8.0	20.6	20.6	7.47	1565	8.2	0.15	0.45	1.18	0.093	7.6	6	1.0	386	1565
SR6	7.4	21.5	21.0	7.49	1549	8.0	0.15	0.45	1.55	0.078	0.5	7	1.0	398	1549
SR7	3.0	23.7	24.8	7.64	1294	7.5	0.18	1.03	2.09	0.170	23.0	12	1.0	331	1294
SR18	0.5	30.9	22.4	7.14	1181	8.2	0.13	11.00	1.55	0.620	2.3	19	4.5	254	1181
Middle Fork North Branch Chicago River - 2020															
MF8	21.1	5.8	24.8	7.29	1504	7.0	0.07	0.02	0.62	0.006	4.9	15	4.5	334	1504
MF9	18.9	8.9	24.5	7.28	1328	8.0	0.07	0.02	0.45	0.058	2.2	24	3.0	297	1328
MF10	16.7	11.9	24.3	7.43	1167	7.7	0.06	0.06	0.72	0.006	1.2	10	2.0	228	1167
MF11	14.1	16.1	24.6	7.56	915	9.1	0.05	0.02	0.95	0.006	0.4	23	4.0	165	915
MF12	10.8	19.2	24.7	7.55	905	7.8	0.01	0.02	0.92	0.006	0.6	8	1.0	166	905
MF13	8.6	21.0	24.9	7.42	887	8.0	0.06	0.09	1.46	0.006	0.8	10	3.5	170	887
MF14	6.0	22.5	24.1	7.63	961	8.9	0.01	0.02	1.51	0.006	0.8	8	1.5	182	961
MF15	4.0	24.3	25.0	7.57	909	8.8	0.09	0.02	0.97	0.006	0.3	17	3.0	172	909
MF16	3.0	56.1	22.5	7.49	960	7.2	0.09	5.88	2.15	0.390	3.5	18	2.0	176	960
MF17	1.8	57.3	23.5	7.49	911	6.8	0.18	6.67	1.29	0.325	3.5	15	2.0	151	911
Condition Category Thresholds		**Excellent**	25.0		<739	>8.0	<0.084	≤3.77	<1.07	≤ 0.106	<2.5	≤17.5	≤5.00	<40.0	<739
		Good	29.4		<1038	>6.5	<0.100	<5.05	<1.12	<0.277	<5.1	<31.6	<7.76	<120.0	<1038
		Fair	31.7		<1208	>5.6	<0.190	<7.34	<1.63	<1.020	<13.8	<35.2	<9.83	<184.9	<1208
		Poor	32.2		<1378	>4.4	<0.280	<9.64	<2.14	<1.730	<28.9	<38.7	<11.88	<249.8	<1378
		Very Poor	36.0		>1378	<4.4	≥0.280	≥9.64	≥2.14	≥1.730	>28.9	>38.7	>11.88	≥249.8	>1378
Source		**IPS**	**IL/OH WQS**		**IPS**	**IPS**	**IPS**	**IPS**	**IPS**	**IPS**	**MBI/NSAC**	**IPS**	**IPS**	**IPS**	**IPS**

***Table 10**. continued.*

Site ID	River Mile	Drainage Area (sq. mi.)	Tempera-ture (°C)	pH (S.U.)	Conduct-ivity (µS/cm)	D.O. (mg/L)	Ammonia-N (mg/L)	Nitrate-N (mg/L)	TKN (mg/L)	Total Phos-phorus (mg/L)	Chloro-phyll a, Sestonic (ug/L)	Total Suspend-ed Solids (mg/L)	Volatile Suspend-ed Solids (mg/L)	Chloride (mg/L)	Specific Conduct-ance (µS/cm)
Middle Fork North Branch Chicago River - 2021															
MF8	21.1	5.8	22.1	6.99	2865	5.7	0.08	0.02	1.36	0.110	3.8	11	1.0	773	2865
MF9	18.9	8.9	21.0	7.11	2665	4.7	0.07	0.02	1.32	0.130	5.8	14	1.0	700	2665
MF10	16.7	11.9	23.5	7.20	1969	5.3	0.06	0.02	1.56	0.063	1.6	6	1.0	555	1969
MF11	14.1	16.1	23.0	7.05	1845	5.4	0.06	0.02	1.33	0.073	4.1	13	1.0	505	1845
MF12	10.8	19.2	22.4	7.33	1847	4.4	0.06	0.09	1.06	0.068	2.1	6	1.0	522	1847
MF13	8.6	21.0	22.2	7.18	1912	6.1	0.12	0.16	1.09	0.150	0.9	8	2.0	541	1912
MF14	6.0	22.5	21.2	7.49	1832	7.5	0.07	0.17	1.30	0.115	0.4	5	1.0	518	1832
MF15	4.0	24.3	21.8	7.62	1752	8.3	0.13	0.35	1.01	0.063	1.4	5	1.0	490	1752
MF16	3.0	56.1	24.1	7.07	1290	8.3	0.08	13.85	1.47	0.705	3.2	25	1.0	284	1290
MF17	1.8	57.3	24.1	7.24	1299	8.0	0.19	13.25	1.74	0.760	1.7	19	2.5	287	1299
West Fork North Branch Chicago River - 2020															
WF20	12.5	3.9	23.2	7.33	800	8.3	0.14	0.11	1.36	0.173	3.0	12	1.0	147	800
WF21	10.4	7.0	25.7	7.27	872	7.8	0.15	0.07	1.96	0.006	1.3	8	1.0	183	872
WF22	9.2	9.4	25.6	7.51	1047	10.0	0.13	6.70	2.15	1.285	4.1	10	3.0	210	1047
WF23	4.9	17.9	26.1	7.59	1101	9.3	0.13	3.64	1.77	0.665	4.2	20	4.5	221	1101
WF24	2.9	24.5	25.0	7.59	1177	8.1	0.34	2.71	1.72	0.460	2.2	7	3.0	236	1177
WF25	1.3	28.0	26.7	7.64	1172	8.1	0.29	2.53	0.87	0.470	1.0	6	1.0	243	1172
West Fork North Branch Chicago River - 2021															
WF20	12.5	3.9	22.7	6.98	1379	4.8	0.15	0.13	1.72	0.235	10.0	20	3.5	357	1379
WF21	10.4	7.0	22.7	6.92	1566	3.7	0.30	0.37	1.52	0.225	1.2	9	2.5	418	1566
WF22	9.2	9.4	23.0	7.16	1142	5.9	0.35	7.40	2.05	2.065	2.9	17	2.0	232	1142
WF23	4.9	17.9	24.8	8.02	1478	9.7	0.19	3.37	1.69	0.735	24.0	60	5.0	283	1478
WF24	2.9	24.5	23.3	7.46	1699	6.3	0.38	1.92	1.62	0.515	6.7	18	1.0	323	1699
WF25	1.3	28.0	23.7	7.19	1347	6.3	0.28	2.28	1.49	0.435	1.7	15	1.5	312	1347
North Branch Chicago River - 2020															
MF19	18.6	93.4	24.4	7.62	944	7.5	0.14	5.02	1.42	0.305	1.0	13	1.0	166	944
North Branch Chicago River - 2021															
MF19	18.6	93.4	25.8	7.24	1380	8.5	0.14	11.75	2.19	0.600	2.4	15	1.0	349	1380
Condition Category Thresholds		**Excellent**	25.0		<739	>8.0	<0.084	≤3.77	<1.07	≤ 0.106	<2.5	≤17.5	≤5.00	<40.0	<739
		Good	29.4		<1038	>6.5	<0.100	<5.05	<1.12	<0.277	<5.1	<31.6	<7.76	<120.0	<1038
		Fair	31.7		<1208	>5.6	<0.190	<7.34	<1.63	<1.020	<13.8	<35.2	<9.83	<184.9	<1208
		Poor	32.2		<1378	>4.4	<0.280	<9.64	<2.14	<1.730	<28.9	<38.7	<11.88	<249.8	<1378
		Very Poor	36.0		>1378	<4.4	≥0.280	≥9.64	≥2.14	≥1.730	>28.9	>38.7	>11.88	≥249.8	>1378
Source		**IPS**	**IL/OH WQS**		**IPS**	**IPS**	**IPS**	**IPS**	**IPS**	**IPS**	**MBI/NSAC**	**IPS**	**IPS**	**IPS**	**IPS**

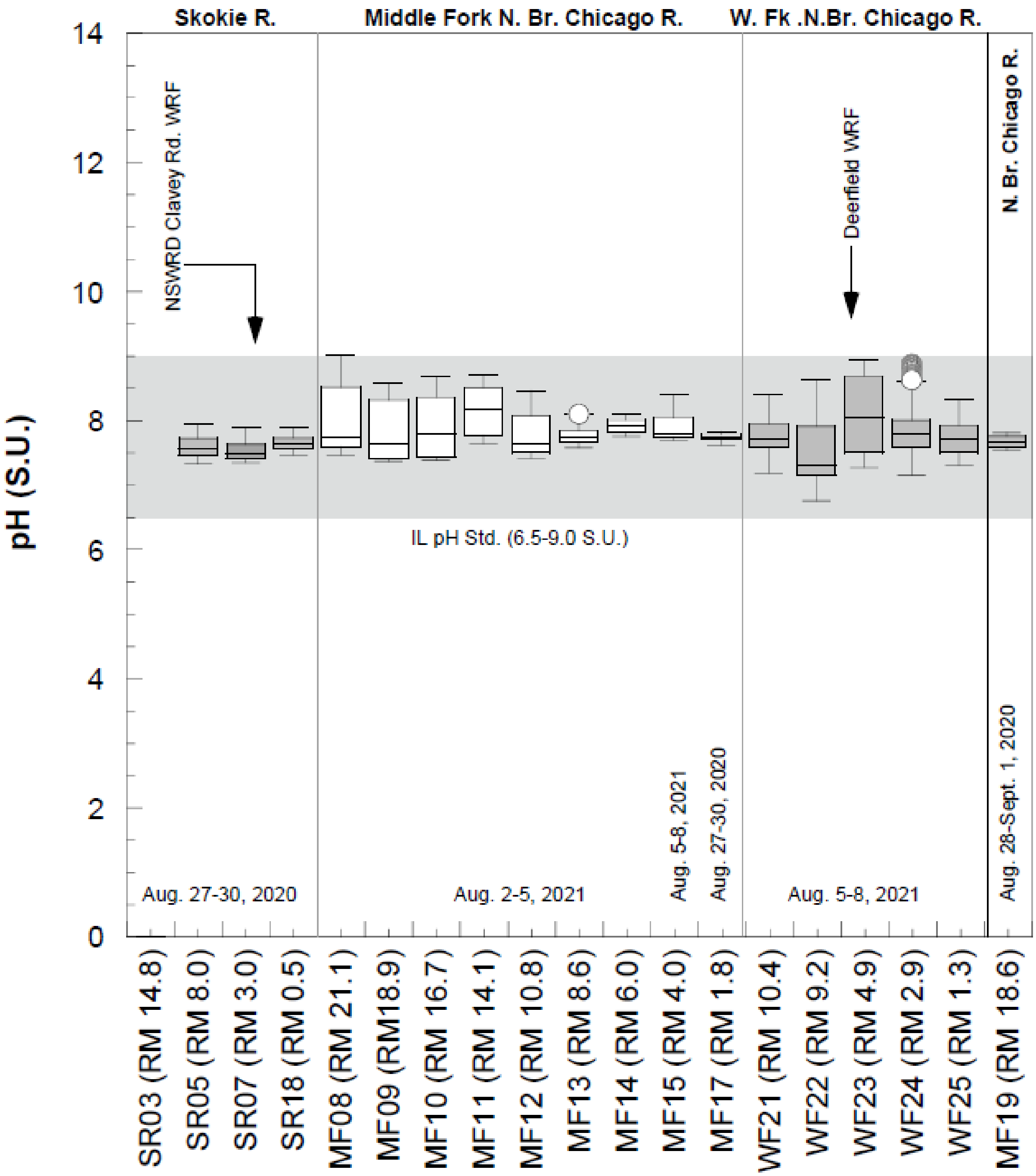


***Figure 7**. pH (S.U.) measured continuously by Datasondes deployed for 4-5 day periods during August 27-September 1, 2020 and August 2-8, 2021 at 19 locations. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The Illinois EPA standard is expressed as a range depicted by the shaded area.*

minimum and maximum values. The widest range occurred in the Middle Fork between MF08 (RM 21.1) and MF12 (RM 10.8) with one maximum value exceeding 9.0 S.U. at MF08. pH values declined as did the range at the four downstream sites. Similarly wide variations and maximum values of 8.5-9.0 S.U. occurred at three sites in the West Fork in 2021 both upstream and downstream from the Deerfield WRF. Sufficient continuous pH data was not available in 2018-19 and it was not included in that report.

Temperature (℃)

Temperature is a critical factor in aquatic systems as it both directly and indirectly influences individual organism health and well-being and various physicochemical processes that also have direct and indirect effects. Fish will avoid lethal temperatures and seek the temperature regime that each species prefers. Temperature affects chemical rates and processes and the toxicity of certain pollutants (e.g., ammonia-N). While much of the concern with temperature has centered on discharges of heat, modifications and alterations to natural temperature regimes have received increased attention due to climate change.

Based on continuous data collected during the Datasonde deployments in early August 2020 and late August 2021. Typically the potential for adverse thermal effects are evaluated based on the warmest period of the year and against temperature criteria that are intended to protect aquatic life. There was only one temperature value in the Middle Fork (MF09) that exceeded the Illinois temperature standard of 32.2°C (90°F) with the upstream most site (MF08) having the second highest maximum value near 30°C (86°F; Figure 8). The remaining 17 sites had much lower maximum and mean temperatures. The Illinois EPA summer maximum criterion of 32.2°C (90°F) is at the extreme upper maximum avoidance and lethal temperatures for the most sensitive stream fish species. The same two Middle Fork sites (MF08 and MF09) also exceeded the more modern Ohio temperature criteria that are specific to smaller streams and rivers with a maximum and average criteria of 31.7°C (89.0°F) and 29.4°C (85.0°F), respectively. A maximum of 29.2°C at the uppermost site in the Middle Fork North Branch, MF10, was the highest value measured in 2019 and was below the Ohio maximum criterion. The maximum temperature value measured in 2018 was 29.2°C at the uppermost site on the Skokie River (SR03), which was also below the Ohio maximum criterion. While, there is no reason to believe that temperatures are a widely limiting factor to the biota in the study area, the high values measured in the upper Middle Fork reveal the vulnerability of urbanized watersheds to potentially adverse thermal impacts.

Dissolved Oxygen (D.O.)

Exceedances of dissolved oxygen (D.O.) were assessed with continuous data obtained from Datasonde deployments during early August 2020 and late August 2021 at 18 sites (WF12 had invalid data). As in 2018-19 exceedances of parts of the Illinois EPA D.O. criteria were observed, but at many more sites (Figure 9). All of the deployments were made after August 1 hence the minimum was evaluated against the 3.5 mg/L criterion and the 5.0 mg/L 7-day average criterion. Exceedances of the 3.5 mg/L minimum criterion occurred at 14 of the 19 sites and were the most pronounced in the Skokie River (3 of 4 sites), the Middle Fork (5 of 9 sites), and the West Fork (5 of 5 sites). The North Branch (MF19) was only one of two sites that met both the average and minimum standards. Median values were used to assess exceedances of the

5.0 mg/L average criterion which occurred at only 6 of 18 sites. Of these the median value of 5 mg/L at SR07 was the largest exceedance of the average. Seven sites had maximum values

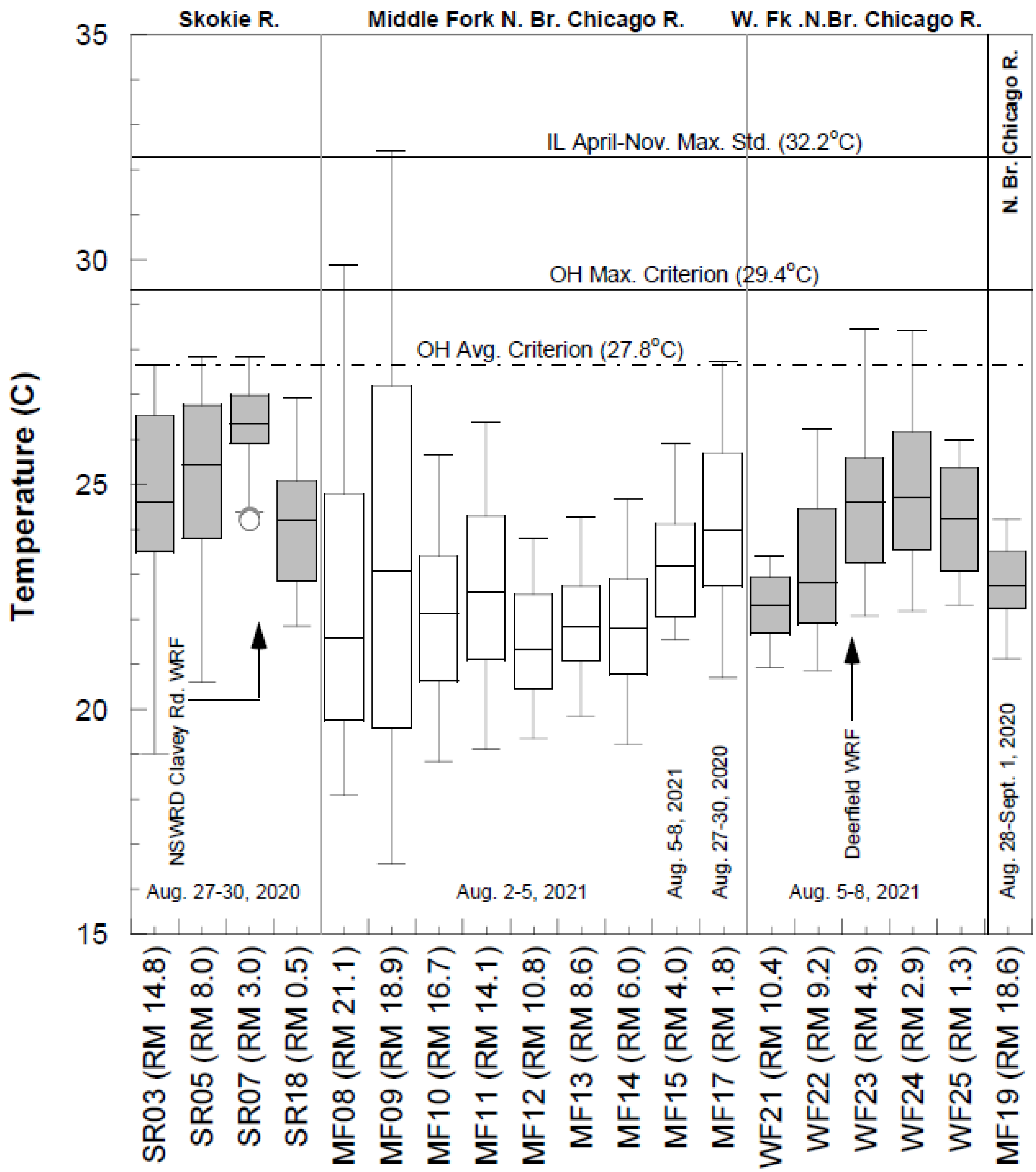


***Figure 8**. Temperature (°C) measured continuously by Datasondes deployed for 4-5 day periods during early August 2020 and late August 2021 at 19 locations in the 2020-21 study area. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The Illinois EPA maximum April 1-November 30 standard (32.2°C) and the Ohio EPA streams and rivers maximum (29.4°C) and average (27.8°C) criteria are shown by solid and dashed lines.*

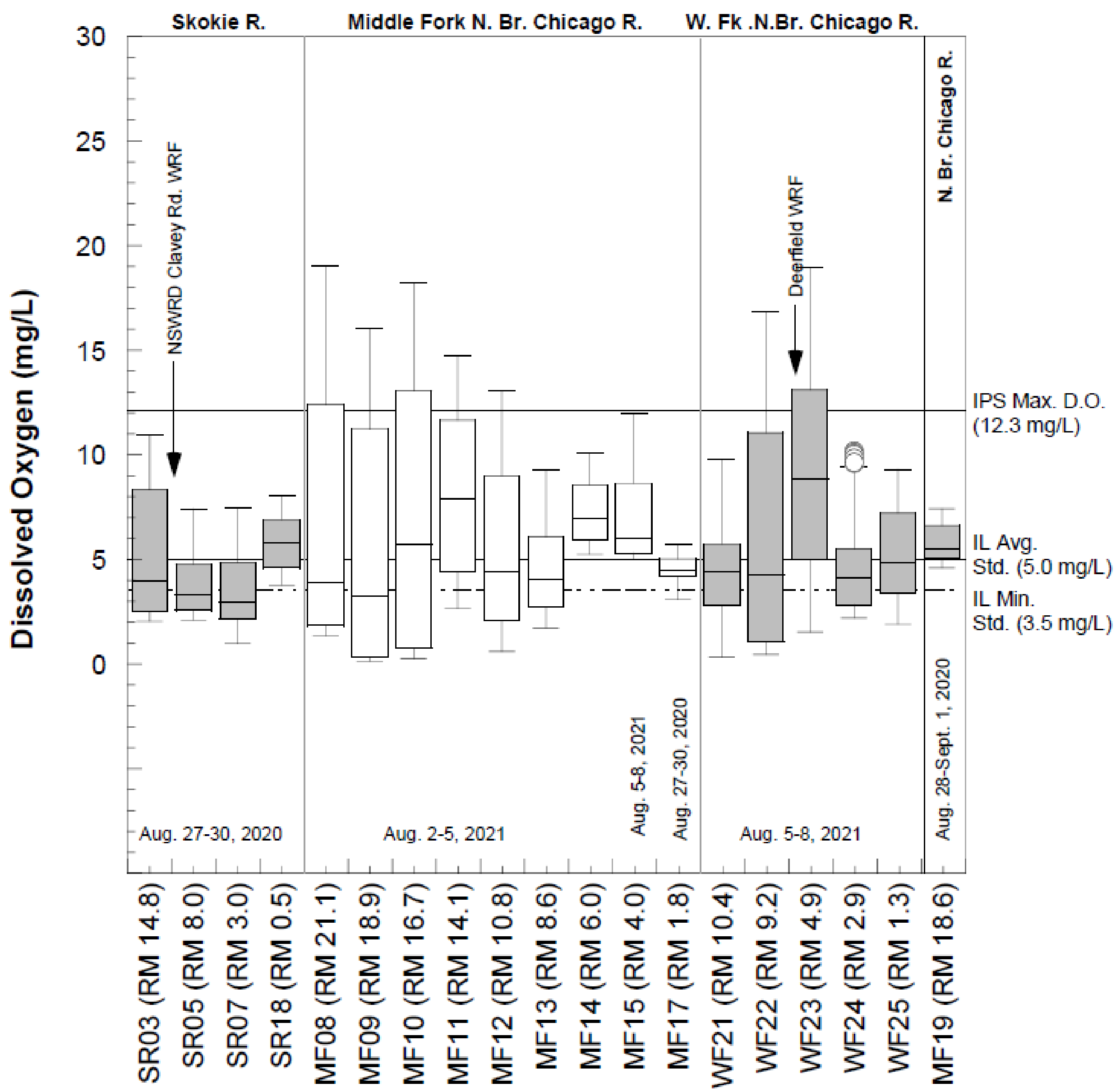


***Figure 9**. Dissolved oxygen (D.O.) concentrations (mg/L) measured continuously by Datasondes deployed for 4-5 day periods during early August 2020 and late August 2020 at 18 locations. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The Illinois EPA August-February minimum (3.5 mg/L) and the 7-day average (5.0 mg/L) D.O. standard are shown by solid and dashed lines along with the IPS maximum D.O. (12.3 mg/L) by a solid line.*

greater than the IPS maximum of 12.3 mg/L with 5 in the upper Middle Fork and the other two in the West Fork upstream and downstream from the Deerfield WRF. These sites also had the widest diel variation which was evaluated as symptom of excessive nutrient enrichment in the modified SNAP assessment. The increased exceedances between 2018-19 and 2020-21 are most likely related to sustained low flows in the latter contributing to increased residence time and lower reaeration.

Exceedances of Standards

Exceedances of standards in the Illinois WQS as measured by the short-term deployment of Datasondes was assessed (Table 11). All except two of the exceedances were for the minimum or 7-day minimum D.O. standard (Table 11) numbering 65 in 2020 and 2021. This compares with 47 measured over roughly the same number of days in 2018-19. Of the 2020-21 exceedances, 47 occurred in 2021 compared to only 20 in 2020. Lower flows in 2021 compared to the other three years likely contributed to the higher frequency of standards exceedances including one for maximum pH and one for maximum temperature. Most parameters monitored and assessed in the 2018-2021 surveys either do not have a standard or the current standard is outdated, hence the use of the IPS and other source thresholds enhanced the analysis of the water chemistry results. Any exceedances of other standards measured by grab sampling are detailed at the end of the water chemistry results.

Skokie River

Ammonia-Nitrogen (N)

Ammonia-N concentrations between years ranged between the fair and excellent IPS thresholds with an overall tendency to increase downstream (Figure 10). Values in 2018 were either just above or below the NE Illinois IPS good threshold of 0.15 mg/L at all sites with no values exceeding the fair threshold (Figure 10; Table 10). The 2019 ammonia-N levels were higher than in 2018 being with the fair range throughout the Skokie River (Figure 10). Levels in 2020 were similar to 2019 in the upper mainstem, but decreased to the good and excellent ranges further downstream. Ammonia-N levels in 2021 were low in the upper mainstem and increasing to near 2019 levels in the lower mainstem. None of the ammonia-N levels exceeded the Illinois standard during any of the four years and the pattern suggested no relationship with a specific influence other than diffuse nonpoint point sources.

Total Nitrate-N (NO_3-N)

Median nitrate levels in all years were consistently low and ranged from good to excellent at all sites in the Skokie River (Figure 11). All results were well within the excellent threshold of 3.767 mg/L except SR18 downstream of the Skokie Lagoons and the entry of the NWRSD Clavey Rd. WRF downstream from which nitrate-N levels increased sharply (Table 11). Nitrate-N levels at this site were in the good range in 2018, the fair range in 2019 and 2020, and the poor range in 2021 an overall increase from 4.0 to 11.0 mg/L. The role of total nitrate-N and other indicators as a contributor to overall nutrient enrichment effects was considered as part of the modified SNAP procedure (Ohio EPA, 2015b).

Total Kjeldahl Nitrogen (TKN)

Median total organic nitrogen measured by Total Kjeldahl Nitrogen (TKN), an indicator of the living or recently dead fraction of sestonic algae, is an informative indicator of organic and nutrient enrichment. While TKN is not a direct effect parameter, it is indicative of the effects of organic enrichment by nitrogenous biomass the latter primarily resulting from increased algal biomass. Major sources of organic nitrogen in urban stormwater runoff include lawn and

***Table 11**. Exceedances of Illinois WQS standards measured by the short term deployment of Datasondes at 19 sites in 2020 and 2021. Each exceedance lists the dates, the parameter, the numeric criterion, the term of the standard, the cumulative exceedances at each site, and the exceedances by year. Cumulative and annual totals appear at the bottom of the table.*

Site ID	River	Year	River Mile	Dates	Pollutant	Criteria	Standard	Cumulative Exceedances	2020	2021
MF8	Middle Fork North Branch Chicago River	2021	21.1	Aug - # Days: 4	D.O.	<3.5 mg/l	Not to exceed	6		28
MF8	Middle Fork North Branch Chicago River	2021	21.1	8/ 2 - 8/ 5	D.O.	<4.0 mg/l	7-day Minimum			
MF8	Middle Fork North Branch Chicago River	2021	21.1	8/ 2 - 8/ 5	pH	6.5-9.0 S.U.	Not to exceed			
MF9	Middle Fork North Branch Chicago River	2021	18.9	Aug - # Days: 4	D.O.	<3.5 mg/l	Not to exceed	5		
MF9	Middle Fork North Branch Chicago River	2021	18.9	8/ 2 - 8/ 5	D.O.	<4.0 mg/l	7-day Minimum			
MF10	Middle Fork North Branch Chicago River	2021	16.7	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	5		
MF10	Middle Fork North Branch Chicago River	2021	16.7	8/ 2 - 8/ 5	D.O.	<4.0 mg/l	7-day Minimum			
MF10	Middle Fork North Branch Chicago River	2021	16.7	8/ 2 - 8/ 5	Temp.	32.2C	Not to exceed			
MF11	Middle Fork North Branch Chicago River	2021	14.1	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	4		
MF11	Middle Fork North Branch Chicago River	2021	14.1	8/ 2 - 8/ 5	D.O.	<4.0 mg/l	7-day Minimum			
MF12	Middle Fork North Branch Chicago River	2021	10.8	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	4		
MF12	Middle Fork North Branch Chicago River	2021	10.8	8/ 2 - 8/ 5	D.O.	<4.0 mg/l	7-day Minimum			
MF13	Middle Fork North Branch Chicago River	2021	8.6	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	4		
MF13	Middle Fork North Branch Chicago River	2021	8.6	8/ 2 - 8/ 5	D.O.	<4.0 mg/l	7-day Minimum			
MF17	Middle Fork North Branch Chicago River	2020	1.8	Aug - # Days: 1	D.O.	<3.5 mg/l	Not to exceed	2	20	
MF17	Middle Fork North Branch Chicago River	2020	1.8	8/28 - 8/31	D.O.	<4.0 mg/l	7-day Minimum			
MF19	North Branch Chicago River	2020	18.6	8/30 - 9/ 1	D.O.	<4.0 mg/l	7-day Minimum	1		
SR3	Skokie River	2020	14.8	Aug - # Days: 4	D.O.	<3.5 mg/l	Not to exceed	5		
SR3	Skokie River	2020	14.8	8/27 - 8/30	D.O.	<4.0 mg/l	7-day Minimum			
SR5	Skokie River	2020	8	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	4		
SR5	Skokie River	2020	8	8/27 - 8/30	D.O.	<4.0 mg/l	7-day Minimum			
SR7	Skokie River	2020	3	Aug - # Days: 4	D.O.	<3.5 mg/l	Not to exceed	5		
SR7	Skokie River	2020	3	8/27 - 8/30	D.O.	<4.0 mg/l	7-day Minimum			
SR18	Skokie River	2020	0.5	8/31 - 8/31	D.O.	<4.0 mg/l	7-day Minimum	3		
WF21	West Fork North Branch Chicago River	2021	10.4	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	4		19
WF21	West Fork North Branch Chicago River	2021	10.4	8/ 5 - 8/ 8	D.O.	<4.0 mg/l	7-day Minimum			
WF22	West Fork North Branch Chicago River	2021	9.2	Aug - # Days: 4	D.O.	<3.5 mg/l	Not to exceed	5		
WF22	West Fork North Branch Chicago River	2021	9.2	8/ 5 - 8/ 8	D.O.	<4.0 mg/l	7-day Minimum			
WF23	West Fork North Branch Chicago River	2021	4.9	Aug - # Days: 1	D.O.	<3.5 mg/l	Not to exceed	2		
WF23	West Fork North Branch Chicago River	2021	4.9	8/ 5 - 8/ 5	D.O.	<4.0 mg/l	7-day Minimum			
WF24	West Fork North Branch Chicago River	2021	2.9	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	4		
WF24	West Fork North Branch Chicago River	2021	2.9	8/ 5 - 8/ 8	D.O.	<4.0 mg/l	7-day Minimum			
WF25	West Fork North Branch Chicago River	2021	2.9	Aug - # Days: 3	D.O.	<3.5 mg/l	Not to exceed	4		
WF25	West Fork North Branch Chicago River	2021	2.9	8/ 5 - 8/ 8	D.O.	<4.0 mg/l	7-day Minimum			
							Totals	**67**	**20**	**47**

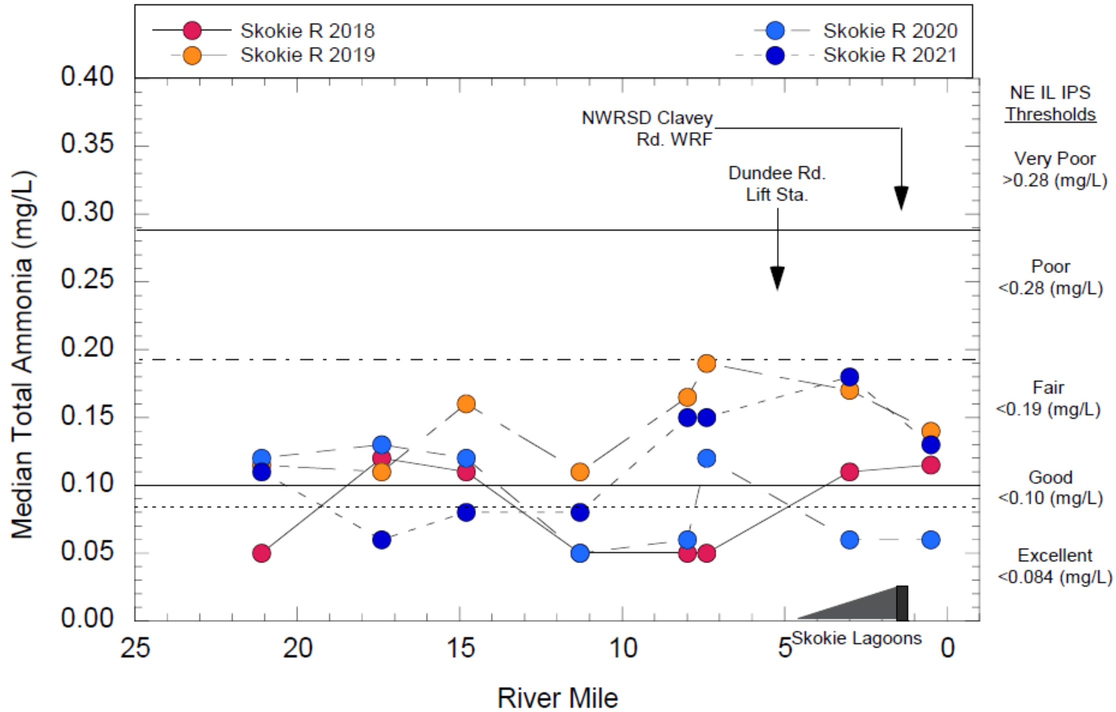


***Figure 10**. Concentrations of median ammonia-N in the Skokie River during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

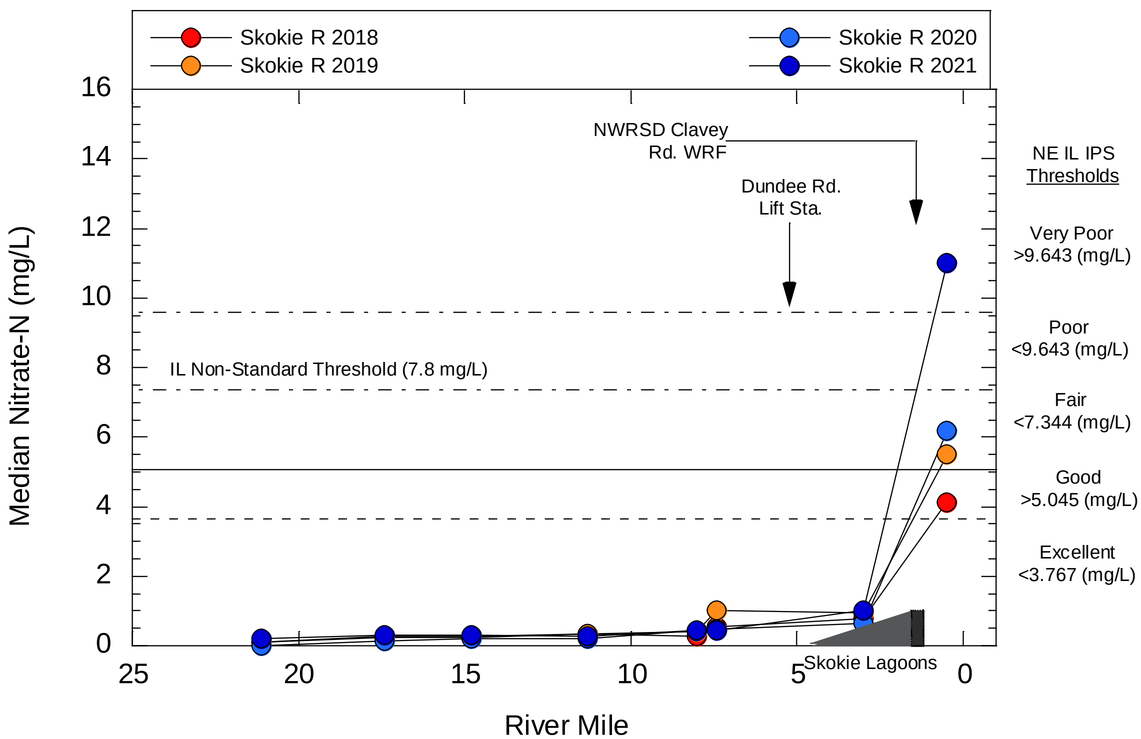


***Figure 11**. Concentrations of median total Nitrate-N in the Skokie River during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

garden fertilizers, pet waste, leaking septic tanks, landfills, effluent from sewage treatment plants, and vehicle exhaust (U.S. EPA 2020). Nitrogen from aerial and terrestrial sources accumulates on urban roads and parking lots until runoff from a precipitation event carries the pollutants into stormwater drains and directly to local waterbodies. Among different land uses, the highest concentrations of TKN originate from impervious surfaces (e.g., freeways, parking lots, and high density residential. The median TKN concentrations showed an overall downstream increase with no clear patterns between years. Values in 2021 were generally excellent upstream from SR6 (RM 7.4), but increased to the fair range through and downstream from the Skokie Lagoons (Figure 12; Table 10). In 2020 excellent results occurred further upstream, but transitioned to fair at SR8 (RM 8.0) and a poor value in the Skokie Lagoons at SR7 (RM 3.0). The 2018 and 2019 values were generally higher with borderline poor values at the upstream most site SR1 (RM 21.1). The TKN results roughly followed the pattern of the ammonia-N values with the likely sources being of nonpoint source and instream origins.

Total Phosphorus

Median concentrations of total phosphorus (P) in all years were consistently low and in the excellent range except for the lowermost site. The median concentration at SR18 (RM 0.5) exceeded the excellent threshold, but was within the good range in 2018 and 2019 (Figure 13).

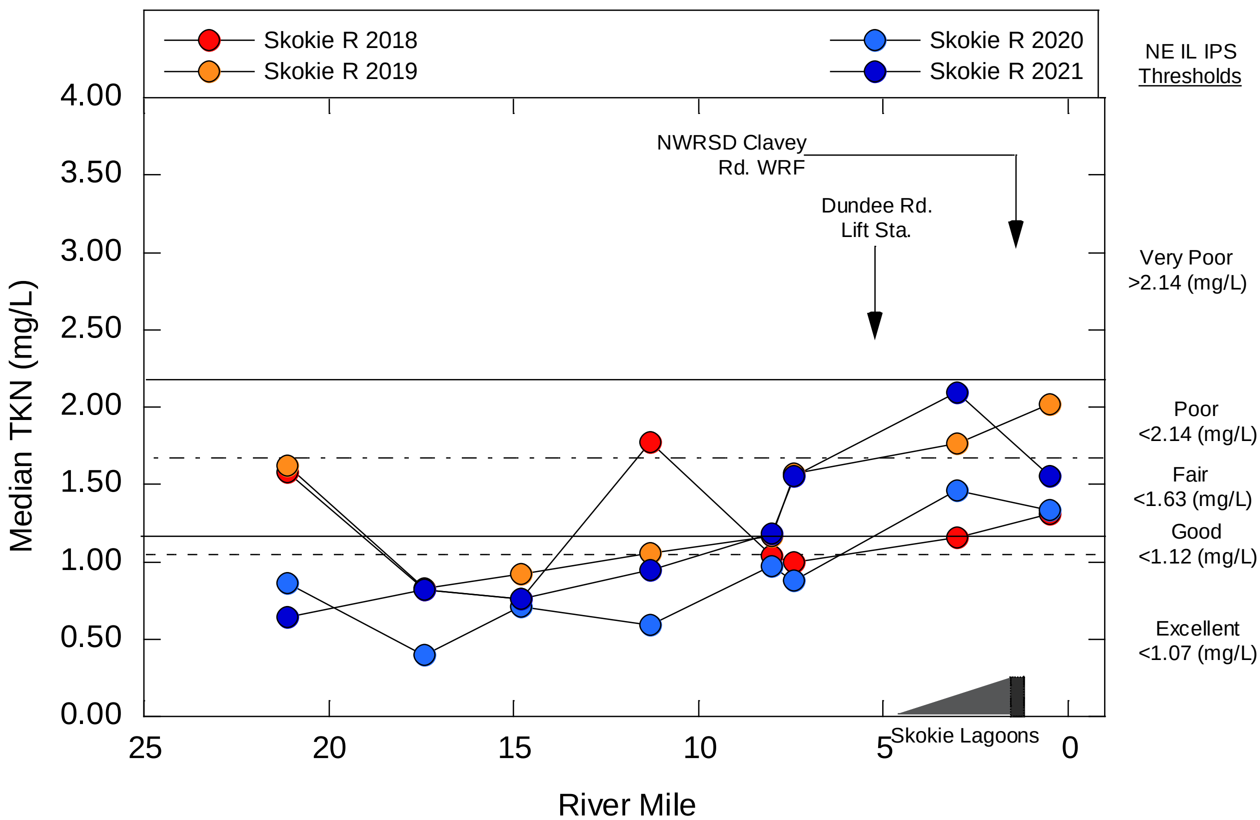


Figure 12*. Concentrations of median total Kjeldahl nitrogen (TKN) in the Skokie River during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Total P increased slightly to 0.325 mg/L (fair range) in 2020 and nearly doubled to 0.620 mg/L in 2021 (Table 10). The NSWRD Clavey Rd. WRF had a minimal, yet measurable influence on TP concentrations in the lower Skokie River. The role of TP (and other indicators) as a contributor to overall nutrient enrichment effects was evaluated as part of the modified SNAP procedure (Ohio EPA 2015b) discussed later.

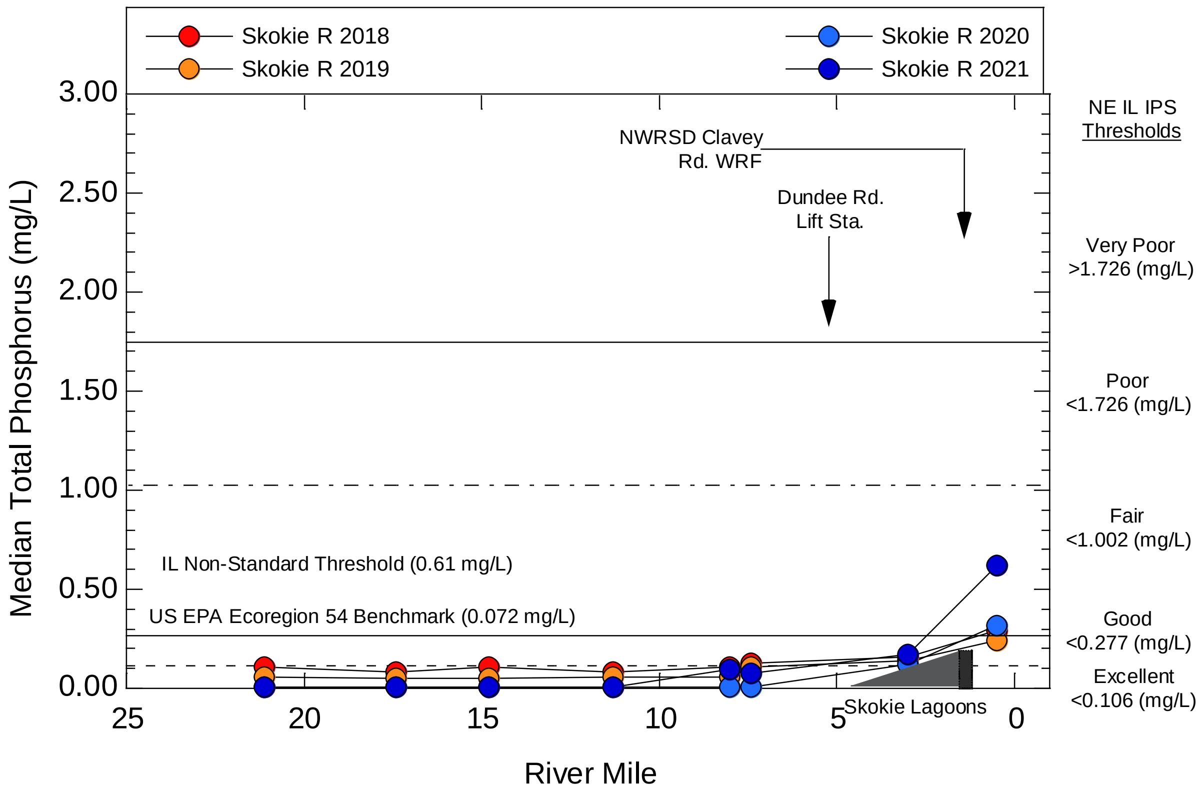


***Figure 13**. Concentrations of median total phosphorus in the Skokie River during May-October during 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Total Suspended Solids (TSS)

Total suspended solids can indicate inorganic suspended sediment and/or organic matter in the form of sestonic algae. The median TSS values were the highest among years and generally in the poor to very poor range in the Skokie River in 2018 (Figure 14). The Skokie Lagoons impoundment apparently promoted to settling of suspended solids and combined with the entry of the NSWRD Clavey Rd. WRF effluent resulted in reduced TSS at SR18. Median TSS values in 2019, 2020, and 2021 were about one-third of the levels in 2018 with mostly in the excellent range (Table 10). Because TSS levels can also reflect the effects of nutrient enrichment they are included in the modified SNAP procedure.

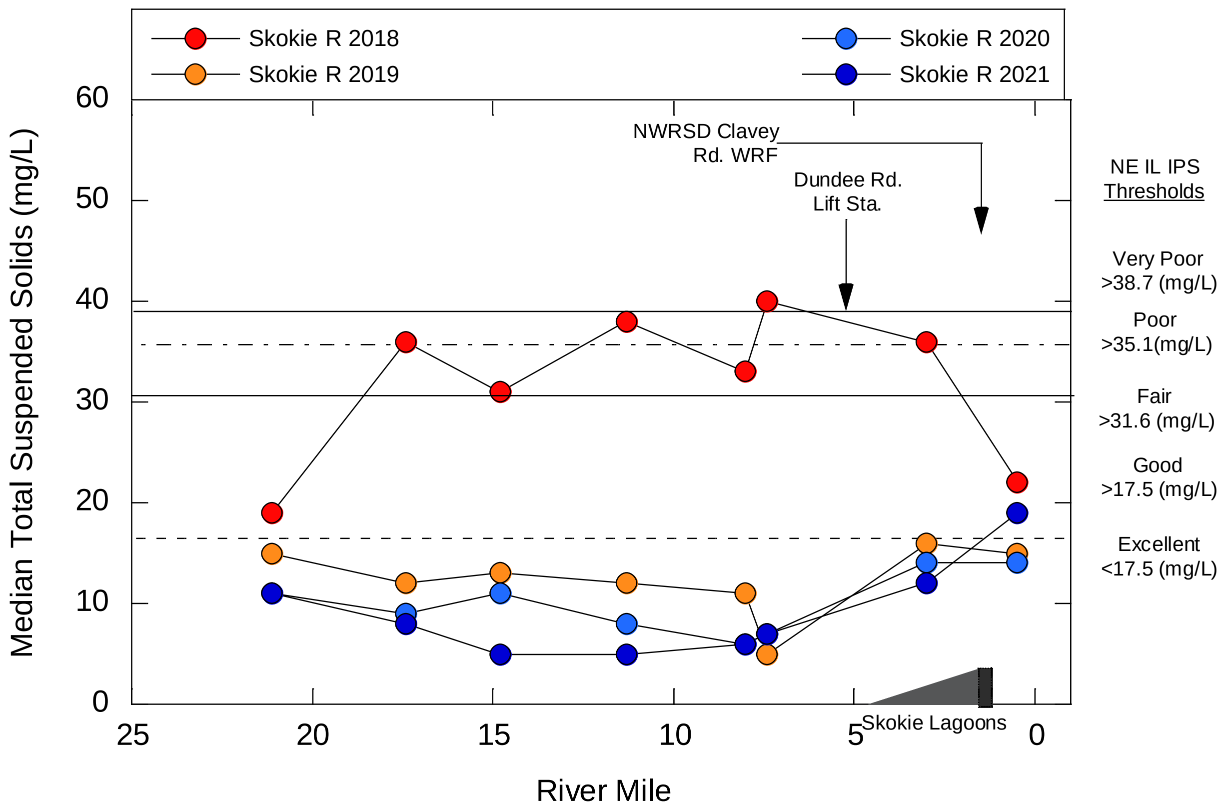


__Figure 14__. Concentrations of median total suspended solids in the Skokie River during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.

Middle Fork North Branch Chicago River & North Branch Chicago River

Ammonia-Nitrogen (N)

Median concentrations of ammonia in 2020 and 2021 were mostly in the excellent range of 0.084 mg/L and below the good threshold of 0.10 mg/l with the exception of three values in the fair range (Figure 15; Table 10), one downstream of the Skokie River confluence which carries NWRSD Clavey Rd. effluent. The longitudinal plot indicates no influence from the Deerfield WRF excess flow outfall 004 in any year. None of the ammonia-N levels exceeded the Illinois standard during any of the four years and the pattern suggested only a slight relationship with a specific influence other than diffuse nonpoint point sources. The 2020-21 results were not markedly different than the 2018-19 results except that 2019 had values below the MDL at all sites. The North Branch Chicago River site (MF19) had median ammonia concentrations of 0.14 mg/L in both years which exceeded the 0.10 mg/L good threshold and within the range of the fair IPS threshold.

Total Nitrate-N (NO_3-N)

Nitrate-N concentration levels in the Middle Fork in 2020-21 were generally excellent with the exception of the two sites downstream from the confluence with the Skokie River (Figure 16; Table 10). Nitrate-N concentrations increased markedly and exceed the IPS poor threshold in

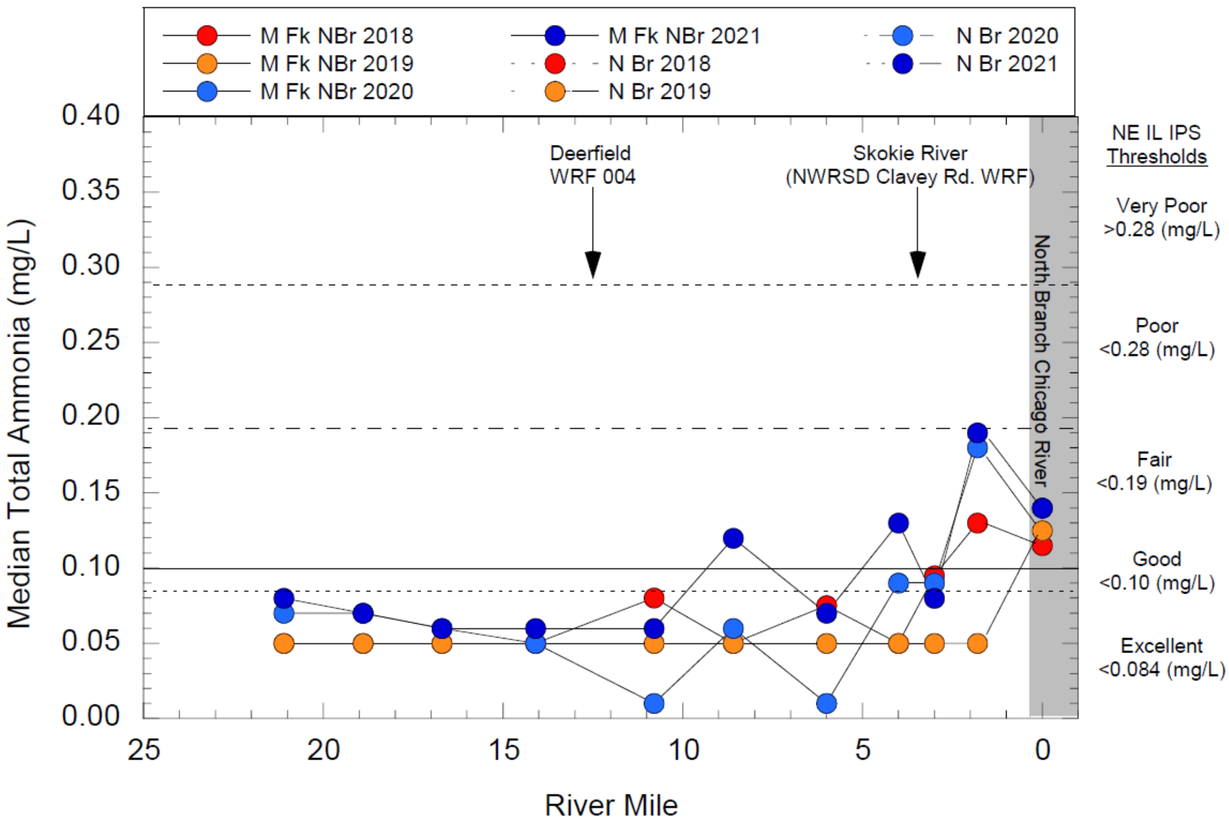


***Figure 15**. Concentrations of median ammonia-N in the Middle Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

2020 and the very poor threshold in 2021 with concentrations doubling during the latter. These levels were also much higher than in 2018 and 2019 when the highest nitrate-N concentrations at Middle Fork sitesMF16 and MF 17 were the at the upper end of the good range and low portion of the fair range. The North Branch Chicago River site nitrate-N values were similarly impacted in all years with the highest levels in 2021 (Figure 16). The lower Middle Fork and North Branch values exceeded the Illinois non-standard threshold of 7.8 mg/L. The elevated nitrate levels in the North Branch site were considerably higher due to the Skokie River impact. The role of total nitrate-N and other indicators as a contributor to overall nutrient enrichment effects was considered as part of the modified SNAP procedure (Ohio EPA, 2015b).

Total Kjeldahl Nitrogen (TKN)

Median TKN concentrations in 2020-21 varied in that the 2020 levels were in the good range downstream to site MF12 (RM 10.8) increasing to fair and one very poor value at MF 16 (RM 3.0) downstream from the Skokie River (Figure 17). The 2021 results were different in that all values were fair downstream to MF11 (RM 14.1), then decreasing to excellent, good, and one fair result (Table 10). The two sites downstream from the Skokie River were both fair in 2021. The North Branch site had the highest TKN value of 2.19 mg/L (very poor) in 2021 and second

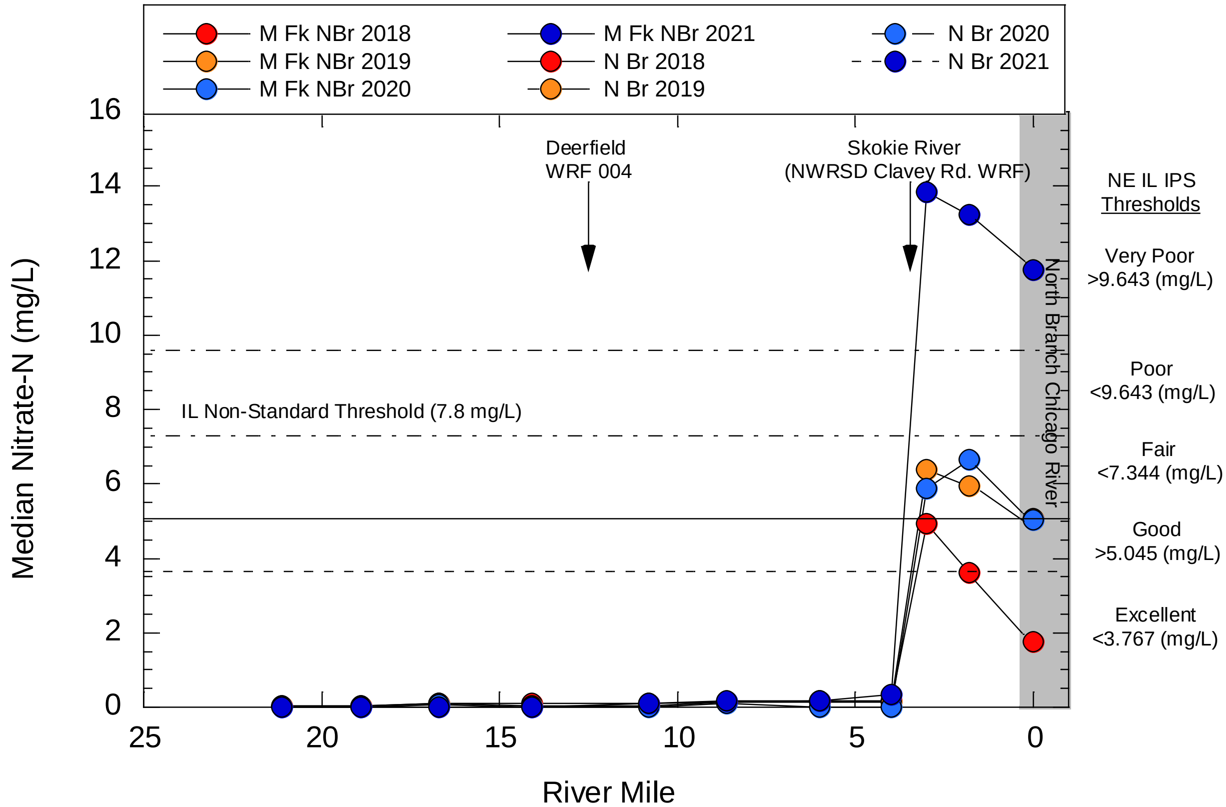


***Figure 16**. Concentrations of median nitrate-N in the Middle Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

highest value of 1.42 mg/L (poor) in 2020, both well above the 2018 and 2019 values. Median TKN median values roughly tracked ammonia-N concentrations in the Middle Fork North Branch Chicago River. The role of TKN and other indicators as a contributor to overall nutrient enrichment effects was considered as part of the modified SNAP procedure (Ohio EPA, 2015b).

Total Phosphorus

Median phosphorus concentrations in the Middle Fork Chicago River were excellent at all except two sites in 2020 and good and excellent at all sites in 2021 (Figure 18). The 2020 results showed the influence of the NSWRD Clavey Rd. effluent affected Skokie River at MF 16 (RM 3.0) and MF17 (RM 1.8) increasing from 0.006 mg/L to 0.390 and 0.325 mg/L, respectively, and similar to the 2018 and 2019 results (Table 10). There was an even greater increase at the same sites in 2021 with values of 0.705 and 0.760 mg/L at MF16 and MF17, respectively. The North Branch results showed the same influence with a lower value of 0.305 mg/L in 2020 and higher value of 0.600 mg/L in 2021. Two values exceeded the Illinois non-standard threshold of 0.61 mg/L, but all values upstream from the Skokie River confluence were below or at the U.S. EPA Ecoregion 54 benchmark of 0.072 mg/L. The role of total P and other indicators as a contributor to overall nutrient enrichment effects was considered as part of the modified SNAP procedure (Ohio EPA 2015b).

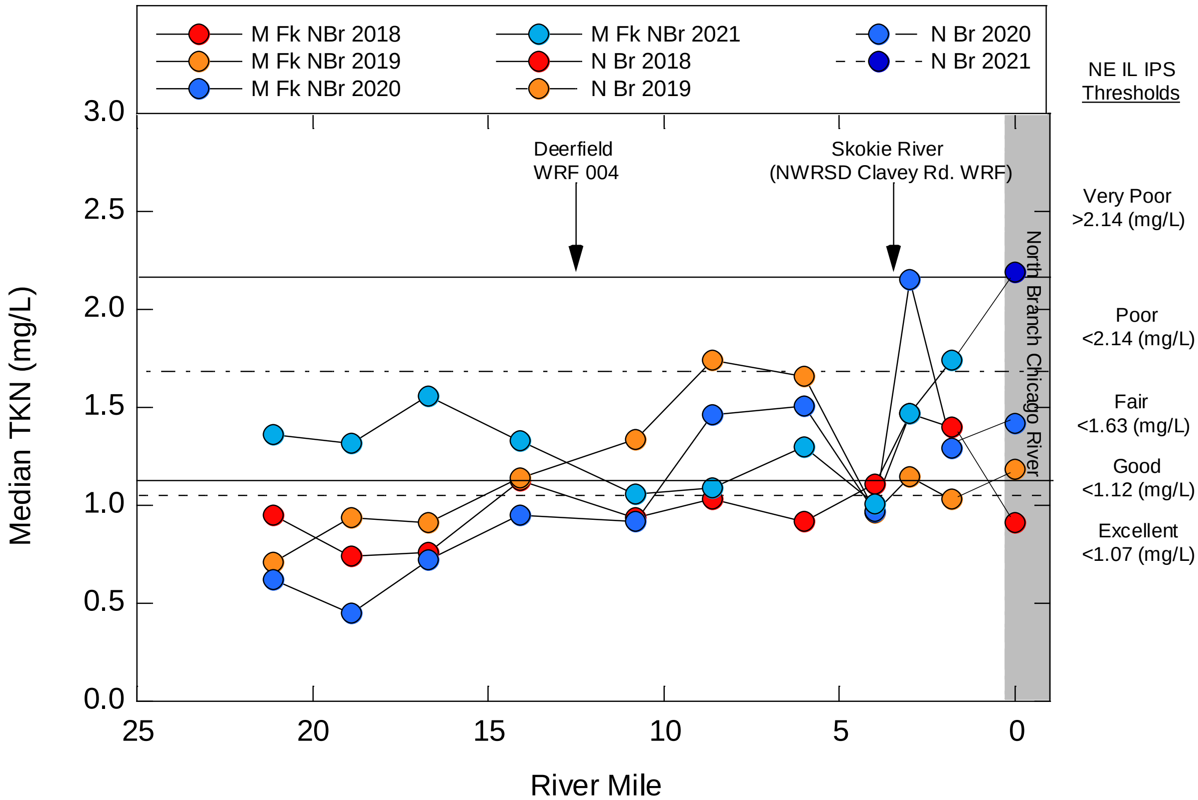


Figure 17*. Concentrations of median total Kjeldahl nitrogen in the Middle Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

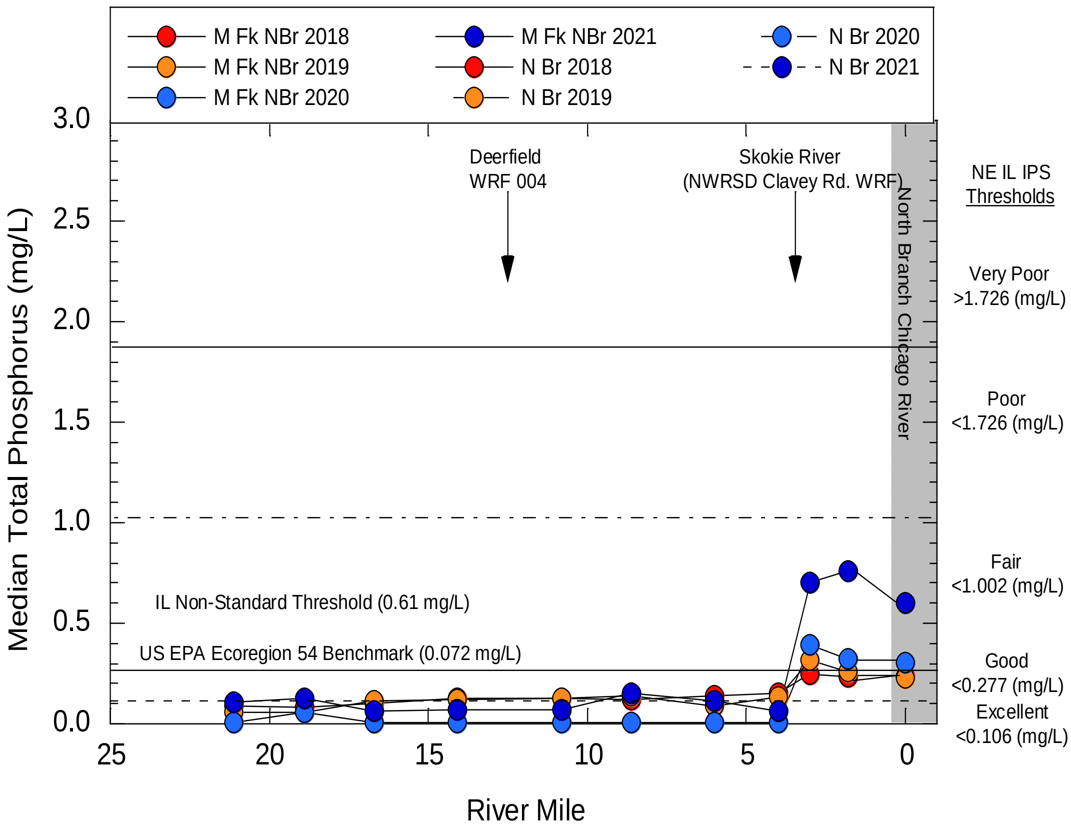
Total Suspended Solids (TSS)

Median TSS values in 2020 were in the excellent range with the exception of good values at MF9 (RM 18.9), MF11 (RM 14.1), and MF 16 (RM 3.0) and with no discernable longitudinal pattern in 2020 (Figure 18; Table 10). The 2021 values were uniformly excellent upstream from the Skokie River increasing downstream, but remaining within the good range. The 2018 and 2019 levels were generally higher, especially in 2018 when a discernible downstream increase was observed. The North Branch values were excellent in 2020 and 2021 the same as in 2018 and 2019. The role of total TSS and other indicators as a contributor to overall nutrient enrichment effects was considered as part of the modified SNAP procedure (Ohio EPA, 2015b).

West Fork North Branch Chicago River

Ammonia-Nitrogen (N)

Ammonia-N concentration levels in the West Fork were consistently in the fair, poor, and very poor IPS threshold ranges in 2020-21, with more frequent very poor excursions in 2021 (Table 10). The longitudinal profile in 2021 especially showed a net increase downstream from the



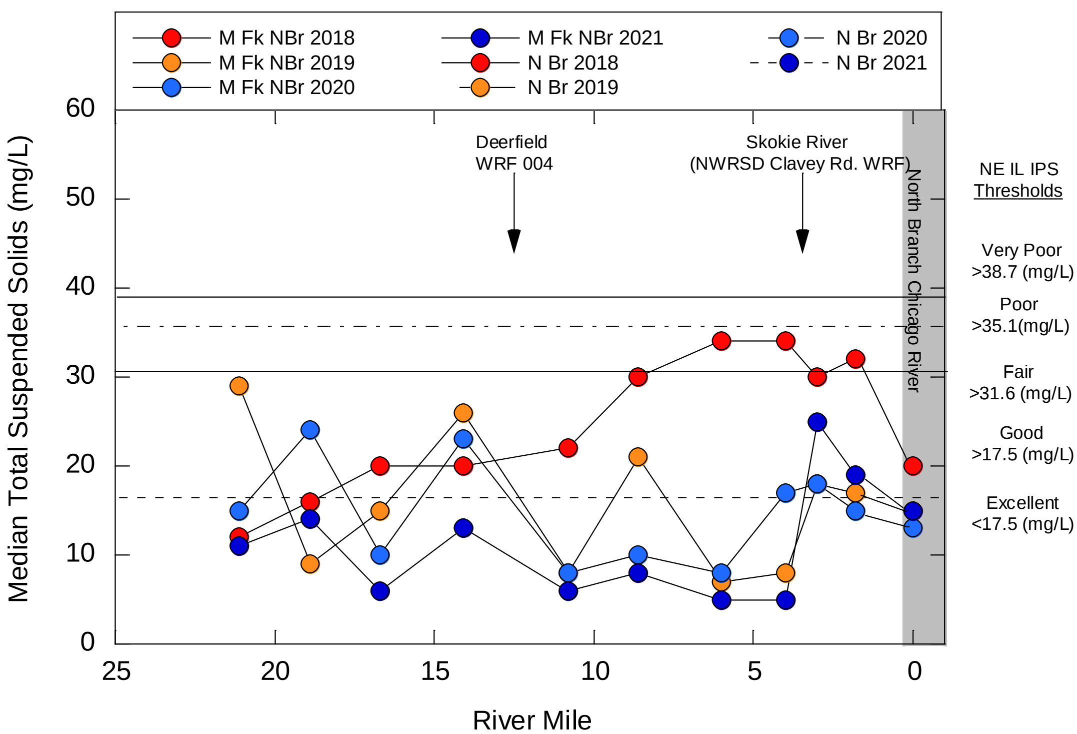


Figure 18. *Concentrations of median total phosphorus (TP; upper) and total suspended solids (TSS; lower) in the Middle Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Deerfield WRF 001 and 002 outfalls with median ammonia-N levels at very poor levels of 0.30 and 0.35 mg/L, respectively (Figure 19). However, no detectable increase was observe downstream from Deerfield in 2020 or 2018, the latter having the lowest levels among all years and consistently in the good or lower fair range. An increase below Deerfield was observed in 2019, but at much lower median levels than in 2021. None of the individual 2021 values for ammonia-N exceeded the Illinois WQS standard. After declining to a median of 0.19 mg/L at WF23 (RM 4.9) more than four (4) miles downstream, median levels of ammonia-N increased to 0.38 mg/L and 0.28 mg/L at WF 24 (RM 2.9) and WF 25 (RM 1.3) downstream of the Village of Glenview 1800 E Lake Ave lift station. The median declined sharply downstream from the West Fork confluence with the Middle Fork where the median values in 2018-21 at N. Branch site MF19 (RM 18.6) were in the lower fair range.

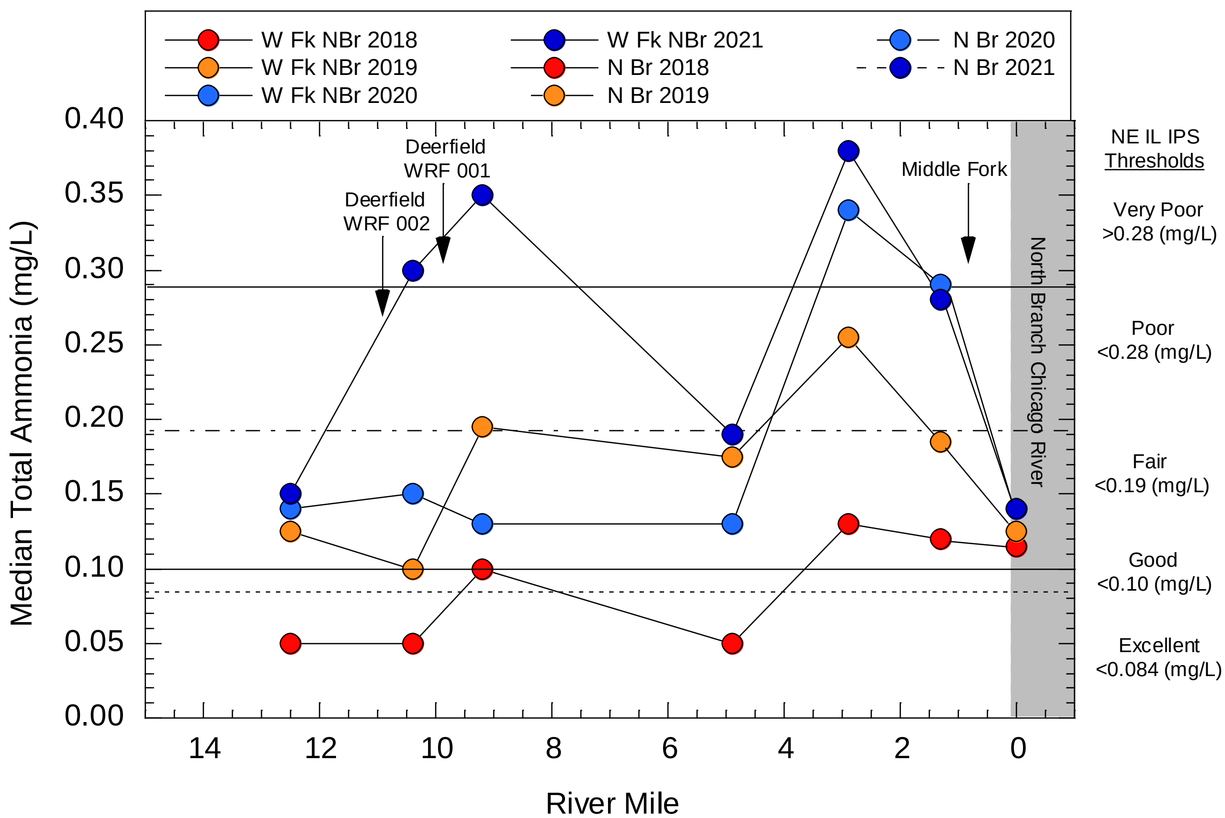


***Figure 19**. Concentrations of median ammonia-N in the West Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Total Nitrate-N (NO_3-N)

Median nitrate values in 2020 and 2021 were excellent at West Fork sites except at site WF22 (RM 9.2) where the median value of 7.40 mg/L was in the poor range (Table 10). This value occurred downstream of the Deerfield WRF (Figure 20). Median values in 2019 ranged from fair to excellent with the highest value of 5.020 mg/L downstream from the Deerfield WRF. Concentrations of nitrate-N then fell sharply in all years to the excellent range at WF24 (RM

2.9). The Deerfield WRF 001 outfall was the source of elevated nitrate-N in all years 2018-21 (Figure 21) downstream from which medina values sharply declined. The elevated values at MF19 (RM 18.9) in the N. Branch emanates from the Skokie R. as was described on p. 41.

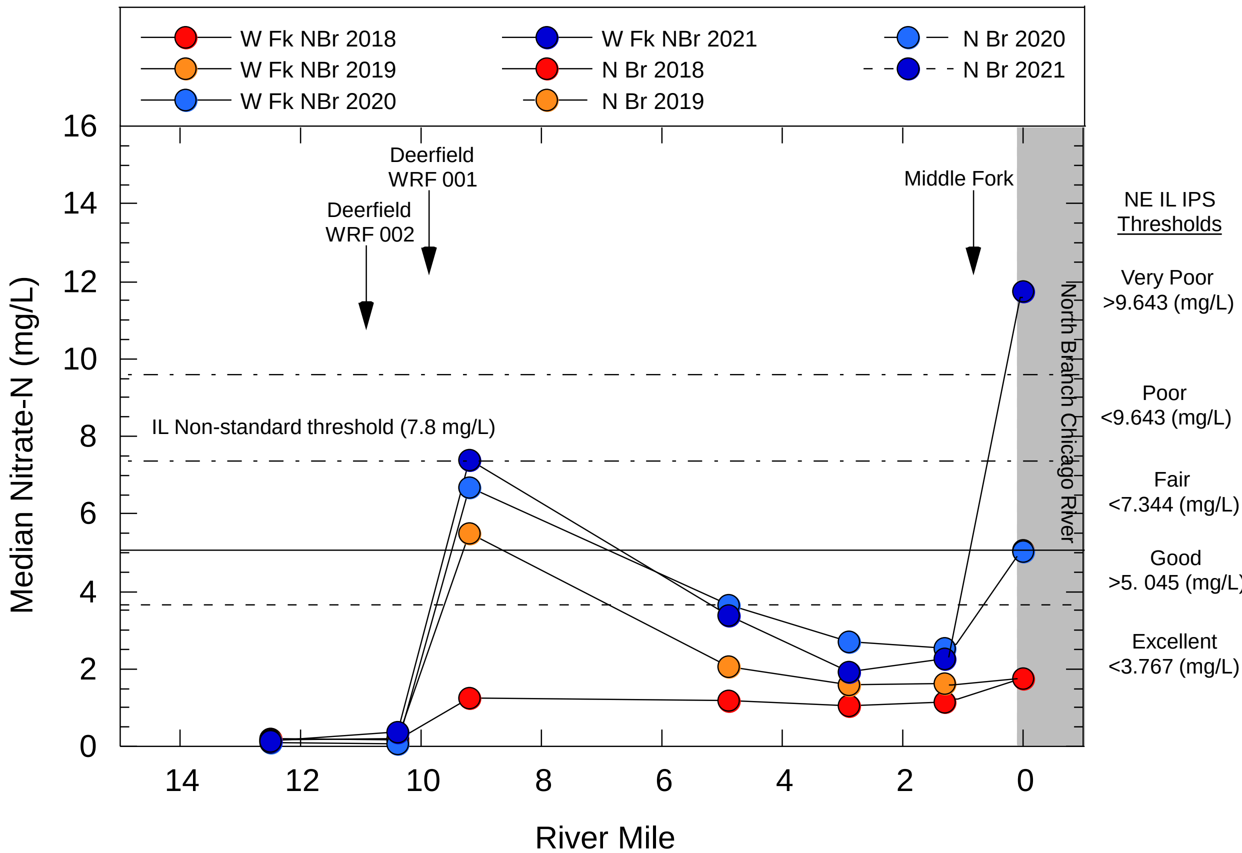


***Figure 20**. Concentrations of median total nitrate-N in the West Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Total Kjeldahl Nitrogen (TKN)

Median TKN concentrations were mostly poor in 2020 and a mix of fair and poor values in 2021. A single very poor value occurred at WF 22 (RM9.2) downstream from the Deerfield WRF 001 outfall (Table 10). The longitudinal profile resembled ammonia-N with some important exceptions (Figure 21) including a steady decline downstream to the confluence with the Middle Fork. The impact of the Deerfield WRF 001 outfall was more pronounced in 2021 than in 2020. The occurrence of the higher values in 2020 was a reversal of the ammonia-N pattern. Values in 2018 and 2019 were mostly in the good to excellent ranges with the highest values observed downstream from the Village of Glenview lift station at RM 3.0. TKN values at MF19 in the N. Branch emanated from the Skokie R. and were discussed on pp. 41 and 43.

Total Phosphorus

Median concentrations of phosphorus (P) in 2020 and 2021 were consistently low rating good

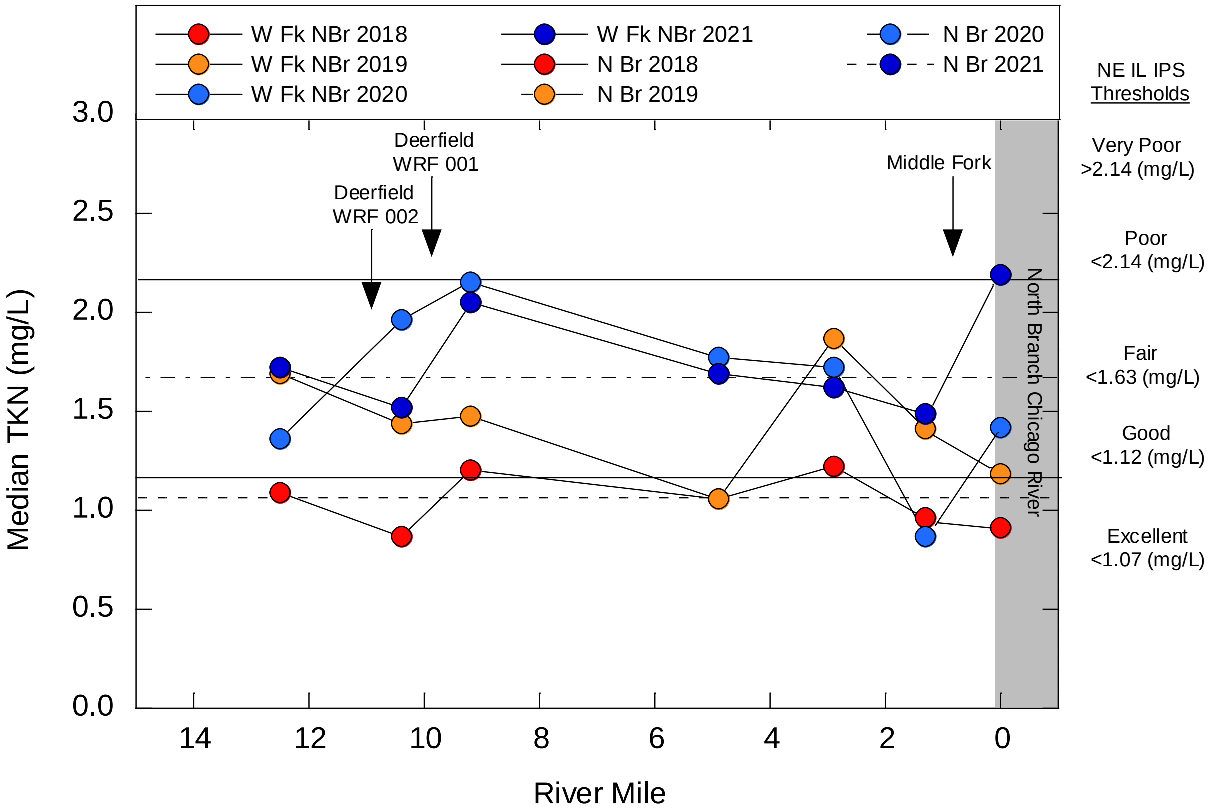


***Figure 21**. Concentrations of median total Kjeldahl nitrogen (TKN) in the West Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

to excellent in the upstream most reach at WF20 (RM 12.5) and WF 21 (RM 10.4; Table 10) upstream from the Deerfield WRF 001 outfall (Figure 22). Below Deerfield WRF 001 median total P values increased sharply to poor and very poor levels in 2020 and 2021, respectively (Figure 21). Values declined downstream in both years, but remained elevated in the fair range at 2-4 times the good threshold of 0.277 mg/L. Median concentrations of phosphorus (P) in2019 were consistently in the good range except for an elevated value of 1.27 mg/L (poor) downstream from Deerfield WRF 001. All values in 2018 were lowest among years consistently in the good range even downstream from Deerfield WRF 001. A sharp decline in P concentration levels occurred downstream at WF23 (RM 4.9) to WF25 (RM 1.3) with values decreasing to good and excellent.

Total Suspended Solids

Median TSS values were mostly excellent in 2020 and good to excellent in 2021 excepting a very poor value of 60 mg/L at WF 23 (RM 4.9; Table 10). The source is unknown, but it corresponds to a poor sestonic chlorophyll a value of 25.0 µg/L (Table 10). Median values were good in 2018 and 2019 excepting a poor value of 39 mg/L at WF20 (RM 12.5). The highest values in 2018 and 2019 were observed downstream of the Village of Glenview lift station and downstream from the Deerfield WRF with all values in the good range Figure 22). TSS inputs below the WWTP increased to just above the 17.5 mg/L IPS threshold for excellent levels.

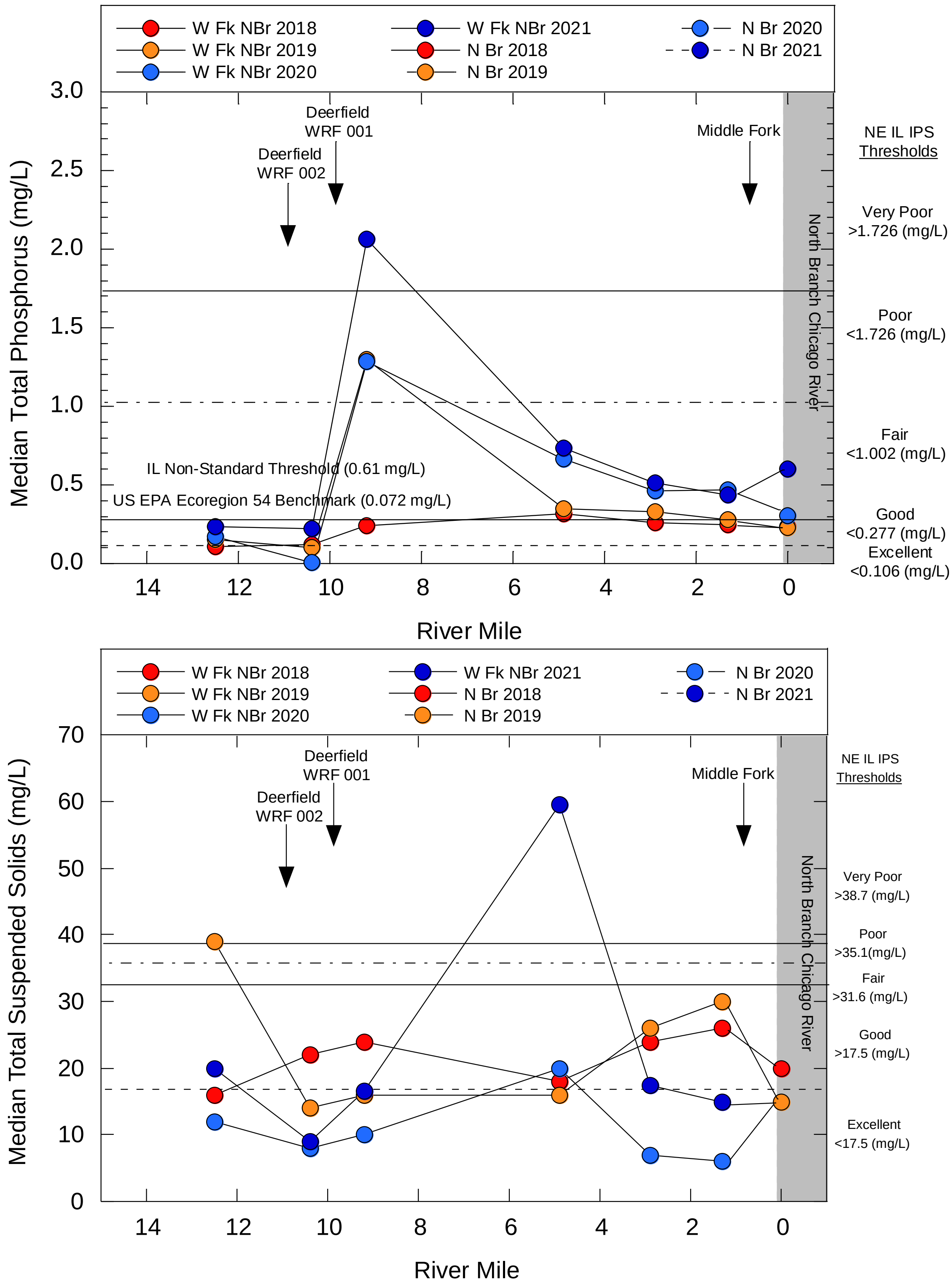


***Figure 22**. Concentrations of median total phosphorus (TP; upper) and total suspended solids (TSS; lower) in the West Fork North Branch Chicago River and the North Branch Chicago River mainstem during May-October in 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Nutrient Effects Assessment

The impact of nutrients on aquatic life has been well documented (e.g., Allan 2004), but the derivation of criteria and their form and application are only just now emerging. Because of the widely varying efforts to develop nutrient criteria by the States, conflicting U.S. EPA oversight, and the potential cost of additional nutrient controls it has been a controversial issue (Evans-White et al. 2014). Unlike toxicants, the influence of nutrients on aquatic life is indirect and primarily via their influence on algal photosynthesis and respiration and the resulting increased magnitude of diel D.O. swings and by the oxygen demand exerted by algal decomposition. Nutrients can also affect food sources for macroinvertebrates and fish and the response of aquatic life to elevated nutrients is co-influenced by habitat (e.g., substrate composition), stream flow (e.g., scouring and dilution), temperature, and exposure of the water column to sunlight. Illinois is the leading state in terms of nitrogen (16.8%) and phosphorus (12.9%) loadings exported via the Illinois and Upper Mississippi Rivers to the Gulf of Mexico where an anoxic zone has developed (U.S. EPA 2008). In Illinois, as in neighboring Midwestern states that drain to the Mississippi River, efforts are underway to modernize nutrient water quality criteria. However, nutrient export is not the only concern – local impacts are also important and the focus of this evaluation is on reach scale effects in the three branches of the upper North Branch Chicago R. watershed.

The combined effects of nutrient enrichment were assessed to better integrate the preceding descriptions of concentrations of each of the key nutrient related parameters and the other non-chemical factors described previously. A multiparameter approach modified from the Ohio SNAP methodology (Ohio EPA 2015a) and a large rivers methodology (Miltner 2018), and as described in the Methods section, was employed in a progressive manner as has been done previously in other NE Illinois watershed assessments since 2017. The results are detailed in a matrix that shows the fish and macroinvertebrate IBIs, the QHEI score, total P, nitrate-N, TKN, the maximum and minimum D.O. (based on Datasondes), the width of the diel D.O. swing, benthic chlorophyll a (as biomass), sestonic chlorophyll a and an overall rating of the degree of nutrient enrichment based on the frequency and magnitude of exceedances of thresholds for the aforementioned indicators and parameters expressed as the total SNAP score for 19 sites in the NBWW 2020-21 survey area (Table 12). This followed the recently developed weighted scoring procedure used to assess the 2020 results in the upper Des Plaines mainstem (MBI 2020b)

The SNAP score results from summing parameter-specific scores that are weighted highest for five primary response indicators – the fIBI, mIBI, diel D.O. swing, benthic chlorophyll a, and sestonic chlorophyll a, less for three secondary indirect and exposure parameters – QHEI, total phosphorus, and the maximum D.O., and least for four tertiary exposure parameters – total nitrate-N, minimum D.O., TSS, and TKN. The final SNAP score is normalized on a 0-100 scale with the degree of nutrient enrichment effects being inverse to the total SNAP score (see bottom of Table 12). The overall degree of nutrient enrichment effects are represented by five narrative ratings of Enrichment Status that results from the degree to which each of the nutrient related parameters and SNAP indicators exceeded their respective primary, secondary,

Table 12*. Results of applying a modified Stream Nutrient Assessment Procedure to 19 sites in the 2020-21 NBWW survey area. Descriptions of how each result reflects the degree of nutrient enrichment effects and which ones result in an assignment of overall enrichment status are shown at the bottom of the matrix along with the source of the thresholds for each primary (blue shaded), secondary (green shaded), and tertiary (tan shaded) parameter. The weighted SNAP score for each parameter and the total SNAP score for deriving the overall enrichment status are shown adjacent to each site parameter value. Only sites with the full suite of continuous D.O. indicators were included.*

Site ID	River Mile	Drainage Area (mi.^{2})	fIBI	fIBI Score	mIBI	mIBI Score	QHEI	QHEI Score	AQLU Attainment Status	Mean TP (mg/L)	Total P Score	Mean Nitrate-N (mg/L)	NO_3-N Score	Continuous Max. D.O. (mg/L)	Max. D.O. Score	Continuous Min D.O. (mg/L)	Min. D.O. Score	Max. Diel D.O. Swing (mg/L)	Diel Swing Score	Benthic Chlorophyll a (mg/m^3)	BChl a Score	Sestonic Chlorophyll a (µg/L)	Seston-ic Chl a Score	Mean TSS (mg/L)	TSS Score	Mean TKN (mg/L)	TKN Score	Total SNAP Score	Overall Enrichment Status	IEPA Eutrophication Risk
Skokie River 2020																														
SR3	14.80	11.5	23.0	7.0	24.6	7.0	**48.0**	5.0	NON - Fair	0.006	0.0	0.20	0.0	10.95	1.0	2.05	1.5	8.9	10.0	41.0	1.0	1.22	0.0	12.0	0.0	0.66	0.0	67.5	**Enriched**	**Risk Present**
SR5	8.00	20.6	23.5	7.0	21.2	7.0	**46.8**	5.0	NON - Fair	0.006	0.0	0.41	0.0	7.42	0.0	2.10	1.5	5.3	7.0	65.8	1.0	3.00	1.0	13.3	0.0	1.15	1.0	69.5	**Enriched**	**No Risk**
SR7	3.00	23.7	15.0	10.0			**38.0**	5.0	NON - Poor	0.006	0.0	0.91	0.0	7.45	0.0	0.97	2.0	6.5	10.0	45.2	1.0	32.40	10.0	15.8	0.0	1.13	1.0	61.0	**Enriched**	**Very High Risk**
SR18	0.50	30.9	34.5	3.0	40.8	3.0	**41.5**	5.0	NON - Fair	0.006	0.0	8.53	1.5	8.03	0.0	3.78	1.5	3.8	1.0	94.3	3.0	15.88	7.0	17.5	0.5	1.45	1.0	73.5	**Possible Nutrients**	**High Risk**
Middle Fork North Branch Chicago River 2020																														
MF17	1.80	57.3	16.5	7.0	25.2	7.0	**45.8**	5.0	NON - Poor	0.006	0.0	8.13	1.5	5.69	0.0	3.09	1.5	2.5	1.0	56.4	1.0	3.66	1.0	13.8	0.0	1.12	1.0	74.0	**Possible Nutrients**	**No Risk**
Middle Fork North Branch Chicago River 2021																														
MF8	21.10	5.81	13.0	10.0	17.5	7.0	**29.0**	5.0	NON - Poor	0.107	1.0	0.10	0.0	19.03	6.0	1.35	2.0	17.7	10.0	28.0	0.0	7.94	3.0	17.8	0.5	1.69	1.5	54.0	**Highly Enriched**	**Very High Risk**
MF9	18.90	8.91	14.0	10.0	24.0	7.0	**31.5**	5.0	NON - Poor	0.120	1.0	0.10	0.0	16.06	5.0	0.14	2.0	15.8	10.0	28.1	0.0	8.48	3.0	23.8	0.5	1.09	0.5	56.0	**Highly Enriched**	**Very High Risk**
MF10	16.70	11.9	12.0	10.0	41.1	3.0	**41.0**	5.0	NON - Poor	0.079	0.0	0.10	0.0	18.23	6.0	0.28	2.0	17.9	10.0	21.0	0.0	7.72	3.0	5.8	0.0	1.38	1.0	60.0	**Enriched**	**Very High Risk**
MF11	14.10	16.11	20.0	7.0	21.5	7.0	**44.0**	5.0	NON - Fair	0.093	0.0	0.10	0.0	14.71	5.0	2.65	1.5	12.0	10.0	21.5	0.0	5.32	3.0	16.3	0.0	1.45	1.0	60.5	**Enriched**	**Very High Risk**
MF12	10.80	19.23	15.0	10.0	34.0	3.0	**45.5**	5.0	NON - Poor	0.074	0.0	0.24	0.0	13.07	2.0	0.61	2.0	12.5	10.0	59.9	1.0	2.16	0.0	5.5	0.0	0.96	0.0	67.0	**Enriched**	**High Risk**
MF13	8.60	20.96	13.0	10.0	15.7	7.0	**60.0**	2.0	NON - Poor	0.136	1.0	0.76	0.0	9.28	0.0	1.72	2.0	7.5	10.0	29.8	0.0	1.24	0.0	7.8	0.0	1.04	0.5	67.5	**Enriched**	**Risk Present**
MF14	6.00	22.48	15.0	10.0	39.5	3.0	**64.5**	2.0	NON - Poor	0.095	0.0	0.78	0.0	10.09	0.0	5.25	1.0	4.8	3.0	62.2	1.0	0.52	0.0	5.0	0.0	1.39	1.0	79.0	**Possible Nutrients**	**Risk Present**
MF15	4.00	24.29	17.0	7.0	21.4	7.0	**55.5**	2.0	NON - Poor	0.074	0.0	0.87	0.0	11.99	1.0	4.98	1.0	7.0	10.0	49.0	1.0	1.16	0.0	6.5	0.0	0.92	0.0	71.0	**Possible Nutrients**	**High Risk**
West Fork North Branch Chicago River 2021																														
WF21	10.40	7.02	11.0	10.0	18.7	7.0	**42.0**	5.0	NON - Poor	0.224	1.0	0.35	0.0	9.78	0.0	0.33	2.0	5.5	7.0	104.0	3.0	1.20	0.0	11.5	0.0	1.80	1.5	63.5	**Enriched**	**Risk Present**
WF22	9.20	9.41	9.0	10.0	15.8	7.0	**46.5**	5.0	NON - Poor	1.953	6.0	6.26	1.0	16.81	6.0	0.46	2.0	15.2	10.0	37.3	1.0	2.76	1.0	25.0	0.5	2.02	1.5	49.0	**Highly Enriched**	**Very High Risk**
WF23	4.90	17.86	9.0	10.0	13.8	10.0	**41.0**	5.0	NON - Poor	0.712	2.0	3.20	0.0	18.95	6.0	1.52	2.0	9.4	10.0	45.4	1.0	28.48	7.0	50.5	2.0	1.65	1.5	43.5	**Highly Enriched**	**Very High Risk**
WF24	2.90	24.52	10.0	10.0	21.0	7.0	**66.0**	2.0	NON - Poor	0.472	2.0	2.23	0.0	10.18	0.0	2.21	1.5	7.8	10.0	37.4	1.0	6.44	3.0	19.5	0.5	1.66	1.5	61.5	**Enriched**	**Risk Present**
WF25	1.30	27.97	12.0	10.0	21.9	7.0	**48.0**	5.0	NON - Poor	0.408	2.0	2.33	0.0	9.22	0.0	1.89	2.0	5.5	7.0	46.3	1.0	9.24	3.0	15.5	0.0	1.15	1.0	62.0	**Enriched**	**High Risk**
North Branch Chicago River 2020																														
MF19	18.60	93.4	13.0	10.0	21.4	7.0	**48.5**	5.0	NON - Poor	0.006	0.0	5.62	1.0	7.42	0.0	4.61	1.0	2.6	1.0	40.5	1.0	1.92	1.0	16.3	0.0	1.62	1.0	72.0	**Possible Nutrients**	**No Risk**
Condition Category Thresholds		**Excellent**	≥50	0	>73	0	>84.5	0	FULL	≤0.106	0	≤3.77	0	<10.36	0	>6.9	0	<2.0	0	<35	0	<2.5	0	≤17.50	0	<1.07	0	≥94	Not Nutrients	No Risk
		Good	>41-49	1	≥41.8	1	>75.9	1	FULL	<0.277	1	<5.05	0.5	<12.2	1	>6.0	0.5	<4.0	1	<79	1	<5.1	1	>17.50	0.5	<1.12	0.5	≥82	Not Nutrients	No Risk
		Fair	30- <41	3	≤41.7	3	<75.9	2	NON-Partial	<1.020	2	<7.34	1	<14.2	2	>4.0	1	<5.0	3	<150	3	<13.8	3	>31.60	1	<1.63	1	≥70	Possible Nutrients	Risk Present
		Poor	>15-29	7	≤29	7	<50.1	5	NON-Fair	<1.726	5	<9.64	1.5	<16.3	5	>2.0	1.5	<6.5	7	<320	7	<28.9	7	>35.15	1.5	<2.14	1.5	≥60	Enriched	High Risk
		Very Poor	<15	10	<15	10	<25	6	NON-Poor	≥1.726	6	≥9.64	2	≥16.3	6	<2.0	2	≥6.5	10	≥320	10	>28.9	10	>38.69	2	≥2.14	2	<60	Highly Enriched	Very High Risk
Source		IPS	IEPA	MBI	IEPA	MBI	IPS	MBI	IPS	IPS	MBI	IPS	MBI	IPS	MBI	IPS	MBI	MBI/SNAP	MBI/SNAP/NSAC			MBI/NSAC	MBI	IPS	MBI	IPS	MBI	MBI/SNAP		**IEPA/MBI**

and tertiary thresholds. The Highly Enriched and Enriched narratives are assigned where the indicators are exceeded in terms of the number and magnitude of poor and very poor exceedances that are associated with a biological impairment. The Possible Nutrients narrative is assigned where there is a predominance of fair exceedances, but an insufficient number and/or magnitude of poor or very poor exceedances to warrant an Enriched status. Hence it serves as an indication where a threat for adverse effects from nutrient enrichment exists, but not necessarily an actual enrichment effect. A Not Nutrients narrative rules out nutrient effects as a cause of impairment and is also assigned to sites that exhibit full attainment of the General use biocriteria.

The NBWW 2020-21 results are detailed in a SNAP matrix that shows the fish and macroinvertebrate IBIs, the QHEI score, total P, nitrate-N, TKN, the maximum and minimum D.O. (based on Datasondes), the width of the diel D.O. swing, benthic chlorophyll a (as biomass), and an overall rating of the degree of nutrient enrichment based on the frequency and magnitude of exceedances of thresholds for the aforementioned indicators and parameters at 19 sites (Table 12). Nineteen (19) of the 25 sites had the full array of SNAP indicators with the number of Datasondes that could be deployed during short-term surveys in 2020 and 2021 being the limiting factor. The results showed highly enriched conditions at four (4) locations (Table 12), two each in the upper Middle Fork and upper West Fork. In each there was a wide diel D.O. swing (very poor), a high maximum D.O. (very poor), and a low minimum D.O. (very poor). The two Middle Fork sites also had the lowest QHEI scores in the 2020-21 survey area and were subject to urban nonpoint source runoff. The West Fork sites were downstream from the Deerfield WRF 001 and 002 outfalls with the site at WF23 with an elevated mean total P in the very poor range and a mean sestonic chlorophyll a value in the poor range.

Eleven (11) sites were Enriched and occurred at multiple sites in all three branches - three (3) of four (4) Skokie River sites, four (4) of eight (8) Middle Fork sites, and three (3) of five (5) West Fork sites. At each site there was a wide diel D.O. swing, a high maximum D.O., and a low minimum D.O., with nine (9) of these sites in the very poor ranges and the remaining two (2) in the poor range of the D.O. indicators. Sestonic chlorophyll a was very poor at only one of these sites SR07 (RM 3.0) which was an impounded site located in the Skokie Lagoons which also appeared to affect the next downstream site at SR18 (RM 0.50) with a poor value. Benthic chlorophyll a values at all except one of the Highly Enriched or Enriched sites were in the excellent or good range. The site at WF21 had a fair value of 104 mg/m^2. TKN values were elevated into the poor range at only five (5) of the 15 Highly or Enriched sites. Possible enrichment was indicated for the remaining five (5) sites of with a mix of wide diel D.O. swings, low minimum D.O., elevated TKN, and elevated sestonic chlorophyll a listed as the rationale for the assigned enrichment status. Two of these sites, MF1 (RM 6.00) and the MF19 (RM 18.60) had only four fair exceedances each and the Possible Nutrients status was mostly the result of the impaired biota and Low QHEI at one site. Zero sites had a Not Nutrients result as all sites had primary and secondary indicator exceedances into the poor and fair ranges at least. Habitat was generally poor throughout the study area and at all of the Highly Enriched and Enriched sites, which contributes to the very poor and poor nutrient effect parameter exceedances.

There were no obvious patterns between the three major branches as all had enriched sites with the four (4) Highly Enriched sites restricted to the Middle Fork (MF10) and the West Fork (WF23). In some cases it was difficult to determine the definitive cause of the low minimum D.O. values, but these are more likely the result of excessive organic enrichment in addition to nutrient related effects. The *E. coli* results (see Table 2) suggest excessive organic enrichment throughout much of the Middle Fork and West Fork in particular. That coupled with mostly poor habitat and low gradient degrades the assimilative capacity of each branch.

Levels of primary nutrients were comparatively low at most Skokie and Middle Fork sites with only one nitrate-N exceedance of the poor threshold with a value of 8.53 mg/L (Poor) at SR18 and extending downstream into the N. Branch at MF19. Total phosphorus was excellent or good in the Skokie R. and Middle Fork, but was elevated into the very poor and fair range at four (4) locations in the West Fork downstream from the Deerfield WRF.

Also included in the SNAP assessment is an assessment of the “Risk of Eutrophication” developed by IEPA to screen for the potential for adverse nutrient related impacts for stream and river reaches that are not listed by IEPA for phosphorus related impairments. Developed by the IEPA Risk of Eutrophication Committee[1] the procedure utilizes a flow chart that essentially includes the exceedance of any one of three thresholds for pH (>9.0 S.U.), sestonic chlorophyll a (>26 µg/L), or D.O. saturation >110% and pH >8.35 for two (2) or more days. The Risk of Eutrophication was assessed for the same 19 sites as the SNAP analysis (Table 13) with enhancements that produced four levels of risk - Very High Risk, High Risk, Risk Present, and No Risk. The Risk Present and No Risk assignments followed the IEPA flow chart with the High and Very High categories based on greater exceedance thresholds and/or a longer duration of exceedances that result in the risk being extended over a longer period time (Table 13). The median sestonic chlorophyll a criterion was supplemented with the maximum value measured at a site. IEPA specifies examining the previous 5 years of data, but only the 2020 and 2021 data used in the SNAP analysis was assessed herein.

The results show seven (7) sites with a Very High Risk, four (4) with a High Risk, five (5) with Risk Present, and three (3) with No Risk. The seven (7) Very High Risk outcomes matched either the Highly Enriched or Enriched SNAP outcomes (Table 12). The four (4) High Risk outcomes matched an Enriched SNAP outcome at two sites and a Possible Nutrients at two sites. The five (5) Risk Present outcomes matched Enriched SNAP outcomes at four (4) sites and a Possible Nutrients at one (1) site. The three (3) No Risk outcomes matched Possible Nutrient at two (2) sites and Enriched at one (1) site. The Very High, High Risk, and Risk Present outcomes were driven primarily by D.O. saturation exceedances. A maximum sestonic chlorophyll a value of 74 µg/L at the impounded SR07 (RM 3.0) site which was the only outcome driven by a result other than D.O. saturation. The other high sestonic chlorophyll a result of 73 µg/L occurred at WF23 (RM 4.9), but was accompanied by a maximum D.O. %saturation of 241.6%. This site is located 5.1 miles downstream from the Deerfield WRF 001 outfall at a point where nutrient loadings would have their maximum impact under the low flows observed in 2021. Only one pH value

[1] Proposal for Phosphorus Conditions in NPDES Permits - Phosphorus-related impairments & eutrophication (January 17, 2018).

***Table 13**. Results of applying an enhanced version of the IEPA Risk of Eutrophication methodology used to screen for the potential for adverse effects of nutrient enrichment on pH, D.O., and sestonic chlorophyll a levels. Enhancement to the ROE include categories that convey the severity of screening criteria exceedances and using the maximum sestonic chlorophyll a in addition to the median. The results are color coded as follows: Red – Very High Risk; Orange – High Risk; Yellow – Risk Present; No Risk – Green. Specific criteria used are listed at the bottom of the table.*

Site ID	River	River Mile	Year	Drainage Area (sq. mi.)	Max. pH (S.U.)	% DO Saturation	Days D.O. Sat. >110%	Median Sestonic Chlorophyll a	Max. Sestonic Chlorophyll a	Risk of Eutrophication
SR3	Skokie River	14.8	2020	11.56		138.1	2	1.3	2.3	Risk Present
SR5	Skokie River	8.0	2020	20.67	7.95	89.9	0	3.1	4.5	No Risk
SR7	Skokie River	3.0	2020	23.73	7.89	95.1	0	25.0	74.0	Very High Risk
SR18	Skokie River	0.5	2020	30.9	7.90	96.2	0	18.0	32.0	High Risk
MF8	Middle Fork North Branch Chicago River	21.1	2021	5.81	9.02	253.4	3	3.8	24.0	Very High Risk
MF9	Middle Fork North Branch Chicago River	18.9	2021	8.91	8.58	221.1	3	5.8	20.0	Very High Risk
MF10	Middle Fork North Branch Chicago River	16.7	2021	11.99	8.68	223.7	3	1.6	30.0	Very High Risk
MF11	Middle Fork North Branch Chicago River	14.1	2021	16.13	8.71	182.9	4	4.1	15.0	Very High Risk
MF12	Middle Fork North Branch Chicago River	10.8	2021	19.23	8.47	155.3	3	2.1	3.1	High Risk
MF13	Middle Fork North Branch Chicago River	8.6	2021	20.97	8.10	111.2	1	0.9	2.6	Risk Present
MF14	Middle Fork North Branch Chicago River	6.0	2021	22.48	8.10	121.9	3	0.4	1.1	Risk Present
MF15	Middle Fork North Branch Chicago River	4.0	2021	24.29	8.39	146.6	3	1.4	1.9	High Risk
MF17	Middle Fork North Branch Chicago River	1.8	2020	57.31	7.83	67.5	0	1.7	9.6	No Risk
MF19	North Branch Chicago River	18.6	2020	93.41	8.05	88.4	0	1.0	5.7	No Risk
WF20	West Fork North Branch Chicago River	12.5	2021	3.9	7.33	19.0	0	10.0	35.0	High Risk
WF21	West Fork North Branch Chicago River	10.4	2021	7.02	8.39	115.2	1	1.2	2.1	Risk Present
WF22	West Fork North Branch Chicago River	9.2	2021	9.41	8.63	208.3	3	2.9	4.4	Very High Risk
WF23	West Fork North Branch Chicago River	4.9	2021	17.86	8.93	241.6	3	24.0	73.0	Very High Risk
WF24	West Fork North Branch Chicago River	2.9	2021	24.52	8.88	126.8	1	6.7	17.0	Risk Present
WF25	West Fork North Branch Chicago River	1.3	2021	27.97	8.33	113.0	1	1.7	40.0	High Risk
		Enhanced IEPA Risk of Eutrophication (ROE) Criteria			Max pH >9.0	%Sat. >200	4 Days	>26 µg/L	Maximum Sestonic Chlorophyll a Used in lieu of Median; >26 µg/L High Risk, >60 µg/l Very High Risk	pH >9.0 S.U.; **or** Median Sestonic Chloropyll a >26 **or** Daily Maximum pH >8.35 S.U. **and** Daily Maximum D.O. Saturation >110% for 2 or more days.
					Max pH >8.35	%Sat.>110	3 Days			
					Max pH >8.35	%Sat.>110	1-2 days			

exceeded 8.35 S.U. All were accompanied by high %D.O. saturation values most of which exceeded two days.

In general the SNAP and ROE analyses yielded roughly similar results with “disagreements” being separated only by a “nearest neighbor” outcome. D.O. however, was the primary driver of both the SNAP and ROE outcomes almost to the exclusion of pH or sestonic chlorophyll a, the latter even when used as a maximum in lieu of the median. Therefore, it will be important to determine the origins of the low and high D.O. values given the greater presence of multiple indicators of organic enrichment, including biological assemblage responses, and a lack of consistently elevated nutrient levels and low chlorophyll a values with the exception of the West Fork downstream from the Deerfield WRF. Habitat is also an important controlling variable that needs to be included in assigning causes of low or high D.O. levels. Most sites had poor QHEI values and the impoundment represented by site SR07 and the site immediately downstream reveal the importance of retention time in exacerbating sestonic chlorophyll a levels. Elements of the ROE procedure could be incorporated in a future update to the current SNAP methodology specifically the D.O. saturation values. However, some of the ROE variables may be redundant to parameters that are already included in SNAP so that would need to be more carefully considered.

Ionic Strength Parameters

Ionic strength parameters are generally in the form of dissolved solutes that can be delivered to rivers and streams in runoff events and point source effluents and some are associated with urban runoff specifically. These include parameters measured in the water column and commonly include conductivity, total dissolved solids, and ions such as chlorides and sulfate. Typically, our analyses have been geared to “urban parameters” which includes certain common heavy metals such a lead, zinc, and copper, and while these were analyzed only one time in August 2018 and 2019 by NBWW the results are presented herein.

Chlorides

In temperate climates such as northern Illinois, chlorides are an emerging problem because they accumulate in soils and shallow groundwater and have been documented to reach concentrations that can threaten and impair aquatic life. Of particular concern in urban areas with high road density is the concentration of chlorides from winter road salt applications and point source loadings from water treatment blowdown. Kelly et al. (2012) identified a steadily increasing trend in chloride levels in the Illinois River at Peoria where the median increased from 20 mg/L in 1947 to nearly 100 mg/L in 2004 with high values in the 1940s of <40 mg/L rising to >300 mg/L by 2003. Chlorides do not exhibit a simple runoff and export mode of effect, but rather accumulate in near surface groundwater (Kelly 2008), soils, and land surfaces adjacent to streams. Seasonal studies have shown that elevated summer concentrations are correlated with higher and acute concentrations during late winter and spring periods (Kaushal et al. 2005). Research in New England (Kaushal et al. 2005) and Minnesota (Novotny et al. 2008) show that chlorides can accumulate in watersheds and that there is a strong association between high winter and elevated summer concentrations. Novotny et al. (2008) identified that 78% of the road salt applied in a Minnesota watershed accumulated in a given year and contributed to an increase in summer chloride concentrations.

Median total chloride concentrations (mg/L) in all three branches were lower in 2020 compared to 2021 with exceedances of poor and very poor levels being common (Table 10). The Skokie River had similar levels of fair, poor, and very poor exceedances in 2018-20 with a general trend of decline from upstream to downstream (Figure 23). With the exception of the upstream most site (SR01), median chloride levels were much higher in 2021 with all values in the very poor range, but also declining downstream.

The Middle Fork showed a similar pattern to the Skokie R. median chloride results declining from very poor levels upstream to progressively lower values into the fair range in the downstream reaches during 2018-20 (Table 10). Median Chloride levels in 2021 more than doubled at the two upstream most sites and all median values exceeded the Illinois WQS current chloride standard of 500 mg/L at seven (7) sites between MF08 (RM 21.1) downstream to MF14 (RM 6.0) a distance of 15.1 miles (Figure 24). While low flows in 2021 likely contributed to a widespread increase in chloride levels, the source of the marked increase in the upper Middle Fork is currently unknown, but definitely emanates from the very headwaters.

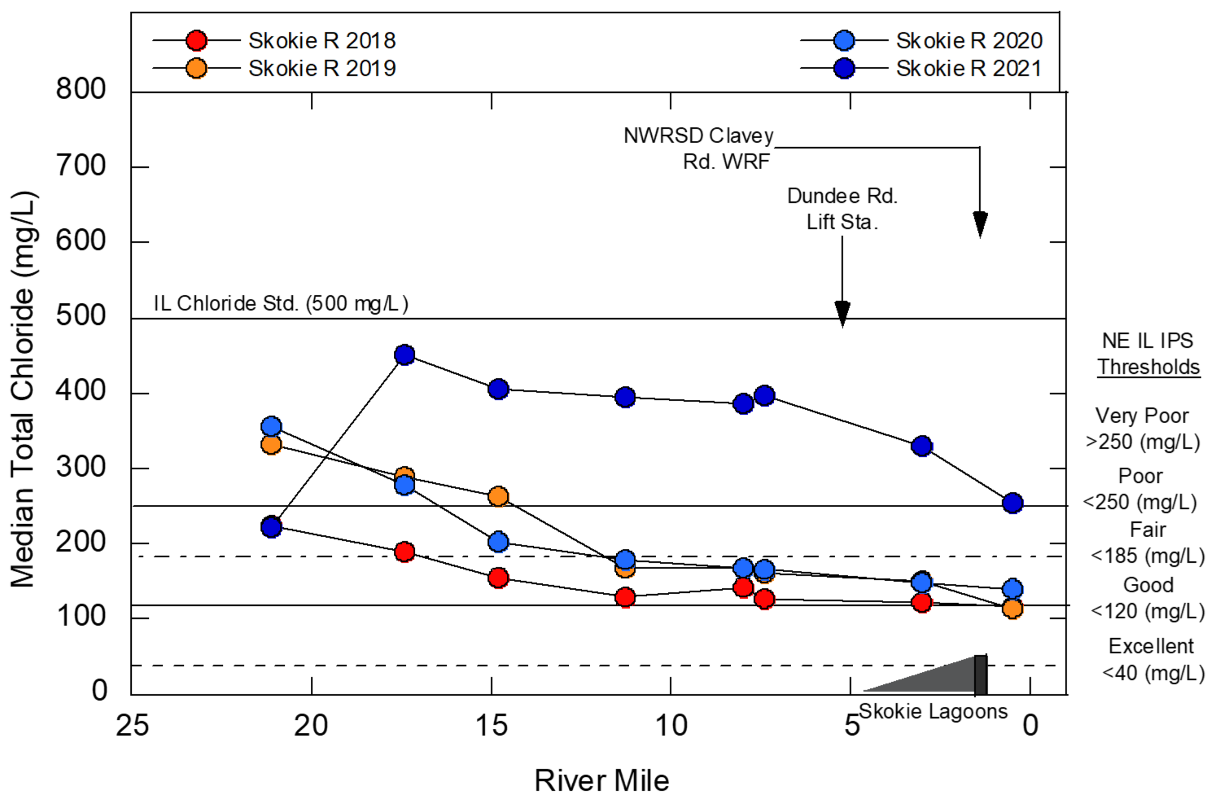


***Figure 23**. Concentrations of median chloride in the Skokie River during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

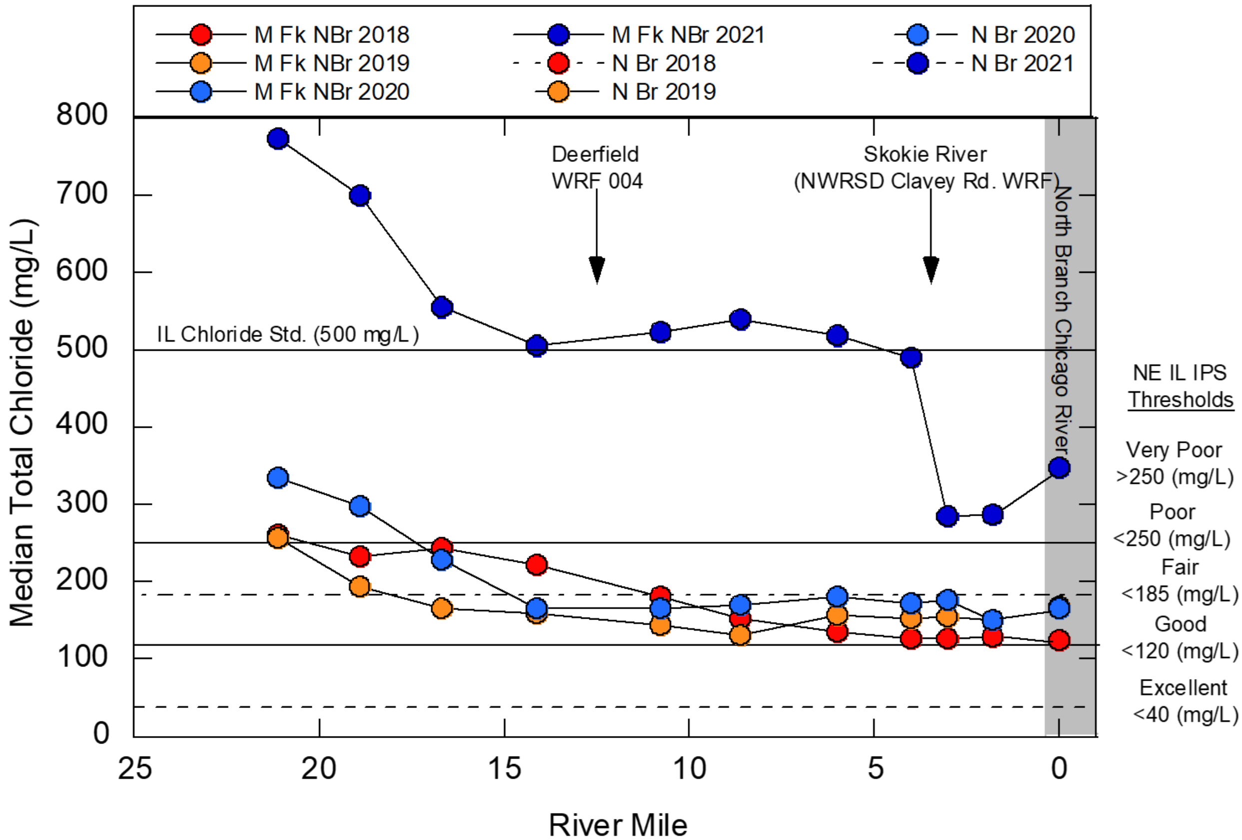


***Figure 24**. Concentrations of median chloride in the Middle Fork during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Median levels of chloride in the West Fork in 2018-20 ranged from good to fair, increasing from upstream to downstream (Figure 25). The downstream sites had median values in the low fair range and upstream values were observed in the high, good range. The Deerfield WRF increased chloride concentrations slightly, but not significantly enough to exceed the 120 mg/L good IPS threshold. Median chloride concentrations in 2021 were higher at the two upstream sites (WF20 and WF21) where they were in the very poor range. Median values declined downstream from the Deerfield WRF 001 outfall apparently the result of the dilution provided by the effluent discharged. From that point and downstream median levels of chloride increased slightly, but remained higher than 2018-20 being in the very poor range.

Conductivity

Dissolved materials are also measured by specific conductance or conductivity which is depicted in Figure 26 for the short-term continuous data in 2020 and 2021. Similar to the trend observed in the grab sample results, values were the highest at the upstream site (SR1) in the Skokie River where the median far exceeded the very poor IPS threshold. Values declined steadily downstream with most readings remaining above the IPS very poor threshold. Median values declined in the N. Branch at MF19, signaling that the high levels in the Middle Fork were diluted by the effluent conveyed by the Skokie River to the Middle Fork and N. Branch. All median values were within the good range in the Skokie River and at the single North Branch

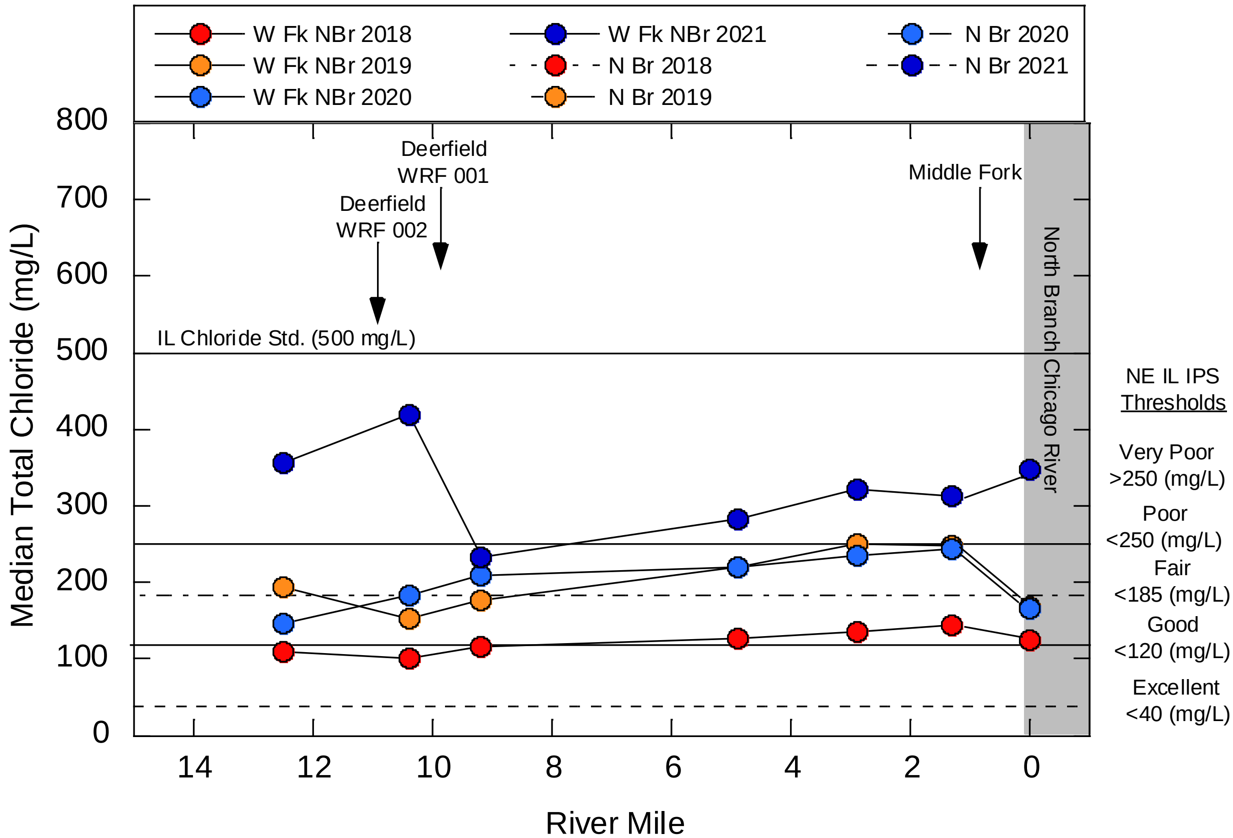


Figure 25*. Concentrations of median chloride in the West Fork during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

site (MF19). The West Fork sites had values exceeding poor and very poor thresholds, but were overall lower than the Middle Fork values. An exception was the upstream most West Fork site (WF21) that had a very wide range of values with the median, upper quartile, and maximum values exceeding the very poor threshold. These results suggest a major sources of dissolved materials in the headwaters of both the Skokie River and the West Fork.

Median conductivity values measured by grab samples only roughly mirrored chloride concentrations in 2020 and 2021. The general pattern in the Skokie River was a gradual decrease from upstream to downstream in all years with the highest values in 2021 (Figure 27), but without the sharp increase shown by the chloride results. The 2018 values ranged from good to excellent while 2019 values were higher, ranging from very poor to good. The 2020 results were intermediate between 2018 and 2019.

Median conductivity values in the Middle Fork in 2020 and 2021 were higher than 2018 and 2019 with values in the very poor range (Figure 28). The 2021 values were more than twice the 2018-19 results and were highest in the headwaters and declining in a downstream direction, but maintaining very poor values until being diluted by the entry of the Skokie River after which values declined to the good range. Values were generally good in 2018 with exceptional values

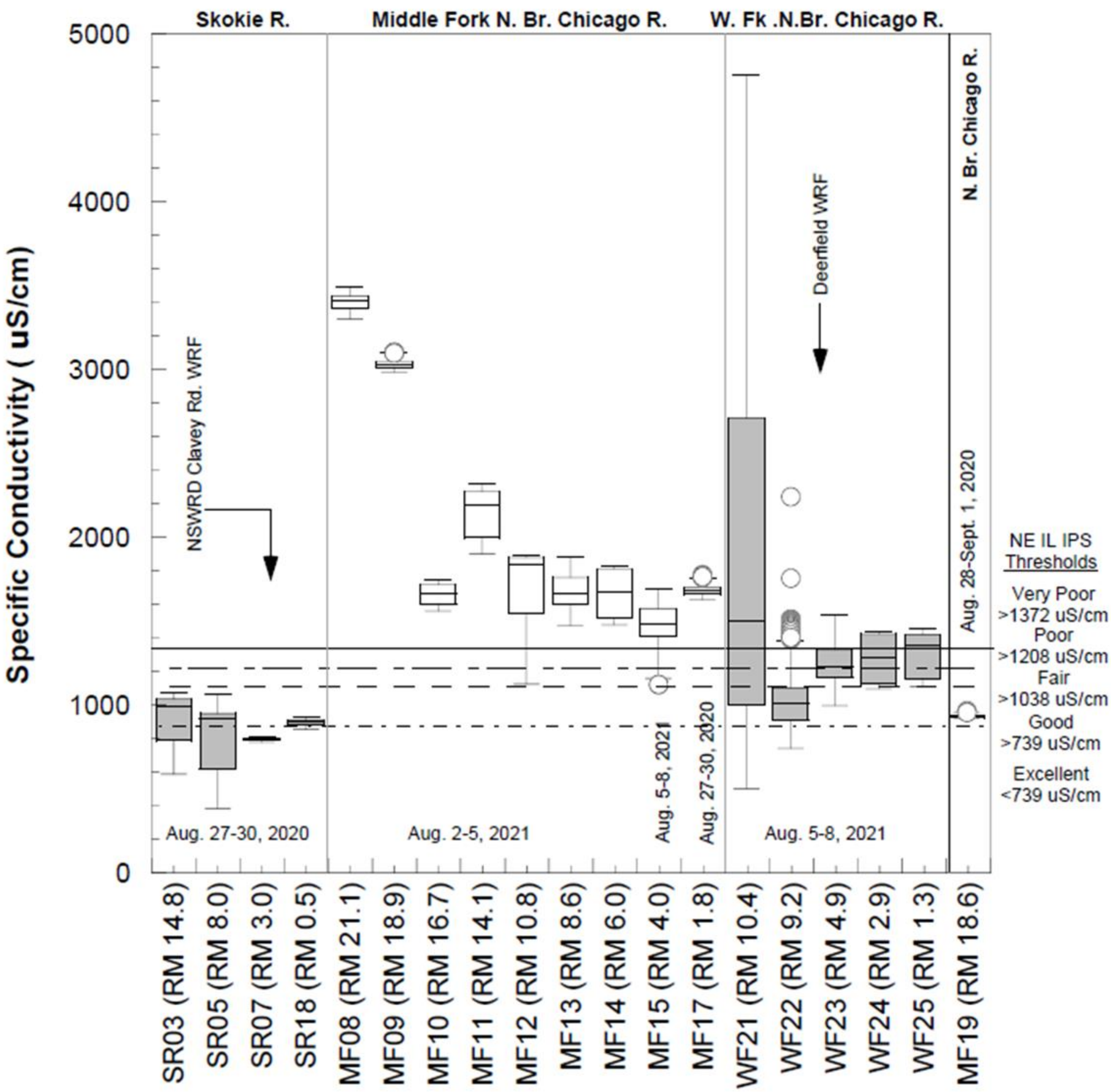


Figure 26*. Specific conductance (µS/cm) measured continuously by Datasondes deployed for 4-5 day periods during late-August 2020 and early-August 2021 at 19 locations in the 2020-21 NBWW survey area. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The IPS thresholds for five narrative ratings are shown by solid and dashed lines.*

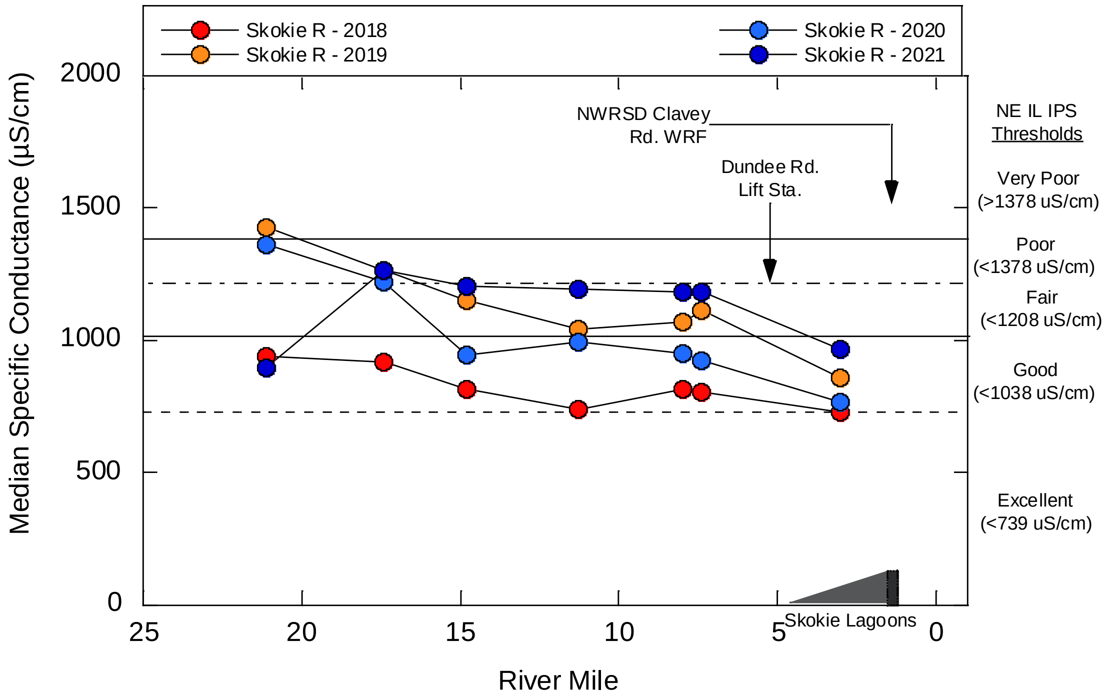


***Figure 27**. Median values of specific conductance in the Skokie River during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

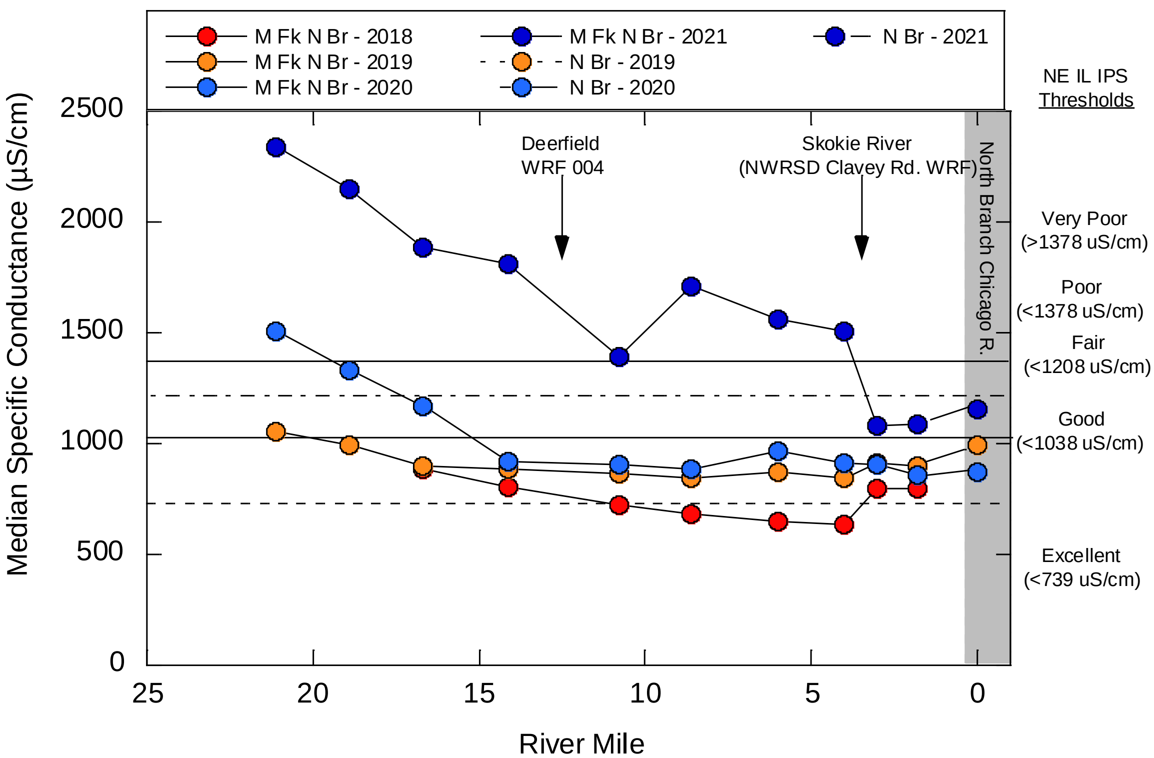


***Figure 28**. Median values of specific conductance in the Middle Fork during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

recorded at MF15 and MF16. The North Branch mainstem site was at the 739 µS/cm excellent IPS threshold in 2018. All median conductivity values in 2019 were within the good IPS threshold for all sites in the Middle Fork and North Branch mainstem. The increases in 2020 and 2021 especially are likely related to lower flows than in 2018 and 2019, but the extremely high values in the headwaters in 2021 that mirrored the chloride results suggests a significant source of dissolved materials entering the upper most reaches of the Middle Fork.

The West Fork results in 2020 were intermediate to 2018 and 2019 results (Figure 29). The 2021 conductivity levels resembled the chloride results being much higher upstream from Deerfield WRF 001 outfall and declining downstream in response to the dilution provided by the WRF effluent. The 2018 values ranged from good to excellent, with a modest increase from upstream to downstream in median conductivity levels. The 2019 values ranged from poor to good, also increasing from upstream to downstream in a near identical pattern to 2018. Overall, dissolved ions are and have been elevated throughout much of the NBWW survey area during 2018-21, with the highest values observed in 2021. While some of this is related to the low flows in 2021, the magnitude of some of the increases that more than doubled previously observed levels (Table 10) is an indication of sources in the headwaters of the Skokie River for dissolved ions and the Middle Fork for extremely elevated chloride and dissolved ion levels.

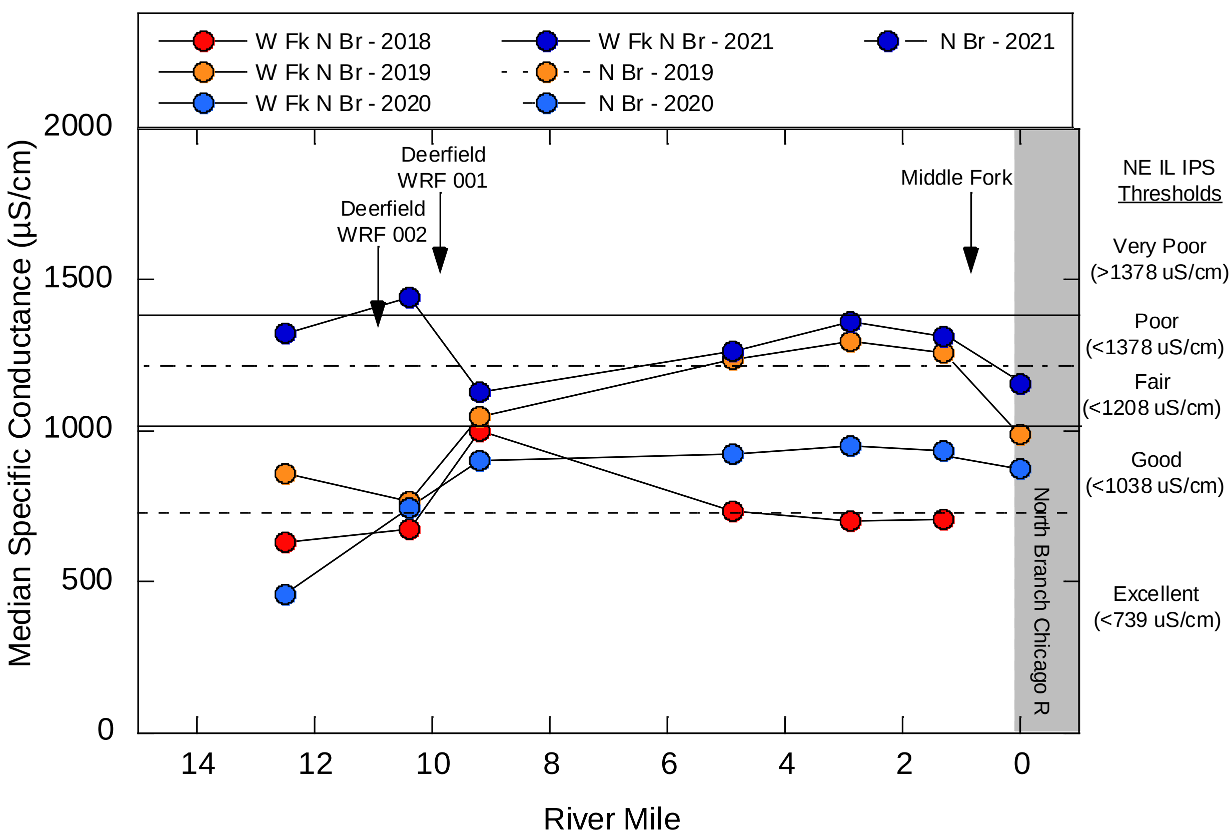


Figure 29. *Median values of specific conductance in the West Fork during May-October 2018-21. Dashed and solid lines represent IPS derived effect thresholds correlated with ranges of biological quality and as listed in Table 7.*

Water Column Metals and Organics

Water samples for the analysis of 14 metals and a scan for organic parameters were collected once annually at the eight (8) Tier 1 sites (Table 14). While the low frequency of sample collection inherently limits the analysis, there were some notable observations of metals and organics in relation to detections. Eight (8) of the 14 metal parameters were consistently detected. The remaining five (5) parameters exhibited a mixed frequency of detections. Two parameters were not detected at all. A single iron value exceeded the Illinois WQS standard once at site WF20 (RM 12.5) and is the only exceedance among metals in 2020-21. Other threshold exceedances including Short (1998) and regional reference values were not exceeded. IPS thresholds for metals were not used in assess for metals threshold exceedances because of the lack of truly poor and very poor values in the IPS database which skews the response gradient. In lieu of developing more realistic thresholds by accessing or even simulating historical data that reflects the gross inputs of heavy metals, the Illinois WQS chronic and acute standards will be used to assess for good and poor results, respectively. Only one organic parameter, acetone, was detected at levels well below any reported effect levels on aquatic life or human health at any of the 2020-21 locations.

Exceedances of Standards

The only exceedances of an Illinois WQS criterion in the grab sample data were for the chloride >500 mg/L standard as a single value. In 2020 and 2021 there were numerous single value exceedances in addition to the median values discussed on pp. 59-60. The exceedances occurred in both 2020 and 2021, but most frequently in the latter year (Table 15). The winter data collected in February was also included to highlight the magnitude of elevated concentrations during the road salt application season. A total of 65 chloride single value exceedances were recorded, 11 in 2020 and 54 in 2021. Forty (40) exceedances occurred in February, 11 in 2020 and 29 in 2021, the latter suggesting substantially higher concentrations of chloride in winter runoff. Values exceeding 1000 mg/L were all recorded in February with the highest value of 2530 mg/L at SR01 (RM 21.1) on February 23, 2021. The Skokie River and Middle Fork had the majority of the exceedances, three (3) in 2020 and 11 in 2021 for the Skokie River and five (5) in 2020 and 12 in 2021 for the Middle Fork. The West Fork had three (3) and six (6) exceedances in 2020 and 2021, respectively. The Middle Fork had the only exceedances recorded in August with eight (8) in 2021. It also had the highest number of May exceedances with eight (8) in 2021 compared to three (3) each in the Skokie River and the West Fork also in 2021. There were no May-October exceedances in 2020.

Sediment Chemistry

Sediment samples were evaluated against guidelines compiled by McDonald et al. (2000), Illinois sediment metals guidelines (Short 1998), and the new IPS derived narrative ranges (see Table 16). The MacDonald et al. (2000) threshold effect levels (TEL) are where toxic effects are initially apparent and likely to affect the most sensitive organisms. Probable effect levels (PEL) are where toxic effects are more likely to be observed over a wider range of organism sensitivities. Short (1998) identified elevated and extremely elevated sediment metal

***Table 14**. Median values for 14 heavy metals eight (8) sites during May-October 2020-21 with exceedances of Illinois WQS standards or other Illinois thresholds listed at the bottom of the table.*

Site ID	River Mile	Drain-age Area (sq. mi.)	Arsenic (ug/L)	Barium (ug/L)	Cadmium (ug/L)	Calcium (mg/L)	Chromium (ug/L)	Copper (ug/L)	Iron (ug/L)	Lead (ug/L)	Magne-sium (mg/L)	Mercury Low Level (ng/L)	Nickel (ug/L)	Silver (ug/L)	Sodium (mg/L)	Zinc (ug/L)
Skokie River 2020																
SR1	21.1	2.7	1.7	39	ND	51	ND	2.2	770	ND	17	3.1	ND	ND	170	20
SR18	0.5	30.9	2.6	25	ND	46	ND	4.1	920	2.00	21	3.3	2.5	ND	82	ND
Skokie River 2021																
SR1	21.1	2.7	1.5	38	ND	51	ND	3.1	440	0.71	18	1.0	ND	ND	110	31
SR18	0.5	30.9	1.8	29	ND	56	ND	5.2	760	1.70	26	2.9	2.4	ND	110	ND
Middle Fork North Branch Chicago River 2020																
MF8	21.1	5.8	3.2	52	ND	39	ND	ND	430	0.51	20	1.0	ND	ND	260	ND
MF15	4.0	24.3	2.6	29	ND	38	ND	3.2	270	0.57	16	1.6	ND	ND	73	ND
Middle Fork North Branch Chicago River 2021																
MF8	21.1	5.8	2.8	43	ND	56	ND	ND	460	ND	23	1.2	ND	ND	380	ND
MF15	4.0	24.3	3.3	43	ND	54	ND	2.8	370	ND	25	1.3	ND	ND	320	ND
West Fork North Branch Chicago River 2020																
WF20	12.5	3.9	2.6	28	ND	37	ND	ND	620	ND	15	1.1	ND	ND	50	ND
WF22	9.2	9.4	3.1	28	ND	50	ND	6.4	350	ND	20	1.7	ND	ND	110	21
WF25	1.3	28.0	3.4	43	ND	45	ND	ND	370	0.76	19	1.7	ND	ND	110	ND
West Fork North Branch Chicago River 2021																
WF20	12.5	3.9	3.4	55	ND	46	ND	5.3	3100	2.10	22	5.4	4	ND	200	25
WF22	9.2	9.4	1.7	25	ND	65	ND	7.8	440	0.52	23	1.9	2.2	ND	130	41
WF25	1.3	28.0	2.3	45	ND	56	ND	2.8	190	ND	25	1.3	ND	ND	190	ND
North Branch Chicago River 2020																
MF19	18.6	93.4	2.9	33	ND	44	ND	2.1	450	1.20	21	2.8	2.5	ND	87	ND
North Branch Chicago River 2021																
MF19	18.6	93.4	2.5	35	ND	54	ND	3.9	280	0.79	25	2.2	2.2	ND	150	ND
Narrative Condition Category Thresholds	Excellent		-	<74.1	<0.937	<84425	<1.398	-	-	<2.851	-	-	-	-	<16.3	<7.47
	Good		<3.616	<84.88	<0.974	<86076	<1.540	<4.480	1000	<3.335	-	1100	<3.470	5.0	>16.3	<9.7
	Fair		>3.616	>84.88	>0.974	>86076	>1.540	>4.480	-	>3.335	-	-	>3.470	-	>45.0	>9.78
	Poor		>5.029	>101.8	>0.983	>86313	>2.682	>4.969	-	>3.884	-	-	>9.585	-	>79.1	>11.00
	Very Poor		>6.603	>118.6	>0.991	>86559	>3.824	>5.458	-	>4.334	-	-	>11.88	-	>113.1	>12.22
Source(s)	IPS		IPS	IPS	IPS	IPS	IPS	IPS	IL WQS	IPS	NONE	IL WQS	IPS	IL WQS	IPS	IPS
Other Bench-marks	Illinois WQS (Chronic)		50	1000	2.7	NA	11	30.2	1000	81.30	NA	1100	12.7	5.0	None	55.5
	IPS Regional Reference		NA	56.3	0.17	54000	1.73	2.00	NA	0.24	NA	NA	5.0	NA	14200	2.0
	MDL		0.23	0.73	0.17	0.027	1.1	0.5	47	0.19	0.019	0.14	0.63	0.12	0.22	6.9

***Table 15**. Exceedances of the Illinois WQS for single value chloride concentration of 500 mg/L in the NBWW 2020-21 survey area.*

Site ID	River	Year	River Mile	Dates	Result mg/L	Chloride Criterion	Chloride Standard	2020	2021
				Skokie River					
SR1	Skokie River	2020	21.10	11-Feb-20	816	>500 mg/L	Single Value	3	
SR2	Skokie River	2020	17.40	11-Feb-20	674	>500 mg/L	Single Value		
SR3	Skokie River	2020	14.80	11-Feb-20	551	>500 mg/L	Single Value		
SR2	Skokie River	2021	17.40	12-May-21	554	>500 mg/L	Single Value		11
SR3	Skokie River	2021	14.80	12-May-21	507	>500 mg/L	Single Value		
SR6	Skokie River	2021	7.40	12-May-21	503	>500 mg/L	Single Value		
SR1	Skokie River	2021	21.10	23-Feb-21	2530	>500 mg/L	Single Value		
SR2	Skokie River	2021	17.40	23-Feb-21	2260	>500 mg/L	Single Value		
SR3	Skokie River	2021	14.80	23-Feb-21	2470	>500 mg/L	Single Value		
SR4	Skokie River	2021	11.30	23-Feb-21	1460	>500 mg/L	Single Value		
SR5	Skokie River	2021	8.00	23-Feb-21	1790	>500 mg/L	Single Value		
SR7	Skokie River	2021	3.00	23-Feb-21	618	>500 mg/L	Single Value		
SR18	Skokie River	2021	0.50	23-Feb-21	509	>500 mg/L	Single Value		
SR6	Skokie River	2021	7.40	25-Feb-21	1090	>500 mg/L	Single Value		
				Middle Fork N. Branch Chicago River					
MF8	Middle Fork	2020	21.10	13-Feb-20	609	>500 mg/L	Single Value	5	
MF9	Middle Fork	2020	18.90	13-Feb-20	618	>500 mg/L	Single Value		
MF12	Middle Fork	2020	10.80	13-Feb-20	542	>500 mg/L	Single Value		
MF13	Middle Fork	2020	8.60	13-Feb-20	656	>500 mg/L	Single Value		
MF14	Middle Fork	2020	6.00	13-Feb-20	518	>500 mg/L	Single Value		
MF8	Middle Fork	2021	21.10	14-May-21	1050	>500 mg/L	Single Value		28 (34 total)
MF9	Middle Fork	2021	18.90	14-May-21	850	>500 mg/L	Single Value		
MF10	Middle Fork	2021	16.70	14-May-21	652	>500 mg/L	Single Value		
MF11	Middle Fork	2021	14.10	14-May-21	626	>500 mg/L	Single Value		
MF12	Middle Fork	2021	10.80	14-May-21	641	>500 mg/L	Single Value		
MF13	Middle Fork	2021	8.60	14-May-21	646	>500 mg/L	Single Value		
MF14	Middle Fork	2021	6.00	14-May-21	631	>500 mg/L	Single Value		
MF15	Middle Fork	2021	4.00	14-May-21	624	>500 mg/L	Single Value		
MF8	Middle Fork	2021	21.10	18-Aug-21	635	>500 mg/L	Single Value		
MF9	Middle Fork	2021	18.90	18-Aug-21	597	>500 mg/L	Single Value		
MF10	Middle Fork	2021	16.70	18-Aug-21	567	>500 mg/L	Single Value		
MF11	Middle Fork	2021	14.10	18-Aug-21	567	>500 mg/L	Single Value		
MF12	Middle Fork	2021	10.80	18-Aug-21	563	>500 mg/L	Single Value		
MF13	Middle Fork	2021	8.60	18-Aug-21	580	>500 mg/L	Single Value		
MF14	Middle Fork	2021	6.00	18-Aug-21	571	>500 mg/L	Single Value		
MF15	Middle Fork	2021	4.00	18-Aug-21	560	>500 mg/L	Single Value		
MF8	Middle Fork	2021	21.10	24-Feb-21	1890	>500 mg/L	Single Value		
MF9	Middle Fork	2021	18.90	24-Feb-21	1360	>500 mg/L	Single Value		
MF10	Middle Fork	2021	16.70	24-Feb-21	1130	>500 mg/L	Single Value		
MF11	Middle Fork	2021	14.10	24-Feb-21	961	>500 mg/L	Single Value		
MF12	Middle Fork	2021	10.80	24-Feb-21	1090	>500 mg/L	Single Value		
MF13	Middle Fork	2021	8.60	24-Feb-21	1470	>500 mg/L	Single Value		
MF14	Middle Fork	2021	6.00	24-Feb-21	1420	>500 mg/L	Single Value		
MF15	Middle Fork	2021	4.00	24-Feb-21	1520	>500 mg/L	Single Value		
MF19	Middle Fork	2021	18.60	25-Feb-21	1130	>500 mg/L	Single Value		
MF19	N. Br. Chicago R.	2021	18.60	25-Feb-21	1130	>500 mg/L	Single Value		
MF16	Middle Fork	2021	3.00	25-Feb-21	852	>500 mg/L	Single Value		
MF17	Middle Fork	2021	1.80	25-Feb-21	876	>500 mg/L	Single Value		

***Table 15**. continued.*

Site ID	River	Year	River Mile	Dates	Result mg/L	Chloride Criterion	Chloride Standard	2020	2021
MF8	Middle Fork	2021	21.10	27-Jul-21	909	>500 mg/L	Single Value		6 (34 total)
MF9	Middle Fork	2021	18.90	27-Jul-21	800	>500 mg/L	Single Value		
MF10	Middle Fork	2021	16.70	27-Jul-21	542	>500 mg/L	Single Value		
MF13	Middle Fork	2021	8.60	27-Jul-21	501	>500 mg/L	Single Value		
MF8	Middle Fork	2021	21.10	28-Sep-21	636	>500 mg/L	Single Value		
MF9	Middle Fork	2021	18.90	28-Sep-21	600	>500 mg/L	Single Value		
West Fork									
WF23	West Fork	2020	4.90	12-Feb-20	627	>500 mg/L	Single Value	3	
WF24	West Fork	2020	2.90	12-Feb-20	837	>500 mg/L	Single Value		
WF25	West Fork	2020	1.30	12-Feb-20	941	>500 mg/L	Single Value		
WF20	West Fork	2021	12.50	13-May-21	669	>500 mg/L	Single Value		9
WF21	West Fork	2021	10.40	13-May-21	665	>500 mg/L	Single Value		
WF25	West Fork	2021	1.30	13-May-21	544	>500 mg/L	Single Value		
WF20	West Fork	2021	12.50	25-Feb-21	1240	>500 mg/L	Single Value		
WF21	West Fork	2021	10.40	25-Feb-21	1330	>500 mg/L	Single Value		
WF22	West Fork	2021	9.20	25-Feb-21	1300	>500 mg/L	Single Value		
WF23	West Fork	2021	4.90	25-Feb-21	1470	>500 mg/L	Single Value		
WF24	West Fork	2021	2.90	25-Feb-21	1290	>500 mg/L	Single Value		
WF25	West Fork	2021	1.30	25-Feb-21	1370	>500 mg/L	Single Value		
							Totals	**11**	**54**

concentrations for Illinois streams and rivers. The newer NE Illinois IPS thresholds are based on analyses against the most sensitive species to each sediment metal and PAH parameter (MBI 2022a). Sediment metal sampling results from 2020 and 2021 are summarized by concentration rating and parameter class in Table 16 and polycyclic aromatic hydrocarbon (PAHs) compounds in Table 17. PAHs result from the incomplete combustion of hydrocarbons and are a common component of stormwater runoff in urban areas – they are not a direct byproduct of any manufacturing process.

Metals in Sediment

Elevated levels of heavy metals in are commonly associated with runoff from roads and highways and industrial and municipal sources. These occurred throughout the NBWW survey area with aluminum being the most prevalent (Table 16) the same as in 2018-19. Exceedances of poor and very poor NE Illinois IPS thresholds were observed for aluminum (14 of 24 sites; 20 of 25 in 2018-19), zinc (8 sites; 16 in 2018-19), nickel (8 sites; 9 in 2018-19), copper (7 sites; 14 in 2018-19), lead (6 sites; 11 in 2018-19) chromium (4 sites; 7 in 2018-19), and manganese (1 site; 3 in 2018-19). A single exceedance of the PEC for mercury was observed at site MF17 (RM 1.8) in 2020, down from 3 TEC and one PEC exceedance in 2018-19. Cadmium was not detected at 15 sites with the remaining 10 in the good range – all sites had detections in 2018-19, all in the good range. Arsenic, barium, and strontium were consistently in the good range along with all except one very poor manganese and the PEC for mercury. Six parameters including boron, beryllium, cobalt, potassium, sodium, and vanadium do not have effect thresholds.

***Table 16**. Heavy metal concentrations (mg/kg) in sediment at 25 sites in the NBWW survey area 2020-21. Highlighted cells indicate an exceedance of one or more of the effect thresholds listed at the bottom.*

Site ID	River Mile	Drainage Area (sq. mi.)	Year	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (µg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Silver (mg/kg)	Sodium (mg/kg)	Strontium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
Skokie River																							
SR1	21.1	2.70	2020	11000	5.4	70	ND	13	ND	20.0	8.3	30	20000	23	750	35	18	2400	ND	560	36	24	140
SR2	17.4	7.80	2020	8800	4.2	49	ND	12	0.49	23.0	6.7	29	12000	62	340	160	15	1900	ND	390	25	19	160
SR3	14.8	11.50	2020	2600	2.2	13	ND	ND	ND	7.3	3.5	8.8	6200	11	200	ND	6.2	620	ND	170	16	8.2	41
SR4	11.3	15.00	2020	9200	5.6	62	ND	13	ND	17.0	8.3	31	16000	28	610	100	18	2300	ND	310	44	20	130
SR5	8.0	20.60	2020	6300	3.6	39	ND	11	ND	13.0	5.6	25	11000	22	390	100	12	1600	ND	280	46	15	94
SR6	7.4	21.50	2020	3900	2.2	21	ND	ND	0.31	9.0	3.9	18	7200	16	220	67	8.2	1000	ND	210	27	10	78
SR7	3.0	23.70	2020	13000	4.8	88	0.98	13	0.49	19.0	8.8	43	15000	20	220	76	26	2000	ND	330	54	30	65
SR18	0.5	30.90	2020	7600	4.1	53	ND	12	ND	19.0	6.0	36	13000	38	380	44	15	1800	ND	280	34	16	110
Middle Fork North Branch Chicago River																							
MF8	21.1	5.81	2021	9900	6.2	69	0.95	12	ND	20.0	9.8	25	20000	21	650	54	23	2000	ND	1100	43	25	110
MF9	18.9	8.91	2021	15000	4.6	86	1.1	17	0.69	27.0	12.0	47	21000	34	420	110	33	2900	ND	1300	61	30	160
MF10	16.7	11.90	2021	7600	3.7	52	ND	ND	ND	16.0	7.8	25	15000	16	620	49	19	1800	ND	860	76	18	89
MF11	14.1	16.11	2021	9300	4.0	55	ND	12	0.75	18.0	9.0	38	16000	22	510	50	20	2000	ND	600	48	22	120
MF12	10.8	19.23	2021	9100	6.4	56	0.85	10	ND	17.0	11.0	22	20000	16	600	40	23	2000	ND	340	32	22	70
MF13	8.6	20.96	2021	8300	4.0	53	ND	ND	ND	17.0	8.4	30	16000	25	470	70	18	1700	ND	460	39	19	110
MF14	6.0	22.48	2021	7800	5.5	53	ND	ND	ND	15.0	9.5	24	19000	19	680	65	18	1600	ND	320	26	19	78
MF15	4.0	24.29	2021	9300	12.0	71	ND	ND	ND	18.0	13.0	29	27000	25	1100	67	23	1800	ND	430	38	27	110
MF16	3.0	56.10	2020	8000	4.0	57	ND	13	ND	16.0	6.3	36	14000	45	430	89	14	1900	ND	380	36	17	120
MF17	1.8	57.30	2020	13000	5.5	87	ND	19	0.61	27.0	8.8	50	19000	140	520	230	22	3000	ND	430	45	24	190
West Fork North Branch Chicago River																							
WF20	12.5	3.87	2021	1100	3.7	48	ND	17	ND	19.0	9.2	24	17000	13	460	40	24	2900	ND	590	38	24	76
WF21	10.4	7.02	2021	10000	3.8	64	0.86	14	0.46	24.0	7.6	55	16000	31	360	120	22	2500	ND	740	45	24	180
WF22	9.2	9.41	2021	14000	4.5	130	ND	22	ND	33.0	9.8	110	24000	30	680	100	27	3600	ND	1200	75	29	290
WF23	4.9	17.86	2021	4600	3.2	41	ND	10	ND	15.0	5.2	31	11000	16	360	34	12	1200	ND	370	44	13	110
WF24	2.9	24.52	2021	12000	4.0	100	ND	17	0.62	27.0	9.8	56	22000	31	700	98	25	2900	ND	700	60	27	200
WF25	1.3	27.97	2021	7400	2.9	64	ND	12	0.58	26.0	7.1	50	14000	64	370	90	18	1700	ND	490	43	18	170
North Branch Chicago River																							
MF19	18.6	93.40	2020	6000	2.3	50	ND	9.3	ND	14.0	5.4	21	10000	29	420	100	11	1400	ND	240	28	13	80
MacDonald et al. 2000			TEC		9.8	None			0.99	43.4		31.6	20000	35.8	460	180	22.7		1.6				121
			PEC		*33.0*				*4.98*	*111.0*		*149*	*40000*	*128*	*1100*	*1060*	*48.6*		*2.2*				*459*
Short 1998			Elevated	None	7.2	145			2.00	37.0		37	26100	60	1100	280	26		None		None		170
			Highly Elevated		18.0	230			9.30	110.0		170	53000	245	2300	1400	45		5				760
NE IL IPS			Excellent		None	None	None	None	None	<20.53	None	<19.00		<15.50	<841.0		None	None	None	None		None	<75.0
			Good	<6480	<8.65	<141.0			<0.933	<23.30		<29.78		<24.80	<845.5		<19.50		<0.483		<81.80		<100.0
			Fair	>6480	>8.65	>141.0			>0.933	>23.30		>29.78	None	>24.80	>845.5	None	>19.50		>0.483		>81.80		>100.0
			Poor	>8272	>15.82	>150.3			>1.354	>26.22		>40.45		>33.04	>996.8		>22.52		>1.261		>106.8		>133.9
			Very Poor	>10064	>23.67	>168.7			>1.963	>29.15		>51.12		>41.27	>1148		>25.53		>2.039		>131.9		>167.8

The West Fork had the highest proportion of very poor and poor exceedances for 17 of 66 analytes (25.5%), followed by the Middle Fork with 16 of 110 analyses (14.5%), and the Skokie River with the least with 10 of 88 analytes (11.4%). The source of the heavy metals are overwhelmingly of nonpoint source origin which is common in heavily urbanized watersheds. There were more exceedances of poor and very poor thresholds in the 2018-19 results compared to 2020-21 for most of the metals with thresholds. This could possibly be the result of more runoff in 2018-19 compared to 2020-21, the later year having the lowest flows of any year.

The applicability of thresholds between the MacDonald et al. (2000), Short (1998), and the NE Illinois IPS thresholds was variable with the IPS being the most consistently available set of thresholds. Exceedances were evaluated primarily against the IPS thresholds with any exceedances of MacDonald et a. (2000) or Short (1998) additionally recognized. Only one exceedance of a MacDonald et al. (2020) PEC occurred for manganese at MF15 and mercury at MF17. Otherwise all exceedances were based on the IPS thresholds which were consistently lower than MacDonald et al. (2020) and Short (1998).

PAH Compounds in Sediment

Most of the detected PAH compounds are in coal tar, gasoline exhaust, tires, and/or products of the incomplete combustion of coal and oil - several are known carcinogens. Some are used in manufacturing processes. They commonly occur at elevated levels in urban areas with asphalt pavement and heavy automobile traffic and presumably enter streams via stormwater runoff. Multiple PAH compounds were elevated at nearly every site sampled in the NBWW 2020-21 survey area with numerous poor very poor IPS threshold values and MacDonald et al. (2000) PEC threshold exceedances observed. Only 10 excellent/good values were observed in the entire study area in 2020-21 (Table 17), up from 7 in 2018-19. Most fair values were located in the Middle Fork with a majority of the poor, very poor, and PEC exceedances in the West Fork (Table 17), which is similar to 2018-19. Benz(b)anthracene, benzo[a}pyrene, benzo[b]fluoranthene concentrations were poor, very poor, or exceeding the PEC at most sites in the NBWW 2020-21 survey area. Fluoranthene, phenanthrene, and pyrene concentrations also exceeded the IPS very poor threshold at most sites, but fair and poor values were recorded in the Middle Fork. Only acenaphthene and acenaphthylene were not detected at any site while fluorene was detected at all sites with the greatest exceedances in the Skokie River and West Fork. The IPS thresholds coincided with the MacDonald et al. (2000) PEC/TEC values with the former generally less than the IPS good level and the latter only roughly consistent with the IPS poor and very poor values. There were considerably more very poor values than non-detected PAHs with these chemicals being ubiquitous throughout the study area. The West Fork had the highest incidence of poor, very poor, or >PEC values for 71 of 84 analytes (84.5%), followed by the Skokie River with 69 of 112 analytes (61.6%), and the Middle Fork with 56 of 154 analytes (36.4%). The high proportion of urban land uses in each subwatershed increases the presence and concentrations of PAHs. Runoff from roads, parking lots, deposition of gas and oil combustion processes, and industrial centers being the most likely sources.

***Table 17**. Sediment PAH levels (mg/kg) in sediments at 25 sites in the NBWW 2020-21 survey area. Highlighted cells indicate an exceedance of one or more of the effect thresholds listed at the bottom (TEC – threshold effect concentration; PEC – probable effect concentration; ND – not detected).*

Site ID	River Mile	Drainage Area (sq. mi.)	Year	Acenaphtene (µg/kg, dry)	Acenaphthylene (µg/kg, dry)	Anthracene (µg/kg, dry)	Benzo[a]anthracene (µg/kg, dry)	Benzo[a]pyrene (µg/kg, dry)	Benzo[b]fluoranthene (µg/kg, dry)	Benzo[g,h,i]perylene (µg/kg, dry)	Benzo[k]fluoranthene (µg/kg, dry)	Chrysene (µg/kg, dry)	Dibenzo[a,h]anthracene (µg/kg, dry)	Fluoranthene (µg/kg, dry)	Fluorene (µg/kg, dry)	Indeno[1,2,3-cd]pyrene (µg/kg, dry)	Phenanthrene (µg/kg, dry)	Pyrene (µg/kg, dry)
Skokie River																		
SR1	21.1	2.70	2020	ND	ND	ND	960	*1900*	3500	*1400*	1300	*2200*	ND	*3200*	ND	1200	820	*2700*
SR2	17.4	7.80	2020	ND	ND	ND	760	970	1800	*620*	ND	1200	ND	*2300*	ND	ND	920	*2000*
SR3	14.8	11.50	2020	ND	ND	390	*1300*	1400	2100	*680*	500	*1600*	ND	*3800*	230	600	*2500*	*3500*
SR4	11.3	15.00	2020	1300	ND	*2400*	*6700*	*6700*	9700	*3900*	2900	*8100*	*960*	*18000*	*1600*	*3200*	*14000*	*19000*
SR5	8.0	20.60	2020	ND	ND	930	*3300*	*3800*	5200	*2000*	1500	*4100*	ND	*9100*	ND	1700	*5800*	*8900*
SR6	7.4	21.50	2020	ND	ND	620	*2400*	*2900*	4400	*1600*	1500	*3200*	ND	*7000*	ND	1400	*3700*	*6700*
SR7	3.0	23.70	2020	ND	ND	ND	ND	ND	83	ND	ND	ND	ND	98	ND	ND	ND	79
SR18	0.5	30.90	2020	ND	ND	580	*2200*	*2500*	3600	*1400*	1100	*2700*	ND	*6200*	ND	1200	3500	*5400*
Middle Fork North Branch Chicago River																		
MF8	21.1	5.81	2021	ND	ND	240	*1600*	*2500*	4800	*1100*	1600	*2900*	*370*	*7100*	ND	1300	*2400*	*4200*
MF9	18.9	8.91	2021	ND	ND	ND	470	690	1200	*450*	470	820	ND	*1600*	ND	510	430	990
MF10	16.7	11.90	2021	ND	ND	ND	ND	310	590	ND	ND	370	ND	760	ND	ND	240	450
MF11	14.1	16.11	2021	ND	ND	ND	740	940	1600	*460*	510	1000	ND	*2700*	ND	540	1000	*1600*
MF12	10.8	19.23	2021	ND	ND	160	670	830	1400	*380*	470	930	ND	2100	ND	440	820	1300
MF13	8.6	20.96	2021	ND	ND	ND	770	1100	2000	*580*	730	*1300*	ND	*2800*	ND	690	800	*1600*
MF14	6.0	22.48	2021	ND	ND	230	730	780	1200	310	440	810	ND	2000	ND	360	900	1300
MF15	4.0	24.29	2021	ND	ND	ND	670	1000	1900	*540*	670	1200	ND	*2500*	ND	630	810	1500
MF16	3.0	56.10	2020	ND	ND	ND	*1300*	*1800*	2700	*1100*	990	*2000*	ND	*3700*	ND	1000	*1300*	*3300*
MF17	1.8	57.30	2020	ND	ND	ND	*1600*	*2300*	3700	*1600*	1200	*2500*	ND	*5200*	ND	1300	*2100*	*4200*
West Fork North Branch Chicago River																		
WF20	12.5	3.87	2021	ND	ND	ND	770	1200	2500	*600*	760	*1500*	ND	*3600*	ND	710	1000	*1900*
WF21	10.4	7.02	2021	220	ND	670	*3900*	*5700*	10000	*3700*	3100	*6900*	*1000*	*16000*	320	*3900*	*5600*	*9100*
WF22	9.2	9.41	2021	ND	ND	730	*4800*	*7600*	*16000*	*3600*	5300	*9100*	*1000*	*21000*	ND	*4000*	*6000*	*12000*
WF23	4.9	17.86	2021	230	ND	*1100*	*5500*	*7200*	11000	*2900*	4700	*7900*	*890*	*20000*	340	*3200*	*6800*	*11000*
WF24	2.9	24.52	2021	ND	ND	500	*2900*	*4500*	9300	*2200*	3400	*5200*	*650*	*12000*	ND	2500	*3500*	*6700*
WF25	1.3	27.97	2021	390	ND	*1100*	*4000*	*5100*	9100	*2200*	3200	*5700*	*680*	*15000*	450	2500	*5600*	*8100*
North Branch Chicago River																		
MF19	18.6	93.40	2020	ND	ND	710	*3300*	*4000*	5700	*2200*	1400	*4300*	ND	*9400*	ND	1900	*5200*	*8700*
MacDonald et al. 2000			TEC	None	None	57.2	108	150	240	170	240	166	33	423	77.4	200	204	195
			PEC			*845*	*1050*	*1450*	*13,400*	*320*	*13,400*	*1,290*	*135*	*2,230*	*536*	*3,200*	*1,170*	*1,520*
NE IL IPS			Exc./Good	<84.25		<78.00	<239.0	<230	<207.0	<335.0	<520.8	<266.0	<101.0	<774.0	<84.25	<260.5	<243.5	<393.0
			Fair	>84.25		>78.00	>239.0	>230	>207.0	>335.0	>520.8	>266.0	>101.0	>774.0	>84.25	>260.5	>243.5	>393.0
			Poor	>104.8		>119.9	>699.4	>798.3	>434.7	>792.1	>1437	>958.3	>167.3	>2432	>104.8	>623.3	>803.3	>1570
			V. Poor	>125.3		>161.8	>1160	>1367	>662.4	>1249.0	>2354	>1651	>233.7	>4091	>125.3	>986.2	>1363	>2747

Physical Habitat Quality for Aquatic Life – QHEI

The physical habitat of a stream or river is a primary determinant of biological quality and potential. Streams in the glaciated Midwest, left in their natural state, typically offer pool-run-riffle sequences, moderate to high sinuosity, and well-developed channels with deep pools, heterogeneous substrates, and cover in the form of woody debris, hard substrates, and aquatic macrophytes. Lower gradient streams may not offer as distinct riffle habitats and are oftentimes run and glide dominated, but can still offer a diversity of substrates, well developed pool habitats, and well-developed instream cover features associated with woody debris and aquatic macrophytes. The Qualitative Habitat Evaluation Index (QHEI) categorically scores basic components of stream and riverine habitat into ranks according to the degree to which those components are found compared to a natural state, or conversely, in an altered or modified state. In the NBWW study area, QHEI scores and physical habitat attributes were recorded in conjunction with the fish sampling conducted at each site. Examples of the range of habitat offered in the study area are the Middle Fork at sites MF11 (Figure 30) and MF14 (Figure 31) in 2021, the latter offering the best habitat in the study area and the former reflecting ongoing and legacy modifications to the stream channel.

Based on the QHEI scores and the number and ratios of good and modified attributes (after Rankin 1989, 1995; Table 18 and Figure 32), overall habitat quality in 2020-21 ranged from poor (20 sites - 19 in 2018-19) to fair (five sites) with three of the fair sites in the lower Middle Fork and one each in the West Fork (WF 24) and Skokie R. (SR04). The IPS derived QHEI thresholds for the five narrative categories were used and these are more stringent than the prior usage of narrative ratings from Ohio. The fair ratings for the Middle Fork North Branch sites located in the lower section (MF13, MF14, and MF15) resulted from a comparatively lower number of highly modified attributes. Other than MF14, these sites still had numerous moderate modified attributes and with very few good habitat attributes (Table 18). The highest habitat score in the NBWW 2020-21 survey area was recorded at WF14 (MF 14 in 2018-19), which had seven (7) good and six (6) modified attributes with a 0.86 ratio of modified:good attributes (Good; Table 18). This site reflected a continuation of some of the same issues affecting upstream habitat scores. It was still recovering from past channelization, there were no fast current types, it had moderate to high silt cover and moderate to high embeddedness of the natural substrates. Moderate and high influence modified habitat attributes were common throughout the NBWW survey area in 2018-19 and 2020-21.

The 19 sites which rated poor were apportioned across each of the three subwatersheds. The Skokie River offered poor habitat throughout its length while only modest improvements in habitat were observed in the downstream sections of both the Middle and West Forks of the North Branch Chicago River. The mainstem of the North Branch offered poor quality habitat as judged by the IPS thresholds. Moderate and high influence modified attributes outnumbered good attributes at 24 of the 25 sites in the NBWW survey area. Of these, 20 had at least one high influence modified attribute and fifteen (15) had multiple high influence modified attributes. Only two sites had a modified:good ratio <2.0 while four had very poor (>6.0), eight poor (>4.0) and 11 fair (>2.0) ratios (Table 12). Ratios <2.0 generally can support minimum

Figure 30*. Riparian habitat modification in the form of tree removal at site MF11 (RM 16.1) at Illinois St. Rt. 22 leaving stumps that will eventually give way to scouring flows. Legacy channel modification is evident as it is at most sites in the NBWW survey area.*

Figure 31*. The Middle Fork North Branch Chicago River downstream from Sunset Drive (MF14) in 2019. Only nine (9) of the twenty-five (25) sites in the NBWW survey area had riffle habitats all of which were moderately to extensively embedded at every site and some were the result of channel restrictions formed by bridge abutments.*

***Table 18**. QHEI matrix of good (■) and high influence (●) and moderate influence (●) modified habitat attributes at 25 sites in the NBWW study area during 2020-21. QHEI scores are shaded in accordance with IPS derived narrative ratings; green – Good; yellow – Fair; orange – Poor; red – Very Poor).*

Site ID	River Mile	QHEI	Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
			No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	Good Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	< 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle Embeddedness	No Riffle	Poor Habitat Attributes	Ratio of Modified (High) to Good	Ratio of Modified (All) to Good
Skokie River - 2020																																		
SR1	21.10	**37.0**						■					1	●	●	●		●	4		●			●				●	●		●	5	4.0	9.00
SR2	17.40	**38.0**						■			■		2	●	●	●	●		4		●			●				●	●		●	5	2.0	4.50
SR3	14.80	**48.0**		■		■		■			■		4		●	●			2	●	●			●				●	●		●	6	0.5	2.00
SR4	11.30	**52.5**	■	■		■		■			■		5			●			1	●	●			●				●	●		●	6	0.2	1.40
SR5	8.00	**46.8**						■			■		2	●	●	●			3		●			●				●	●		●	5	1.5	4.00
SR6	7.40	**39.5**						■			■		2	●	●	●			3		●			●				●	●		●	5	1.5	4.00
SR7	3.00	**38.0**					■	■			■		3		●				1		●			●				●	●		●	5	0.3	2.00
SR18	0.50	**41.5**						■			■		2	●	●				2		●			●	●			●	●		●	6	1.0	4.00
Middle Fork North Branch Chicago River - 2021																																		
MF08	21.10	**29.0**						■			■		2		●				1	●	●			●	●			●	●		●	7	0.5	4.00
MF09	18.90	**31.5**		■				■			■		3	●		●			2		●			●				●	●		●	5	0.7	2.33
MF10	16.70	**41.0**						■					1	●	●			●	3		●			●	●			●	●		●	6	3.0	9.00
MF11	14.10	**44.0**						■			■		2	●	●	●			3		●			●				●	●		●	5	1.5	4.00
MF12	10.80	**45.5**		■				■			■		3	●					1		●			●	●			●	●		●	6	0.3	2.33
MF13	8.60	**60.0**						■			■		2	●					1		●			●	●			●	●		●	6	0.5	3.50
MF14	6.00	**64.5**						■			■		2	●		●			2		●			●				●	●		●	5	1.0	3.50
MF15	4.00	**55.5**		■			■	■			■		4						0	●	●			●	●			●	●	●		7	0.0	1.75
Middle Fork North Branch Chicago River - 2020																																		
MF16	3.00	**38.5**	■	■		■	■	■			■		6						0		●							●	●	●		4	0.0	0.67
MF17	1.80	**45.8**				■	■				■		3				●		1	●	●			●				●	●	●		6	0.3	2.33
West Fork North Branch Chicago River - 2021																																		
WF20	12.50	**30.5**						■			■		2	●	●				2		●			●	●			●	●		●	6	1.0	4.00
WF21	10.40	**42.0**		■						■			2			●	●	●	3	●	●			●		●		●	●	●		7	1.5	5.00
WF22	9.20	**46.5**		■				■			■		3	●					1		●			●	●			●	●		●	6	0.3	2.33
WF23	4.90	**41.0**						■			■		2	●	●				2		●			●	●			●	●		●	6	1.0	4.00
WF24	2.90	**66.0**	■	■		■	■	■			■	■	7						0	●	●			●				●	●	●		6	0.0	0.86
WF25	1.30	**48.0**						■			■		2						0	●	●			●	●			●	●	●		7	0.0	3.50
North Branch Chicago River - 2020																																		
MF19	18.60	**48.5**		■		■		■			■		4						0	●	●			●	●			●	●		●	7	0.0	1.75
	Excellent	≥81.3											9						0													0	0	<0.50
	Good	69.3-81.0											8						0													2	<0.5	<2.00
	Fair	50.1-69.0											>2						1													≤5	≤1.00	≥2.00
	Poor	25-50											≤2						2													6	≤2.00	≥4.00
	Very Poor	<25											0						5													>6	>2.00	≥6.00

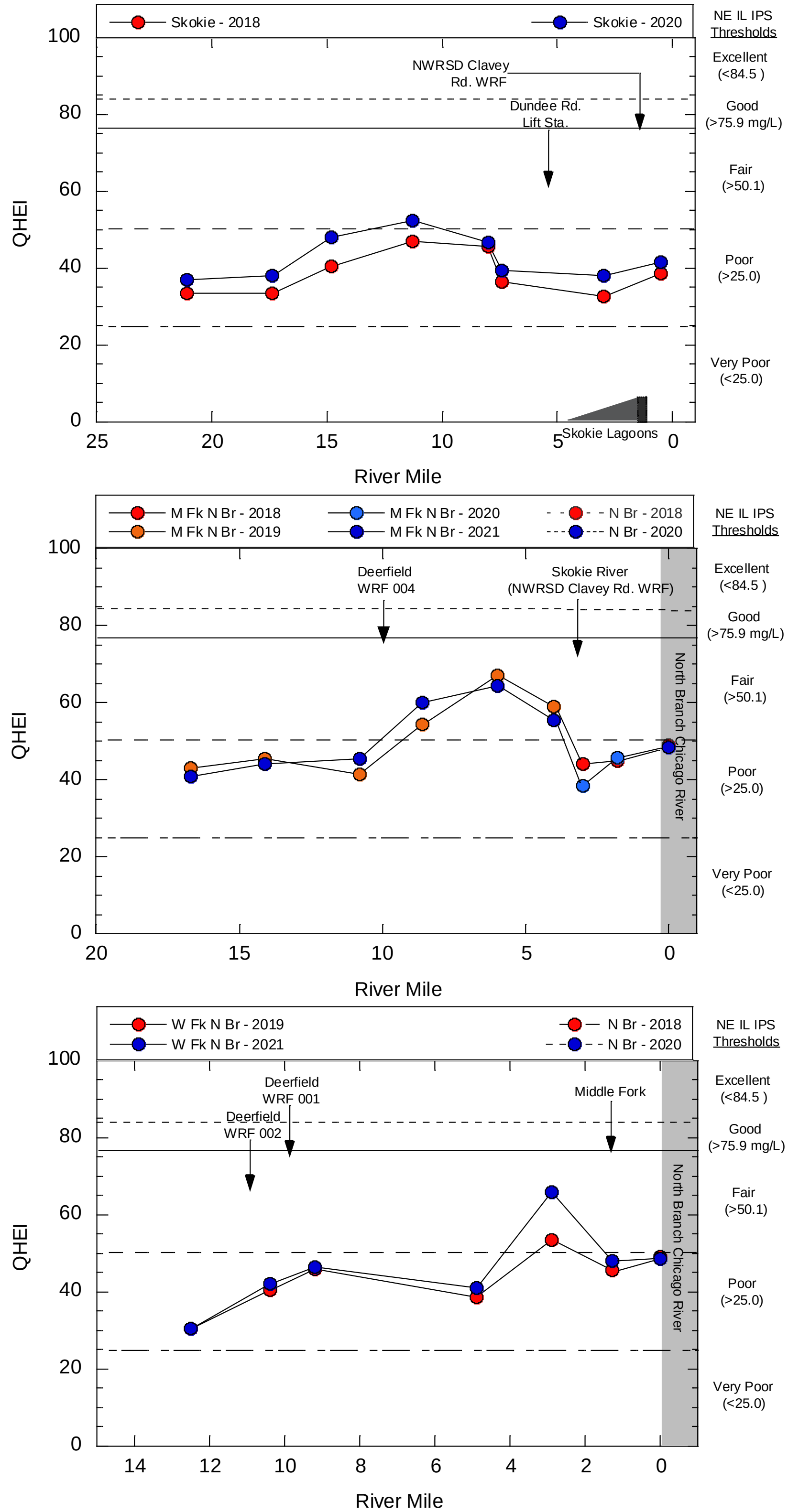


***Figure 32**. Qualitative Habitat Evaluation Index (QHEI) scores in the Skokie River (2020), the Middle Fork (2020-21), and the West Fork (2021). The IPS narrative ranges of QHEI scores from excellent to very poor are indicated by solid and dashed lines.*

biological goals such as the Illinois General Uses, but ratios >2.0 generally indicate a proportion of modified attributes that would require direct mitigation to reverse. It also means that meeting the General Use biocriteria would likely be precluded by habitat regardless of water quality conditions, thus raising concerns about use attainability (Rankin 1995). The sites with ratios <2.0 are the result of having fewer modified attributes coupled with enough good attributes to offset the negative influence of the modified attributes. All sites within the NBWW survey area lacked fast current types, possessed moderate to extensive silt coverage and all except one site had moderate to extensive embeddedness of natural substrates and fair to poor development. Most sites lacked riffles and of the sites that had riffles, they were moderately to extensively embedded by sand or silt. Low sinuosity was observed at half the sites and nearly three quarters had not recovered from historic channelization. Given the list of channel modifications and other hydrological alterations in the MWRD 2011 North Branch Watershed Plan (HDR 2011) executing needed habitat improvements may prove difficult.

Biological Assemblages – Fish

Twenty-three (23) fish species and two (2) hybrids were collected in the NBWW 2020-21 survey area (Appendix A). The fish assemblage was predominated by tolerant and moderately tolerant species (Table 19). Gizzard Shad, Largemouth Bass, Bluegill Sunfish, Green Sunfish, Goldfish, Blackstripe Topminnow, White Sucker, Yellow Bullhead, Common Carp, and Golden Shiner were the most numerous species collected in 2020-21 combined. Common Carp, White Sucker, Bluegill Sunfish, Goldfish, Yellow Bullhead, Green Sunfish, Largemouth Bass, Common Carp X, Goldfish, Gizzard Shad, and Black Bullhead comprised the highest percentages of biomass. Of the ten most numerous species by numbers and weight six (6) are highly tolerant, two (2) are moderately tolerant. In total there were 11 highly tolerant and three moderately intolerant species with no sensitive of intolerant species. The species collected are common to highly disturbed streams and are adaptive to degraded water quality and modified habitat.

The Skokie River had 18 fish species and one (12) hybrid with Gizzard Shad, Largemouth Bass, Green Sunfish, Bluegill Sunfish, White Sucker, Golden Shiner, Blackstripe Topminnow, Yellow Bullhead, Common Carp, and Fathead Minnow being the numerically most abundant species (Table 19). The Skokie River fish assemblage included eight (8) tolerant and three (3) moderately tolerant species and no sensitive or intolerant species. Walleye were not collected in the Skokie Lagoons in 2020, but they were present in good numbers in 2018.

The Middle Fork N. Branch had 18 fish species and one (1) hybrid with Gizzard Shad, Blackstripe Topminnow, Bluegill Sunfish, Green Sunfish, Largemouth Bass, White Sucker, Yellow Bullhead Common Carp, Golden Shiner, and Central Mudminnow being the numerically most abundant species (Table 19). Two (7) Iowa Darters, a formerly Illinois threatened species, were collected, a result similar to 2018-19. The occurrence of species such as Central Mudminnow, Tadpole Madtom, Golden Shiner, and Iowa Darter reflect the low gradient and aquatic macrophyte dominated legacy of this system. The Middle Fork fish assemblage

***Table 19**. Fish species collected in the Skokie River in 2020 (upper), the Middle Fk. N. Branch in 2020-21 (middle), and the West Fork (lower) in 2021 arranged by numerical abundance. The tolerance codes for tolerant (T) moderately intolerant (P), and moderately intolerant species are indicated along with the number of samples within which each species occurred. No sensitive or intolerant species were collected.*

Skokie River 2020 Fish Grand Numbers and Biomass

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Rel. Number	% by Number	Average Weight (g)	Rel. Weight (kg)	% by Weight
20	003	GIZZARD SHAD	*Dorosoma cepedianum*		1620.5	34.13	4.94	6.922	5.67
77	006	LARGEMOUTH BASS	*Micropterus salmoides*		1252.5	26.38	33.99	8.008	6.56
77	008	GREEN SUNFISH	*Lepomis cyanellus*	T	519.0	10.93	12.49	6.020	4.93
77	009	BLUEGILL SUNFISH	*Lepomis macrochirus*	P	512.5	10.80	16.72	13.025	10.67
40	016	WHITE SUCKER	*Catostomus commersoni*	T	305.5	6.43	96.74	34.992	28.68
43	003	GOLDEN SHINER	*Notemigonus crysoleucas*	T	177.0	3.73	3.49	0.518	0.42
54	002	BLACKSTRIPE TOPMINNOW	*Fundulus notatus*		131.0	2.76	1.68	0.194	0.16
47	004	YELLOW BULLHEAD	*Ameiurus natalis*	T	65.0	1.37	63.17	3.005	2.46
43	001	COMMON CARP	*Cyprinus carpio*	T	33.0	0.70	991.56	42.070	34.48
43	042	FATHEAD MINNOW	*Pimephales promelas*	T	26.0	0.55	2.59	0.102	0.08
77	013	PUMPKINSEED SUNFISH	*Lepomis gibbosus*	P	25.0	0.53	32.00	0.860	0.70
43	002	GOLDFISH	*Carassius auratus*	T	21.5	0.45	79.58	1.560	1.28
47	006	BLACK BULLHEAD	*Ameiurus melas*	P	17.5	0.37	123.81	2.230	1.83
77	015	GREEN SF X BLUEGILL SF	*HYBRID*		15.0	0.32	55.33	0.730	0.60
77	012	REDEAR SUNFISH	*Lepomis microlophus*		14.0	0.29	61.43	0.860	0.70
47	013	TADPOLE MADTOM	*Noturus gyrinus*		5.5	0.12	8.75	0.045	0.04
43	043	BLUNTNOSE MINNOW	*Pimephales notatus*	T	3.0	0.06	2.00	0.006	0.00
47	002	CHANNEL CATFISH	*Ictalurus punctatus*		2.0	0.04	430.00	0.860	0.70
95	001	BROOK STICKLEBACK	*Culaea inconstans*		2.0	0.04	10.00	0.020	0.02

Middle Fork N. Branch River 2020 Fish Grand Numbers and Biomass

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Rel. Number	% by Number	Average Weight (g)	Rel. Weight (kg)	% by Weight
20	003	GIZZARD SHAD	*Dorosoma cepedianum*		551.0	20.55	18.80	4.105	2.45
54	002	BLACKSTRIPE TOPMINNOW	*Fundulus notatus*		429.5	16.02	1.82	0.618	0.37
77	009	BLUEGILL SUNFISH	*Lepomis macrochirus*	P	401.0	14.96	16.05	7.281	4.35
77	008	GREEN SUNFISH	*Lepomis cyanellus*	T	347.5	12.96	14.78	5.103	3.05
77	006	LARGEMOUTH BASS	*Micropterus salmoides*		327.0	12.20	45.23	3.478	2.08
40	016	WHITE SUCKER	*Catostomus commersoni*	T	219.0	8.17	121.76	33.377	19.94
47	004	YELLOW BULLHEAD	*Ameiurus natalis*	T	156.0	5.82	45.57	6.557	3.92
43	001	COMMON CARP	*Cyprinus carpio*	T	61.0	2.28	1355.00	102.225	61.07
43	003	GOLDEN SHINER	*Notemigonus crysoleucas*	T	60.5	2.26	6.75	0.196	0.12
34	001	CENTRAL MUDMINNOW	*Umbra limi*	T	34.0	1.27	5.27	0.120	0.07
77	015	GREEN SF X BLUEGILL SF	*HYBRID*		33.5	1.25	57.82	0.955	0.57
43	002	GOLDFISH	*Carassius auratus*	T	21.0	0.78	104.50	1.995	1.19
47	006	BLACK BULLHEAD	*Ameiurus melas*	P	14.0	0.52	78.00	1.020	0.61
43	043	BLUNTNOSE MINNOW	*Pimephales notatus*	T	12.0	0.45	3.75	0.038	0.02
47	013	TADPOLE MADTOM	*Noturus gyrinus*		4.5	0.17	6.67	0.031	0.02
43	013	CREEK CHUB	*Semotilus atromaculatus*	T	4.0	0.15	45.00	0.180	0.11
77	002	BLACK CRAPPIE	*Pomoxis nigromaculatus*		2.0	0.07	30.00	0.060	0.04
80	021	IOWA DARTER	*Etheostoma exile*		2.0	0.07	2.00	0.004	0.00
77	013	PUMPKINSEED SUNFISH	*Lepomis gibbosus*	P	1.5	0.06	30.00	0.045	0.03

West Fork N. Branch River 2020 Fish Grand Numbers and Biomass

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Rel. Number	% by Number	Average Weight (g)	Rel. Weight (kg)	% by Weight
43	002	GOLDFISH	*Carassius auratus*	T	897.0	53.16	27.36	17.764	20.07
43	001	COMMON CARP	*Cyprinus carpio*	T	261.0	15.47	432.32	44.625	50.41
47	004	YELLOW BULLHEAD	*Ameiurus natalis*	T	160.0	9.48	38.56	8.211	9.27
77	008	GREEN SUNFISH	*Lepomis cyanellus*	T	133.5	7.91	13.91	2.038	2.30
77	009	BLUEGILL SUNFISH	*Lepomis macrochirus*	P	133.0	7.88	12.03	1.582	1.79
77	006	LARGEMOUTH BASS	*Micropterus salmoides*		27.5	1.63	18.39	0.273	0.31
54	002	BLACKSTRIPE TOPMINNOW	*Fundulus notatus*		27.0	1.60	2.77	0.060	0.07
40	016	WHITE SUCKER	*Catostomus commersoni*	T	12.0	0.71	115.00	1.530	1.73
43	045	COMMON CARP X GOLDFISH	*HYBRID*	T	12.0	0.71	602.15	11.385	12.86
20	003	GIZZARD SHAD	*Dorosoma cepedianum*		7.5	0.44	38.75	0.285	0.32
43	003	GOLDEN SHINER	*Notemigonus crysoleucas*	T	6.0	0.36	25.00	0.135	0.15
47	006	BLACK BULLHEAD	*Ameiurus melas*	P	4.5	0.27	100.00	0.525	0.59
57	001	WESTERN MOSQUITOFISH	*Gambusia affinis*		2.0	0.12	2.00	0.004	0.00
34	001	CENTRAL MUDMINNOW	*Umbra limi*	T	1.5	0.09	10.00	0.015	0.02
43	043	BLUNTNOSE MINNOW	*Pimephales notatus*	T	1.5	0.09	5.00	0.008	0.01
77	015	GREEN SF X BLUEGILL SF	*HYBRID*		1.5	0.09	60.00	0.090	0.10

included nine (9) tolerant and three (3) moderately tolerant species and no sensitive or intolerant species present.

The West Fork had 14 fish species and two (2) hybrids with Goldfish, Common Carp, Yellow Bullhead, Green Sunfish, Bluegill Sunfish, Largemouth Bass, Blackstripe Topminnow, White Sucker, Common Carp X Goldfish, and Gizzard Shad being the numerically most abundant species (Table 19). The West Fork fish assemblage included nine (9) tolerant and two (2) moderately tolerant species and no sensitive or intolerant species.

Fish Assemblage
Fish IBI (fIBI) scores are either a single value for one pass or the mean of two sampling passes within the summer-early fall index period. The General Use biocriterion of 41 was not met at any site in 2020-21 (Table 20; Figure 33). In the Skokie River, poor scores were recorded at all sites except for the upstream most site SR1 (RM 21.1) which was very poor and the downstream site SR18 (RM 0.50) which was fair. The Middle Fork N. Branch sites were a mix of poor and very poor results. The West Fork was uniformly very poor with fIBI scores at all sites in that narrative range. The Modified Index of Well-Being (MIwb) has no formal biocriteria in Illinois, but using the Ohio biocriteria it failed to attain the Ohio equivalent of the General Use at zero (0) sites. The MIwb is calculated for wadeable and boatable sites with drainage areas >20 mi^2 and was therefore assessed at only 12 of the 25 sites in the 2020-21 NBWW survey area. Out of these 12 sites, three were fair, two in the lower Skokie River and a single site in the Middle Fork, eight (8) were poor, and a single site at MF13 (RM 8.6) was very poor.

The longitudinal plots for the Skokie River showed only a slight increase downstream in 2020 with all sites rated as non-support poor which was a slight decline from 2018 when two sites were in the margins of non-support fair (Figure 33). The Middle Fork showed similar results with all sites rated as non-support poor in 2020-21 slightly beneath two sites at the margins of non-support fair in 2081-19. The West Fork results showed little variation in the fIBI from upstream to downstream with all sites rated as non-support poor in both the 2019 and 2021 survey periods. The site in the West Fork downstream from E. Lake Ave. (WF24) showed a noticeable decline in the 2019 fIBI. This location is downstream of the Village of Glenview 1800 E. Lake Ave. lift station and where the highest median concentrations of ammonia-N and chlorides in 2019 were located. The Skokie River site (SR7), which attained a fair rating in 2018, was likely buoyed by stocking efforts by the Illinois DNR. Walleye, Northern Pike, Channel Catfish and Largemouth Bass are stocked annually (Illinois DNR 2020).

The Modified Index of Well-Being (MIwb) has no formal biocriteria in Illinois, but using the Ohio biocriteria it attained the Ohio equivalent of the General Use at no sites and was fair at the lower two sites in the Skokie River. The MIwb is calculated for wadeable and boatable sites with drainage areas >20 mi^2 and was therefore assessed at 12 of the 25 sites in the NBWW survey area. High proportions of tolerant fishes were observed at most sites in the 2020-21 survey

***Table 20**. Selected fish assemblage metrics and attributes at 25 sites sampled in the 2020-21 NBWW survey area. Biological index scores are shaded by level of use support: Exceptional – blue; Good (fully supporting) - green; Fair (non-support) - yellow; Poor (non-support) – orange; Very Poor - red; key metrics as signatures of toxic or organic enrichment impacts are based on Yoder and DeShon (2003).*

				Fish Assemblage						
Site ID	**River Mile**	**Drain-age Area (mi.^{2})**	**Year**	**fIBI**	**MIwb**	**Native Sp.**	**% DELT**	**Intoler-ant Sp.**	**%Mineral Spawn-ers**	**% Tolerant**
Skokie River										
SR1	21.10	2.70	2020	5.0	NA	1	0.0	0	0	50.0
SR2	17.40	7.80	2020	16.5		4	0.0	0	0	54.0
SR3	14.80	11.50	2020	23.0		7	0.0	0	0	58.5
SR4	11.30	15.00	2020	17.5		8	0.5	0	0	54.5
SR5	8.00	20.60	2020	23.5	3.9	6	0.0	0	0	41.5
SR6	7.40	21.50	2020	18.0	4.2	6	0.0	0	0	56.5
SR7	3.00	23.70	2020	15.0	7.0	10	0.0	0	0	40.0
SR18	0.50	30.90	2020	34.5	7.5	10	0.3	0	0	60.0
Middle Fork North Branch Chicago River										
MF8	21.10	5.81	2021	13.0	NA	4	0.0	0	0	25.0
MF9	18.90	8.91	2021	14.0		6	0.0	0	0	50.0
MF10	16.70	11.90	2021	12.0		2	0.0	0	0	0.0
MF11	14.10	16.11	2021	20.0		11	0.0	1	0	36.0
MF12	10.80	19.23	2021	15.0		6	0.0	0	0	50.0
MF13	8.60	20.96	2021	13.0	3.0	4	0.0	0	0	50.0
MF14	6.00	22.48	2021	15.0	5.5	8	0.0	0	0	50.0
MF15	4.00	24.29	2021	17.0	6.2	9	0.0	0	0	56.0
MF16	3.00	56.10	2020	21.0	4.8	9	0.0	0	0	61.5
MF17	1.80	57.30	2020	16.5	5.7	8	0.2	0	0	48.0
West Fork North Branch Chicago River										
WF20	12.50	3.87	2021	7.0	NA	3	0.0	0	0	67.0
WF21	10.40	7.02	2021	11.0		4	0.0	0	0	25.0
WF22	9.20	9.41	2021	9.0		5	0.0	0	0	80.0
WF23	4.90	17.86	2021	9.0		7	0.5	0	0	71.0
WF24	2.90	24.52	2021	10.0	5.0	7	1.7	0	0	86.0
WF25	1.30	27.97	2021	12.0	4.6	10	0.0	0	0	60.0
North Branch Chicago River										
MF19	18.60	93.40	2020	13.0	5.0	7	0.1	0	0	77.5
Narrative Categories and Thresholds		**Exceptional**		>50	>9.6	≥24	0	≥6	>44	≤16.1
		Good		≥41	>8.5	≥16	<1.3	≥4	>23	<30.3
		Fair		<41	>5.8	≤13	<3.0	<3	>10	<40
		Poor		<30	<5.8	≥9	>10	1	>5	≥50
		Very Poor		≤15	<4.0	<9	>20	0	0	≥70
		Source		**IEPA/MBI**	**MBI**	**MBI**	**MBI**	**MBI**	**MBI**	**MBI**

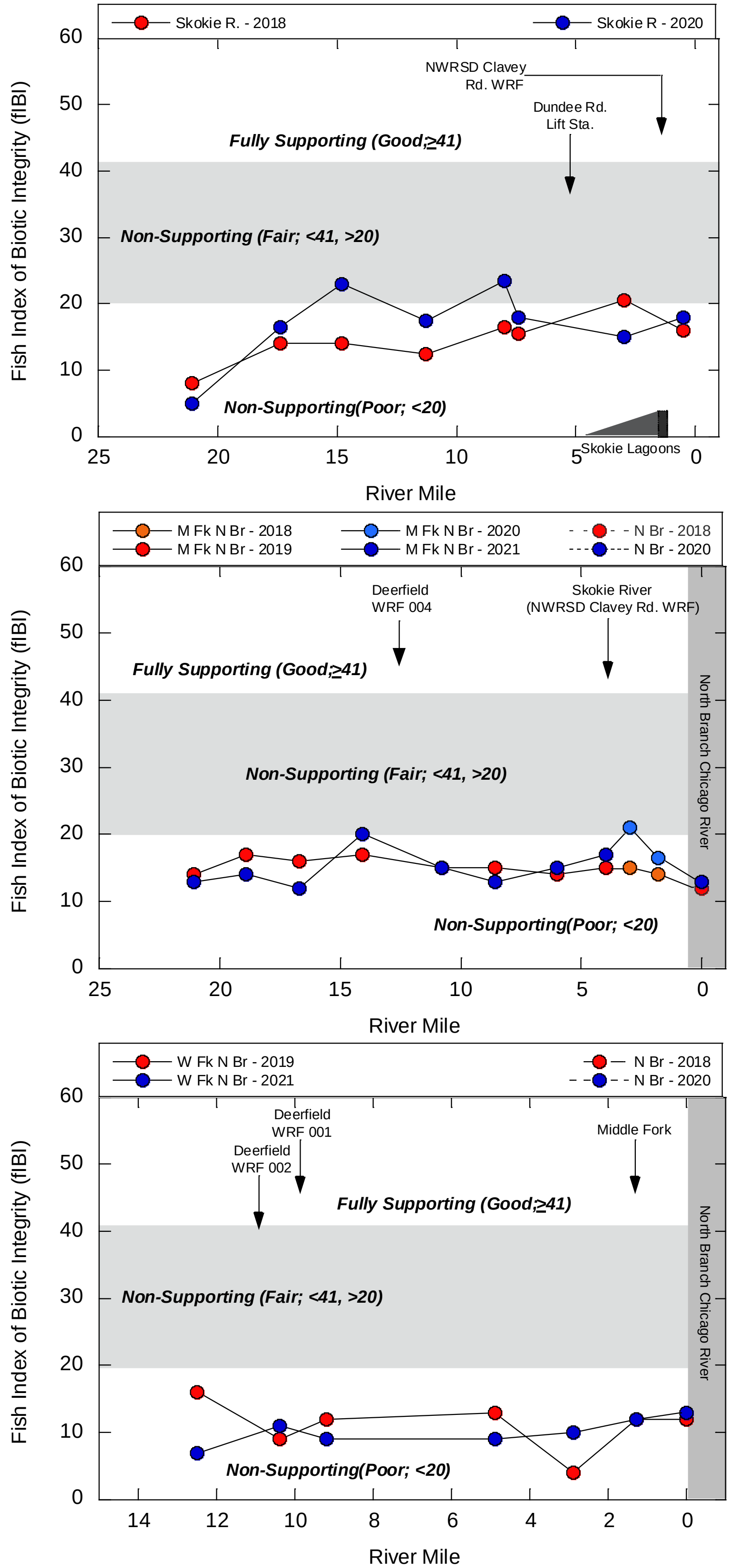


***Figure 33**. Illinois fish IBI (fIBI) scores for the Skokie River (upper), North Branch Chicago River and the lower two sites in the Middle Fork North Branch (center) in 2020 while the West Fork North Branch (lower) and the upper Middle Fork North Branch values were recorded in 2021. IEPA thresholds for fully supporting and two categories of non-support are indicated..*

area which limits both the MIwb and fIBI scores. The percent tolerant fish exceeded the good threshold at all but three sites (MF08, MF10, and WF21; Table 20). DELT anomalies were generally very low, with primarily good and excellent values were observed. Zero intolerant species or mineral substrate spawners were collected (Table 20).

Biological Assemblages – Macroinvertebrates

There were 117 unique macroinvertebrate taxa collected in the NBWW survey area in 2020-21 (Appendix B) compared to 108 taxa in 2018-19. The predominant taxa collected were mostly indicative of poor water quality. The most numerous was *Hyalella azteca,* an amphipod, followed by the genus *Gammarus sp.*, Oligochaeta a segmented worm; *Gammarus sp.* a crustacean; and the genus *Caecidotea sp.*, a crustacean. The majority of the most numerous species collected were either of moderate tolerance, tolerant, or facultative.

The Skokie River had 58 total taxa, the Middle Fork had 91 total taxa, and the West Fork had 63 total taxa. The predominant taxa in each were *Gammarus sp.*, Oligochaeta, *Caecidotea sp.*, *Hyalella azteca*, and *Polypedilum (P.) illinoense,* a toxic tolerant midge, in the Skokie R., *Hyalella azteca*, Oligochaeta, *Caecidotea sp.*, *Cheumatopsyche sp.*, a facultative caddisfly, and Polypedilum (P.) illinoense in the Middle Fork, and Oligochaeta, *Hyalella azteca*, *Polypedilum (P.) illinoense*, *Chironomus (C.) sp.*, and Coenagrionidae, damselflies, in the West Fork (Table 21).

Macroinvertebrate Assemblage

Samples were collected for the West Fork and the majority of the Middle Fork Branches of the Chicago River in 2021 with a single random resample conducted at WF20. Samples for the Skokie River, North Branch Chicago River mainstem site and the lower Middle Fork North Branch were collected in 2020 with a single random resample collected at SR3 and no sample collected at SR7 due to excessive depth in the Skokie Lagoons impoundment. The macro-invertebrate assemblage condition in the NBWW 2020-21 survey area ranged mostly from poor to fair and in non-support of the IEPA mIBI biological criterion (Figure 34). As a result no sites met the mIBI General Use for aquatic life. In terms of any trends between 2020-21 and 2018-19, one site improved in the lower Skokie River nearly meeting the mIBI biocriterion for General Use at SR18 (RM 0.50). The Middle Fork site at MF14 (RM 6.00) missed the General use by only 1.3 units and the 2020 results were somewhat better than 2018 at selected sites. Values in the West Fork were consistently poor to very poor (Table 22). The second highest mIBI of 39.5 at MF14 coincides with the best habitat in the NBWW survey area with a QHEI score of 64.5. This site and SR18 had 47.0% and 36.7% EPT taxa and the only results in the good range for that assemblage attribute whereas 19 sites were in the poor range with 11 at 0% (Table 22). Table 22 lists select mIBI metrics and other macroinvertebrate assemblage attributes, two of which are key biological response signatures associated with toxic impacts (% toxic tolerant taxa) and organic enrichment (% organic enrichment tolerant taxa; Yoder and DeShon 2003). Total taxa ranged from 10-29 taxa (7-27 taxa in 2018-19). The percent of organic enrichment taxa exceeded poor and very poor thresholds at two (2) sites in the Skokie River, six (6) sites in the

Table 21. *The 50 most abundant macroinvertebrate taxa collected at 25 sites in the Skokie River (left), Middle Fork N. Branch (middle), and West Fork (right) in the NBWW 2020-21 survey area including number of times collected, total number collected, taxa group, and taxa tolerance assignments.*

Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In	Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In	Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In
06800	Gammarus sp	F	3			1811	31.76	6	06201	Hyalella azteca	F	4	CG		3292	21.29	7	03600	Oligochaeta	T	10	CG		1438	19.28	6
03600	Oligochaeta	T	10	CG		683	11.98	7	03600	Oligochaeta	T	10	CG		1898	12.27	11	06201	Hyalella azteca	F	4	CG		687	9.21	5
05800	Caecidotea sp	T	6	CG		380	6.66	5	05800	Caecidotea sp	T	6	CG		1379	8.92	6	84470	Polypedilum (P.) illinoense	T	6	SH		406	5.44	2
06201	Hyalella azteca	F	4	CG		257	4.51	2	52200	Cheumatopsyche sp	F	6	CF	CA	719	4.65	2	82710	Chironomus (C.) sp	MT	11	CG		393	5.27	1
84470	Polypedilum (P.) illinoense	T	6	SH		255	4.47	2	84470	Polypedilum (P.) illinoense	T	6	SH		616	3.98	4	22001	Coenagrionidae	T	5.5	PR		332	4.45	5
98200	Pisidium sp	MT	5	CF		170	2.98	6	01801	Turbellaria	F	6	PR		601	3.89	10	01801	Turbellaria	F	6	PR		297	3.98	3
22001	Coenagrionidae	T	5.5	PR		168	2.95	6	95100	Physella sp	T	9	SC		418	2.70	5	95100	Physella sp	T	9	SC		213	2.86	4
83040	Dicrotendipes neomodestus	F	6	CG		164	2.88	6	06800	Gammarus sp	F	3			416	2.69	3	84450	Polypedilum (Uresipedilum) flavur	F	6	SH		173	2.32	1
97601	Corbicula fluminea	F	4	CF		160	2.81	3	68700	Dubiraphia sp	F	5	CG	CO	289	1.87	1	05800	Caecidotea sp	T	6	CG		137	1.84	2
01801	Turbellaria	F	6	PR		117	2.05	6	22001	Coenagrionidae	T	5.5	PR		280	1.81	10	97601	Corbicula fluminea	F	4	CF		126	1.69	3
98600	Sphaerium sp	F	5	CG		97	1.70	3	92300	Valvata sp		2	SC		280	1.81	2	98600	Sphaerium sp	F	5	CG		125	1.68	2
82730	Chironomus (C.) decorus group	T	11			80	1.40	2	13400	Stenacron sp	F	4	SC	MA	257	1.66	1	22300	Argia sp	F	5	PR		103	1.38	1
84450	Polypedilum (Uresipedilum) flavum	F	6	SH		76	1.33	2	84450	Polypedilum (Uresipedilum) flavum	F	6	SH		181	1.17	4	83040	Dicrotendipes neomodestus	F	6	CG		103	1.38	2
98001	Pisidiidae		5			63	1.10	2	93200	Hydrobiidae	F	6	SC		169	1.09	6	84540	Polypedilum (Tripodura) scalaenur	F	6	SH		87	1.17	2
82710	Chironomus (C.) sp	MT	11	CG		49	0.86	1	83300	Glyptotendipes (G.) sp	MT	10	CF		167	1.08	1	92300	Valvata sp		2	SC		80	1.07	2
83300	Glyptotendipes (G.) sp	MT	10	CF		49	0.86	1	17200	Caenis sp	F	6	CG	MA	164	1.06	3	80420	Cricotopus (C.) bicinctus	T	8	SH		78	1.05	2
78655	Procladius (Holotanypus) sp	MT	8	PR		47	0.82	4	98001	Pisidiidae		5			143	0.92	1	74100	Simulium sp	F	6	CF		68	0.91	1
84210	Paratendipes albimanus or P. duplic	F	3	CG		45	0.79	5	84540	Polypedilum (Tripodura) scalaenum group	F	6	SH		137	0.89	4	98200	Pisidium sp	MT	5	CF		67	0.90	4
82820	Cryptochironomus sp	F	8	PR		44	0.77	5	11130	Baetis intercalaris	F	4	CG	MA	132	0.85	2	77120	Ablabesmyia mallochi	F	6	CG		63	0.84	1
95100	Physella sp	T	9	SC		43	0.75	4	98600	Sphaerium sp	F	5	CG		131	0.85	5	83300	Glyptotendipes (G.) sp	MT	10	CF		63	0.84	2
83158	Endochironomus nigricans	MT	6	SH		25	0.44	1	84750	Stictochironomus sp	F	5			114	0.74	2	98001	Pisidiidae		5			60	0.80	1
52200	Cheumatopsyche sp	F	6	CF	CA	23	0.40	1	78655	Procladius (Holotanypus) sp	MT	8	PR		113	0.73	10	04664	Helobdella stagnalis	T	8	PR		45	0.60	3
84520	Polypedilum (Tripodura) halterale gr	MT	6	SH		23	0.40	2	22300	Argia sp	F	5	PR		99	0.64	3	85800	Tanytarsus sp	F	7	CF		39	0.52	3
85800	Tanytarsus sp	F	7	CF		22	0.39	3	79020	Tanypus neopunctipennis	T	8	PR		92	0.59	3	82820	Cryptochironomus sp	F	8	PR		37	0.50	2
79020	Tanypus neopunctipennis	T	8	PR		21	0.37	1	83040	Dicrotendipes neomodestus	F	6	CG		80	0.52	7	52200	Cheumatopsyche sp	F	6	CF	CA	35	0.47	2
84540	Polypedilum (Tripodura) scalaenum	F	6	SH		21	0.37	4	97601	Corbicula fluminea	F	4	CF		78	0.50	6	83000	Dicrotendipes sp	F	6	CG		33	0.44	2
78200	Larsia sp	MT	6	PR		20	0.35	2	85500	Paratanytarsus sp	F	6	CG		60	0.39	2	04964	Erpobdella microstoma	MT	8	PR		31	0.42	1
93200	Hydrobiidae	F	6	SC		19	0.33	1	85625	Rheotanytarsus sp	F	6	CF		60	0.39	3	85625	Rheotanytarsus sp	F	6	CF		30	0.40	2
04901	Erpobdellidae	MT	8	PR		17	0.30	3	77750	Hayesomyia senata or Thienemannimyia nc	F	5			55	0.36	4	83050	Dicrotendipes lucifer	MT	6	CG		21	0.28	1
21200	Calopteryx sp	F	4	PR		11	0.19	1	04664	Helobdella stagnalis	T	8	PR		52	0.34	6	77500	Conchapelopia sp	F	6	PR		17	0.23	1
65800	Berosus sp	MT	99.9	PR	CO	9	0.16	1	98200	Pisidium sp	MT	5	CF		53	0.34	7	84210	Paratendipes albimanus or P. dupl	F	3	CG		17	0.23	1
77500	Conchapelopia sp	F	6	PR		9	0.16	2	04901	Erpobdellidae	MT	8	PR		46	0.30	2	01320	Hydra sp	F	6	PR		15	0.20	1
83820	Microtendipes "caelum" (sensu Sim	MI	6	CF		9	0.16	1	80420	Cricotopus (C.) bicinctus	T	8	SH		46	0.30	7	13400	Stenacron sp	F	4	SC	MA	15	0.20	2
04935	Erpobdella punctata punctata	MT	8	PR		7	0.12	1	82820	Cryptochironomus sp	F	8	PR		46	0.30	6	78655	Procladius (Holotanypus) sp	MT	8	PR		15	0.20	5
04964	Erpobdella microstoma	MT	8	PR		6	0.11	1	84520	Polypedilum (Tripodura) halterale group	MT	6	SH		47	0.30	8	04901	Erpobdellidae	MT	8	PR		13	0.17	1
08200	Orconectes sp	F	5	CG		6	0.11	1	53800	Hydroptila sp	F	2	SC	CA	43	0.28	3	93200	Hydrobiidae	F	6	SC		13	0.17	3
69400	Stenelmis sp	F	7	SC	CO	5	0.09	2	11001	Baetidae		4	CG	MA	41	0.27	1	04666	Helobdella papillata	MT	8	PA		11	0.15	3
85500	Paratanytarsus sp	F	6	CG		5	0.09	1	77500	Conchapelopia sp	F	6	PR		39	0.25	2	80350	Corynoneura sp		2	CG		11	0.15	1
53800	Hydroptila sp	F	2	SC	CA	4	0.07	1	21200	Calopteryx sp	F	4	PR		33	0.21	3	06800	Gammarus sp	F	3			10	0.13	1
59550	Oecetis inconspicua complex sp A (s	F	5	PR	CA	4	0.07	1	77355	Clinotanypus pinguis	MT	6	PR		32	0.21	2	77750	Hayesomyia senata or Thieneman	F	5			10	0.13	2
77750	Hayesomyia senata or Thienemann	F	5			4	0.07	1	85800	Tanytarsus sp	F	7	CF		29	0.19	5	04660	Helobdella sp	MT	8	PA		9	0.12	1
80510	Cricotopus (Isocladius) sylvestris gro	T	8	SH		4	0.07	1	04930	Erpobdella sp	MT	8	PR		27	0.17	1	82770	Chironomus (C.) riparius group	T	11			9	0.12	2
82800	Cladopelma sp	T	6	CG		4	0.07	1	82100	Thienemanniella sp		2	CG		26	0.17	1	82730	Chironomus (C.) decorus group	T	11			8	0.11	3
83002	Dicrotendipes modestus	MT	6	CG		4	0.07	2	80510	Cricotopus (Isocladius) sylvestris group	T	8	SH		23	0.15	5	53800	Hydroptila sp	F	2	SC	CA	6	0.08	1
84700	Stenochironomus sp	F	3	SH		4	0.07	1	84210	Paratendipes albimanus or P. duplicatus	F	3	CG		23	0.15	4	96900	Ferrissia sp	F	7	SC		6	0.08	2
04683	Placobdella multilineata	F	8	PR		3	0.05	1	04666	Helobdella papillata	MT	8	PA		16	0.10	4	83158	Endochironomus nigricans	MT	6	SH		5	0.07	2
28500	Libellula sp	MT	8	PR		3	0.05	1	80350	Corynoneura sp		2	CG		16	0.10	1	84520	Polypedilum (Tripodura) halterale	MT	6	SH		5	0.07	1
74501	Ceratopogonidae	T	5	PR		3	0.05	1	65800	Berosus sp	MT	99.9	PR	CO	12	0.08	1	79020	Tanypus neopunctipennis	T	8	PR		4	0.05	1
77001	Tanypodinae		6	PR		3	0.05	1	74100	Simulium sp	F	6	CF		13	0.08	1	08200	Orconectes sp	F	5	CG		3	0.04	1
22300	Argia sp	F	5	PR		2	0.04	1	83158	Endochironomus nigricans	MT	6	SH		13	0.08	4	28705	Pachydiplax longipennis	T	8	PR		3	0.04	1

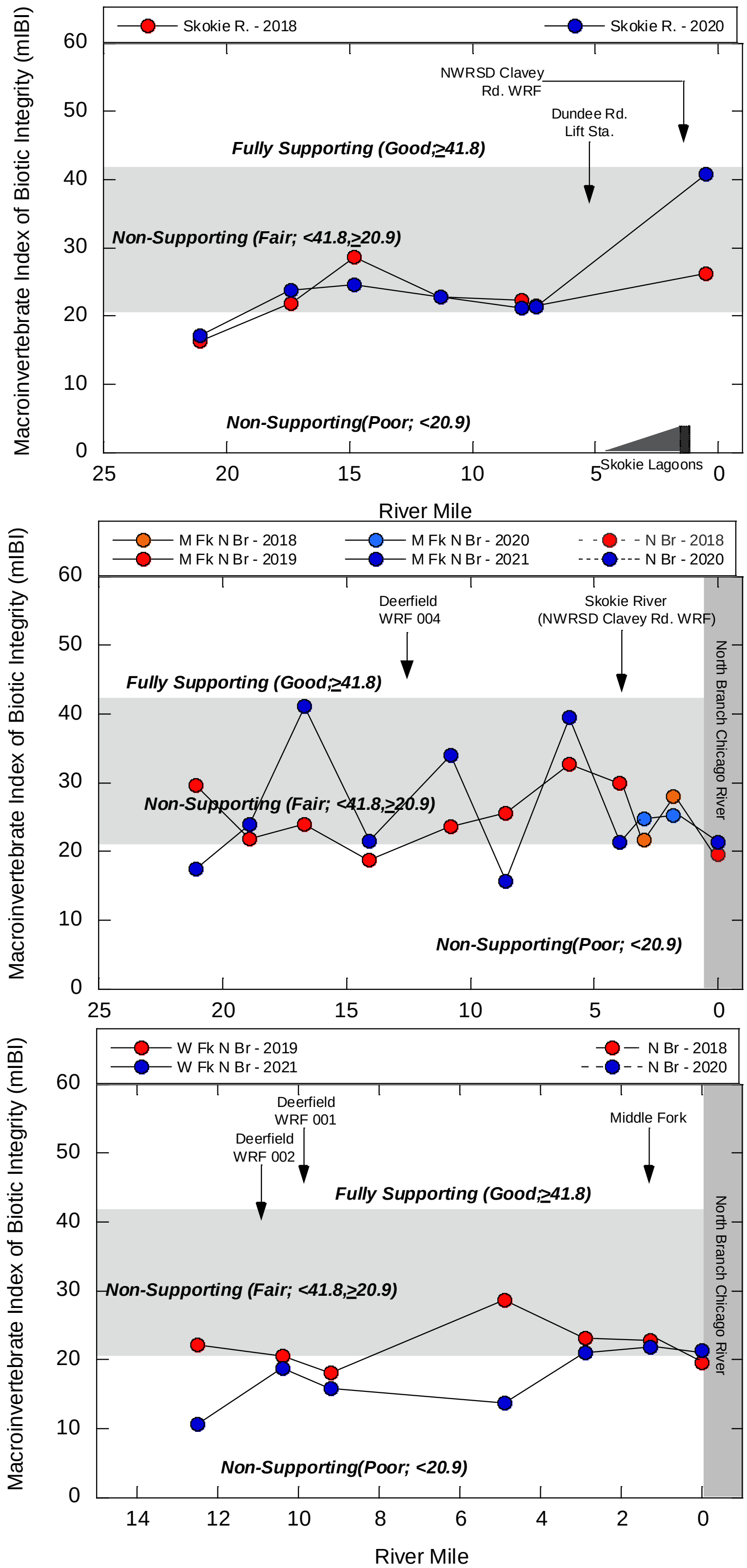


***Figure 34**. Illinois macroinvertebrate IBI (mIBI) scores for the Skokie River (upper), North Branch Chicago River and the lower two sites in the Middle Fork North Branch (center) in 2020 while the West Fork North Branch (lower) and the upper Middle Fork North Branch values were recorded in 2021. IEPA thresholds for fully supporting and two categories of non-support are indicated.*

***Table 22**. Selected macroinvertebrate assemblage attributes at 25 sites sampled in the 2020-21 NBWW survey area. Biological index scores are shaded by level of use support: Exceptional – blue; Good (fully supporting) - green; Fair (non-support) - yellow; Poor (non-support) – orange; Very Poor - red; key metrics as signatures of toxic or organic enrichment impacts are based on Yoder and DeShon (2003).*

Site ID	River Mile	Drainage Area (mi.^{2})	Year	Macroinvertebrate Assemblage								
				mIBI	Total Taxa	Intoler-ant Taxa	%Toler-ant Taxa	EPT Taxa	%EPT	MBI	%Toxic Tolerant Taxa	%Organic Enrich. Taxa
Skokie River												
SR1	21.10	2.70	2020	17.2	16.0	0.0	13.4	0	0.0	5.8	0.0	17.9
SR2	17.40	7.80	2020	23.8	23.0	2.0	22.5	0	0.0	6.6	4.5	39.3
SR3	14.80	11.50	2020	24.6	16.0	2.0	9.4	0	0.0	5.6	0.0	35.0
SR4	11.30	15.00	2020	22.8	15.0	3.0	3.9	0	0.0	5.3	0.0	11.0
SR5	8.00	20.60	2020	21.2	12.0	2.0	1.6	0	0.0	4.0	0.0	8.3
SR6	7.40	21.50	2020	21.3	11.0	2.0	3.0	0	0.0	3.7	0.0	8.9
SR7	3.00	23.70	2020	No macroinvertebrate sample collected								
SR18	0.50	30.90	2020	40.8	20.5	4.0	4.3	6.5	36.7	5.2	0.6	1.8
Middle Fork North Branch Chicago River												
MF8	21.10	5.81	2021	17.5	11.0	0.0	27.5	0	0.0	7.6	0.0	37.6
MF9	18.90	8.91	2021	24.0	20.0	1.0	23.3	3	8.7	6.7	0.0	26.0
MF10	16.70	11.90	2021	41.1	21.0	2.0	13.6	1	13.2	5.4	0.0	22.5
MF11	14.10	16.11	2021	21.5	15.0	0.0	9.5	1	12.7	5.6	0.0	16.3
MF12	10.80	19.23	2021	34.0	16.0	2.0	19.6	1	0.3	6.1	0.3	47.4
MF13	8.60	20.96	2021	15.7	18.0	2.0	31.8	0	0.0	8.3	0.0	71.2
MF14	6.00	22.48	2021	39.5	29.0	0.0	7.6	4	47.0	6.3	0.3	15.2
MF15	4.00	24.29	2021	21.4	27.0	2.0	31.3	3	2.0	8.0	0.0	57.9
MF16	3.00	56.10	2020	24.7	25.0	4.0	26.0	1	2.1	7.3	11.0	48.0
MF17	1.80	57.30	2020	25.2	25.0	5.0	18.9	1	0.6	7.1	14.2	44.9
West Fork North Branch Chicago River												
WF20	12.50	3.87	2021	10.6	10.0	0.0	40.1	0	0.0	8.9	0.0	78.9
WF21	10.40	7.02	2021	18.7	11.0	1.0	35.1	0	0.0	8.2	0.0	78.1
WF22	9.20	9.41	2021	15.8	11.0	1.0	38.5	0	0.0	8.6	0.0	82.6
WF23	4.90	17.86	2021	13.8	22.0	0.0	40.7	3	1.4	8.9	0.0	78.5
WF24	2.90	24.52	2021	21.0	16.5	1.5	9.9	2	3.4	6.7	5.6	42.5
WF25	1.30	27.97	2021	21.9	19.0	2.0	22.4	1	1.8	6.7	0.3	40.6
North Branch Chicago River												
MF19	18.60	93.40	2020	21.4	16.0	2.0	7.7	1	0.3	6.0	44.5	20.9
Narrative Categories and Thresholds		**Exceptional**		>65.0	≥ 36	> 5	≤ 10	≥ 6	> 49	≤ 5.2	0	<5
		Good		≥41.8	< 36	≤ 5	≤ 15	≥3	>24.5	≥5.2	<5	<15
		Fair		<41.8	≤27	≤ 3	≤ 20	2	>10	≥6.0	<20	≥15
		Poor		<30	≤ 22	≤2	< 28	1	>5	≥7.6	≥35	≥35
		Very Poor		≤15	≤ 16	0	≥ 28	0	< 5	≥9.0	>60	>60
		Source		IEPA/MBI	MBI	MBI	MBI	MBI	MBI	IEPA/MBI	MBI	MBI

Middle Fork N. Branch, and all six (6) sites in the West Fork, four (4) of which were very poor. These observations contributed to the assignment of an organic enrichment cause in accordance with the exceedance of very poor, poor, and fair thresholds. Only one site exceeded the good or excellent benchmarks for the percent of toxic tolerant taxa with only one site in the fair range (MF19; 44.5%) compared to two sites (SR3 and WF25) in the poor range in 2018-19.

SYNTHESIS

The baseline biological condition of the North Branch River and its subwatersheds has been shaped by the naturally low gradient and wetland origins of the region. The current condition of the biological assemblages reflects the historical changes that have significantly altered these natural features, mostly through hydrological and physical alterations related to suburban and urban development throughout the 2020-21 NBWW survey area. Both the direct and indirect influences of the altered hydrology and habitat were evident in the chemical, habitat, and bioassessment results the same as they were in 2018-19. The legacy of hydrological and habitat alterations coupled with urban land use have resulted in sluggish flows, excessive siltation, embedded substrates, sparse instream cover, sediments high in organic matter, and indicators of excessive organic enrichment that are further exacerbated by the altered flows and habitat. High levels of PAHs and metals in sediments are due to urban runoff and persist at greater concentrations during low flow periods that occur during the summer and early fall months. Dissolved ions such as chloride were most elevated in the February samples, but persisted at elevated level through the summer-fall months above poor and very poor IPS thresholds and in some cases exceeding the Illinois WQS. Sediments that are high in organic matter have also indirectly resulted from sluggish flows and stream channel alterations that combine to exacerbate low D.O. concentrations and high to wide diel D.O. swings. The introduction of wastewater from the Clavey Rd. WRF in the Skokie River and the Deerfield WRF in the West Fork North Branch appear to be a source of nitrogen compounds including nitrites, TKN, and ammonia, but they also appear to reduce TSS and chloride levels. No site had a QHEI score that was considered good, most were poor with only a few fair scores were recorded. In keeping with the same pattern, neither the fish or macroinvertebrate assemblages attained a rating of good or met their General Use biocriteria with the majority of value sin the non-supporting poor range.

IPS thresholds for water and sediment chemistry and physical habitat attributes (MBI 2022a) were used to assess causes of impairment and their comparative severity. The IPS thresholds are stratified across four or five narrative categories of quality (excellent, good, fair, poor, and very poor). This replaces the formerly used binary (i.e., “pass/fail”) approach to evaluating exceedances of chemical and physical effect thresholds and criteria providing for a graded approach to the assignment of causes and sources of Illinois General Use biological impairments. The IPS framework also offers the semblance of a stratification of protection and restoration goals and thresholds including Restorability and Susceptibility/Threat factors that have been incorporated into all IPS outputs to support local restoration and protection efforts by the respective watershed groups and stakeholders.

The biological criteria for fish and macroinvertebrates used by Illinois EPA (2022) establish the thresholds by which impaired sites and reaches are determined. The assignment of causes in this analysis generally attempts to follow the overall intent of the Illinois Integrated Report assessment guidelines, but is supplemented by the more extensive biological effect thresholds provided by the IPS indicators and thresholds (MBI 2022a) and as measured by more spatially refined intensive pollution survey monitoring design. The delineation of causes and sources was based on integrating and synthesizing the preceding analyses of categorical and parameter-specific stressor threshold exceedances. The most influential of these in 2020-21 are included in Table 23 along with the fish and macroinvertebrate IBI scores and key indicators of stress and response. Habitat alteration is represented by the QHEI and the QHEI modified:good attributes ratio, low D.O. includes the minimum measured by Datasondes, the effect of nutrient enrichment by the diel D.O. swing narrative, the overall nutrient enrichment effect status, the IPS nutrient index, poor and very poor IPS chemical threshold exceedances for water and sediment, and biological response signatures for organic enrichment and toxic tolerant indicators. The rationale for listing the predominant causal categories in 20202-21 follows for any fair, poor, or very poor exceedance of an IPS threshold or other related attribute (results listed in Appendix D):

- **Habitat** (100 observations; weighted frequency of 27.2%) – composed of the QHEI score, IPS substrate score, QHEI modified:good ratio, number of poor attributes, IPS channel condition score, and number of high influence poor attributes.
- **Organic Enrichment/Low D.O.** (70 observations; weighted frequency of 19.1%) – any IPS low D.O. value, exceedance of IPS threshold for TKN, and any organic enrichment biological response signature in Tables 20 or 21.
- **Toxics/Toxicity** (64 observations; weighted frequency of 17.4%) – any sediment or water column metal or PAH threshold exceedance in Tables 16 or 17 (IPS, *PEC or PEL* exceedance, or Illinois EPA elevated), IPS ammonia-N exceedances, and any toxic *Biological Response* in Tables 20 or 21.
- **Ionic Strength/Demand** (56 observations; weighted frequency of 15.4%) any IPS exceedance for chloride, conductivity, or total suspended solids (TSS).
- **Nutrient Enrichment/Effects** (47 observations; weighted frequency of 12.8%) – any exceedance of IPS thresholds for total phosphorus (TP), nitrate-N (Nitrate), the maximum D.O. and D.O. swing measured by Datasondes as part fi the SNAP analysis (Table 13).
- **Urban Land Use** (30 observations; weighted frequency of 8.2%) – any exceedance of IPS thresholds for developed land in a HUC12 watershed (DevWS) or imperious cover in the 30 meter buffer (clipped; IMperv30C).

Habitat causes were the most frequent limiting factor (100 total observations; 27.2% weighted) to aquatic life with very poor substrate scores, poor QHEI scores, poor channel scores, and an accumulation of poor attributes as the primary factors perpetuating these deficiencies. Poor habitat persists throughout the North Branch Chicago River watershed, containing primarily poor habitat at 20 sites, with only five (5) fair QHEI scores located in the Middle Fork of the North Branch and a single fair scores in the Skokie River and West Fork. Organic Enrichment/Low D.O. had 70 observations (19.3% weighted) with very poor to fair low D.O. levels, a high frequency of organic enrichment response signatures, and elevated TKN levels afflicting each subwatershed. Indicators of Toxics and Toxicity included 64 observations (17.4% weighted) of exceedances of IPS thresholds for sediment metals, and PAH compounds, and ammonia-N. The majority were PAH compounds followed by metals and then ammonia-N, the latter of which did not have any exceedances of the Illinois standard. The origin of the majority

***Table 23**. Chemical, physical, and biological response indicators of impairment observed at each site in the 2020-21 NBWW survey area. Causes associated with biological impairments are drawn from analyses of habitat, nutrient effects, IPS, and other threshold exceedances, and biological response signatures. Causes are classified as fair, poor, or very poor in accordance with the exceedance of corresponding thresholds. See legend at bottom for biological, physical, and chemical threshold narrative ranges. IPS Restorability scores are provided for non- and supporting sites.*

Site ID	River Mile	Drain-age Area $(mi.^2)$	Year	AQLU Status	fIBI	mIBI	QHEI	QHEI Modified: Good Ratio	Min. D.O. (Sonde) <WQC	Diel D.O. Swing	Diel D.O. Swing Narrative	IPS Nutrient Index	Chemical WQC Exceed-ances	>Poor Chemical Thresholds	Sediment Metals >IPS Thresh-olds	Sediment PAH >IPS Thresh-olds	Organic Enrichment Signatures	Toxic Tolerant Signatures	2020-21 MBI Causes by Stressor Threshold Narrative Category: Very Poor[11]	Poor[11]	Fair[11]	Restor-ability Score (0-100)
Skokie River 2020																						
SR1	21.1	2.7	2020	NON - Poor	5.0	17.2	**37.0**	9.00				17.4		2	3	10	17.9	0.0	Dev-WS; Substr; Chloride; Conduct; QHEI Ratio; Sed. PAH	Low D.O.; QHEI; Chan; Conduct; High Mod. Attr.; QHEI Ratio	TKN; Secd. PAHs; Sed. Metals	7.9
SR2	17.4	7.8	2020	NON - Poor	16.5	23.8	**38.0**	4.50				14.38		2	3	8	39.3	4.5	Dev-WS; Chloride; Conduct; Sed. PAH	QHEI; Substr; Chan; Org. Enrich.; High Poor Attr.	Low D.O.; Max D.O.; Conduct; Sed. Metals;	24.0
SR3	14.8	11.5	2020	NON - Fair	23.0	24.6	**48.0**	2.00	2.05	8.85	Wide	14.48	5 (D.O.)	2	0	10	35.0	0.0	Sed. PAH; D.O. Swing	Dev-WS; QHEI; Substr; Chloride; Conduct; Low D.O.; Poor Attr.; Org. Enrich,	Low D.O.; Max D.O.; Chan; Conduct; Sed. PAH; Sed. Metals; QHEI Ratio	27.2
SR4	11.3	15.0	2020	NON - Poor	17.5	22.8	**52.5**	1.40				12.18		1	4	14	11.0	0.0	Dev-WS; Sed. PAH	Conduct.; Sed. Metals; Poor Attr.	Max D.O.; QHEI; Substr; Chan; Chloride; Sed. PAH;	35.1
SR5	8.0	20.6	2020	NON - Fair	23.5	21.2	**46.8**	4.00	2.1	5.32	High	18.46	4 (D.O.)	0	0	11	8.3	0.0	Dev-WS; Substr; Sed. PAH	QHEI; Chan; High Poor Attr.; QHEI Ratio; D.O. Swing	Low D.O.; TKN; Max D.O.; Conduct; Chloride; Sed. PAH; Sed. Metals;	20.1
SR6	7.4	21.5	2020	NON - Poor	18.0	21.3	**39.5**	4.00				17.26		0	0	11	8.9	0.0	Dev-WS; Substr; Sed. PAH	Low D.O.; QHEI; Chan; High Poor Attr.; QHEI Ratio	Imperv-30C; Max D.O.; Conduct; Chloride; Sed. PAH;	20.4
SR7	3.0	23.7	2020	NON - Poor	15.0		**38.0**	2.00	0.97	6.48	High	22.7	5 (D.O.)	1	3	0			Dev-WS; Substr;Low D.O.	QHEI; Chan; D.O. Swing	Low D.O.; TKN; Max D.O.; Chloride; Sed. Metals; QHEI Ratio	29.2
SR18	0.5	30.9	2020	NON - Fair	34.5	40.8	**41.5**	4.00	3.78	3.76	Low	25.66	3 (D.O.)	2	4	11	1.8	0.6	Dev-WS; Sed. PAH	Substr; Sed. Metals; High Poor Attr.; QHEI Ratio; Nitrate	TP; TKN; Nitrate; Max D.O.; QHEI; Chan; Chloride; Sed. PAH;	51.4
Middle Fork North Branch Chicago River 2021																						
MF8	21.1	5.8	2021	NON - Poor	13.0	17.5	**29.0**	4.00	1.35	17.68	Wide	19.5	6 (D.O.;pH)	2	3	12	37.6	0.0	Substr; Conduct; Chloride; Sed. PAH; Poor Attr.; Low D.O.; D.O. Swing	Dev-WS; QHEI; Chan; Org. Enrich.; QHEI Ratio	TKN; Low D.O.; TKN; Sed. Metals	54.3
MF9	18.9	8.9	2021	NON - Poor	14.0	24.0	**31.5**	2.33	0.14	15.76	Wide	19.9	6 (D.O.;T)	2	6	8	26.0	0.0	Substr; Conduct; Chloride; Sed. PAH; Low D.O.; D.O. Swing	QHEI; Chan; Poor Attr.	Dev-WS; Org. Enrich.; TKN; QHEI Ratio	52.8
MF10	16.7	11.9	2021	NON - Poor	12.0	41.1	**41.0**	9.00	0.28	17.93	Wide	20.5	4 (D.O.)	2	1	4	22.5	0.0	Conduct; Chloride; Low D.O.; QHEI Ratio; D.O. Swing	Dev-WS; Sed. PAH; QHEI; Substr; Chan; QHEI Ratio; Poor Attr.	TKN; Max D.O.; Org. Enrich.; Low D.O.	55.3
MF11	14.1	16.1	2021	NON - Fair	20.0	21.5	**44.0**	4.00	2.65	11.98	Wide	18.5	4 (D.O.)	3	4	8	16.3	0.0	Conduct; Chloride; Sed. PAH; D.O. Swing	Dev-WS; Low D.O.; QHEI; Substr; Chan; Sed. Metals; Sed. PAH; High Poor Attr.; Org. Enrich.; QHEI Ratio	TKN; Low D.O.	49.9
MF12	10.8	19.2	2021	NON - Poor	15.0	34.0	**45.5**	2.33	0.61	12.46	Wide	18.8	4 (D.O.)	2	2	9	47.4	0.3	Chloride; Sed. PAH; Low D.O.; D.O. Swing	Dev-WS; QHEI; Substr; Chan; Conduct; Org. Enrich.	Low D.O.; Sed. Metals; QHEI Ratio	49.0
MF13	8.6	21.0	2021	NON - Poor	13.0	15.7	**60.0**	3.50	1.72	7.46	Wide	19.4	4 (D.O.)	2	4	9	71.2	0.0	Conduct; Chloride; Sed. PAH; Org. Enrich.; Low D.O.; D.O. Swing	Dev-WS; Substr; Poor Attr. Sed. Metals	Max D.O.; QHEI; Chan; Low D.O.; Ammonia; QHEI Ratio	47.2
MF14	6.0	22.5	2021	NON - Poor	15.0	39.5	**64.5**	3.50	5.25	4.84	Moderate	17.6		2	1	8	15.2	0.3	Conduct; Chloride; Sed. PAH	Dev-WS; High Poor Attr.	Low D.O.; TKN; Max D.O.; QHEI; Substr; Sed. Metals; QHEI Ratio; D.O. Swing	50.4
MF15	4.0	24.3	2021	NON - Poor	17.0	21.4	**55.5**	1.75	4.98	6.98	Wide	14.4		2	6	9	57.9	0.0	Conduct; Chloride; Sed. PAH; D.O. Swing	Dev-WS; Substr; Org. Enrich.; Sed. Metals	Max D.O.; Low D.O.; QHEI; Chan; Ammonia	55.5
MF16	3.0	56.1	2020	NON - Fair	21.0	24.7	**38.5**	0.67				28.8		3	4	10	48.0	11.0	Substr; Sed. PAH; Nitrate	Dev-WS; TKN; Conduct.; QHEI; Org. Enrich.; Sed. Metals	TP; Low D.O.; Nitrate; Max D.O.; Chan; Chloride; PAHs; Sed. Metals; TKN	20.0
MF17	1.8	57.3	2020	NON - Poor	16.5	25.2	**45.8**	2.33	3.09	2.45	Low	29.3	2 (D.O.)	5	4	10	44.9	14.2	Sed. PAH; Nitrate	Dev-WS; QHEI; Substr; Chan; Org. Enrich.; Sed. Metals; Conduct.; TKN; Ammonia; Poor Attr.	TP; Low D.O.; Nitrate; Max D.O.; Chloride; Sed. PAH; Sed. Metals; Low D.O.; QHEI Ratio	21.9
West Fork North Branch Chicago River 2021																						
WF20	12.5	3.9	2021	NON - Poor	7.0	10.6	**30.5**	4.00				24.2		4	1	9	78.9	0.0	Substr; Conduct.; Chloride; Sed. PAH; Org. Enrich.	Dev-WS; QHEI; Chan; Conduct; TSS; TKN: Poor Attr.; QHEI Ratio	TP; TKN; Ammonia	1.2
WF21	10.4	7.0	2021	NON - Poor	11.0	18.7	**42.0**	5.00	0.33	5.53	High	27.5	4 (D.O.)	4	5	14	78.1	0.0	Chloride; Conduct.; Sed. PAH; Org. Enrich.; Low D.O.; Ammonia; Poor Attr.	Dev-WS; QHEI; Chan; Conduct; Sed. Metals; QHEI Ratio; Nitrate; D.O. Swing	TKN; Substr; Sed. PAH; Low D.O.; TKN	13.9
WF22	9.2	9.4	2021	NON - Poor	9.0	15.8	**46.5**	2.33	0.46	15.16	Wide	34.9	5 (D.O.)	4	6	12	82.6	0.0	Dev-WS;TP; Chloride; Sed. PAH; Org. Enrich.; Ammonia; Low D.O.; D.O. Swing	TKN; QHEI; Substr; Chan; Conduct; Sed. Metals; Poor Attr.	Imperv-30C; Low D.O.; Nitrate; Sed. PAH; Sed. Metals; QHEI Ratio	0.7
WF23	4.9	17.9	2021	NON - Poor	9.0	13.8	**41.0**	4.00	1.52	9.35	Wide	24.6	2 (D.O.)	4	2	14	78.5	0.0	Dev-WS; Substr; Chloride; Sed. PAH; Org. Enrich.; TSS; Low D.O.; D.O. Swing	Imperv-30C; QHEI; Chan; Conduct; Chloride; TSS; TKN; Poor Attr.; QHEI Ratio	TP; TKN; Max D.O.; Low D.O.	7.1
WF24	2.9	24.5	2021	NON - Poor	10.0	21.0	**66.0**	0.86	2.21	7.75	Wide	25.6	4 (D.O.)	3	4	12	42.5	5.6	Dev-WS; Conduct; Sed. PAH; Ammonia; D.O. Swing	Low D.O.; Conduct; Org. Enrich.; Sed. Metals; Poor Attr.	Imperv-30C;TP; TKN; QHEI; Substr; Chan; Low D.O.	17.9
WF25	1.3	28.0	2021	NON - Poor	12.0	21.9	**48.0**	3.50	1.89	5.48	High	26.4	4 (D.O.)	3	4	14	40.6	0.3	Dev-WS; Chloride; Conduct.; Sed. PAH: Ammonia; Low D.O.	QHEI; Substr; Conduct; Org. Enrich.; Sed. Metals; Poor Attr.; D.O. Swing	TP; TKN; Chan; Low D.O.; QHEI Ratio	15.9
North Branch Chicago River 2020																						
MF19	18.6	93.4	2020	NON - Poor	13.0	21.4	**48.5**	1.75	4.61	2.65	Low	25.8	1 (D.O.)	0	1	11	20.9	44.5	Dev-WS; Sed. PAH	Imperv-30C; QHEI; Substr; Toxicity	TP; Low D.O.; TKN; Nitrate; Max D.O.; Chan; Conduct; Chloride; Sed. Metals;	28.3
Narrative Category		Excellent		FULL	>50	>73	>84.5	<0.50	>6.9	< 2.0	Normal	<10	None	None	None	None	< 5	<5				Very High
		Good		FULL	>41-49	41.8-72.9	>75.9	<2.00	6-6.9	2.0-4.0	Low	10-15	1	1	1	1	> 5	<15				High
		Fair		PARTIAL	30- <41	30-41.7	<75.9	≥2.00	4.0-5.9	4.0-5.0	Moderate	15-25	2-4	2-4	2-3	2-3	>20	≥15				Moderate
		Poor		Non-Fair	>15-29	>15-29	<50.1	≥4.00	2.0-3.9	5.0-6.5	High	25-35	5-6	5-6	4-6	4-6	>35	>35				Low
		Very Poor		Non-Poor	<15	<15	<25	≥6.00	<2.0	>6.5	Wide	>35	>6	>6	>6	>6	>60	>60				Very Low
Source(s)		IEPA/MBI		IEPA/MBI																		IPS

of this category was urban stormwater. There were 56 observations of Ionic Strength/Demand parameters (15.4% weighted) that included mostly exceedances of conductance and chloride thresholds that latter of which included exceedances of the Illinois standard. There were only two exceedances of TSS which were also related to urban stormwater runoff. Nutrient Enrichment/Effects had 47 observations (12.8% weighted) with the diel D.O. swing being the most severe indicator with 11 very poor and four (4) poor exceedances and the remainder being mostly fair exceedances of maximum D.O., total P, and nitrate-N. Urban Land Use had the fewest observations (30; 8.2% weighted) and only two factors, developed land use in a HUC12 watershed (DevWS) with 24 very poor and poor threshold exceedances and impervious cover in the 30 meter buffer (Imperv30C) with 5 total observations. The predominant causal categories varied somewhat between the three branches with habitat causes dominating in the Skokie River (35.7% weighted) and Middle Fork (26.9% weighted) and ionic strength/conventional dominant in the West Fork (22.7%; Appendix D).

Neither of the two major point sources (NSWRD Clavey Rd. and Deerfield WRFs) played a major role in the observed results with the exception of increases in some chemical constituents associated with municipal wastewater downstream from each. No distinguishable signatures of excessive nutrient enrichment were apparent in the modified SNAP analysis even though the two WRFs dominate the low flows of their receiving streams. The Risk of Exceedance analysis showed the second highest sestonic chlorophyll a value and supersaturated D.O. levels at two sites downstream from Deerfield WRF in 2021 which also influenced total P and nitrate-N levels.

Perhaps the most important observation from the 2020-2021 bioassessment is that the overall habitat in each of the subwatersheds and in the mainstem North Branch Chicago River site is mostly poor. Heavy silt coverage and muck substrates coupled with the lingering effects of legacy channel and hydrological modifications reduce the habitat available for macro-invertebrates and fish and hamper the assimilation of organic pollution in particular. Urban runoff contributes to highly elevated levels of PAHs and metals in sediments that are prevalent throughout the survey area. The biological results are associated with numerous exceedances of IPS thresholds with no sites meeting the Illinois EPA General Use designation for aquatic life.

Reinforcing these observations are the low and very low Restorability scores generated by the NE Illinois IPS (Table 17) which means that the challenges with restoring the streams of the NBWW study area to attaining the Illinois General Use for aquatic life are greater and dependent of restoration actions that address the most limiting chemical and physical factors as is demonstrated by the consistent repetition of very poor and poor causes of impairment related to urban land uses coupled with flow and habitat alterations. The highest Restorability factors were in the Middle Fork and lowest rankings occurred throughout the West Fork, with the Skokie River intermediate between those two forks.

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APPENDIX A: NORTH BRANCH CHICAGO RIVER 2020-2021 FISH ASSEMBLAGE DATA

A-1: Fish Index of Biotic Integrity (IBI) Metrics & Scores
A-2 Fish Species Grand (all sites combined)
A-3: Fish Species by Sampling Event

Appendix Table A-1. Fish IBI results for data collected in North Branch Chicago River study area during 2021 and 2022.

							Number of						Percent							
Site ID	River Mile	Type	Date	DA sq mi	Wetted Width (ft)	IL IBI Reg.	Native species	Sunfish species	Sucker species	Intolerant species	Benthic Invert. species	Minnow species	Mineral Substrate Spawners	Tolerant Fish (as Species)	Generalist Feeders	Specialized Benthic Invert-ivores	Rel.No. /(0.3km)		IBI	Modified Iwb
NORTH BRANCH CHICAGO RIVER - (95009)																				
Year: 2020																				
MF19	18.60	D	07/09/2020	93.4	15.4	3	5(1)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	80(2)	89(2)	0(0)	69	*	11.0	3.6
MF19	18.60	D	08/31/2020	93.4	15.4	3	8(2)	3(6)	1(2)	0(0)	0(0)	1(1)	0(0)	75(2)	90(2)	0(0)	557		15.0	6.3
MIDDLE FORK NORTH BRANCH CHICAGO RIVER - (95291)																				
Year: 2020																				
MF16	3.00	D	07/09/2020	56.1	15.2	3	8(2)	3(6)	1(2)	0(0)	1(1)	1(1)	0(0)	63(3)	58(6)	2(1)	99	*	22.0	4.6
MF16	3.00	D	08/31/2020	56.1	15.2	3	10(2)	3(6)	1(2)	0(0)	1(1)	2(1)	0(0)	60(3)	74(4)	1(1)	224		20.0	4.9
MF17	1.80	D	07/09/2020	57.3	15.2	3	7(1)	3(6)	0(0)	0(0)	1(1)	0(0)	0(0)	29(5)	85(2)	1(1)	147	*	16.0	5.0
MF17	1.80	D	08/31/2020	57.3	15.2	3	9(2)	4(6)	1(2)	0(0)	0(0)	1(1)	0(0)	67(3)	83(3)	0(0)	324		17.0	6.4
Year: 2021																				
MF8	21.10	F	08/01/2021	5.8	28.0	3	4(1)	1(2)	0(0)	0(0)	0(0)	0(0)	0(0)	25(5)	60(5)	0(0)	30	**	13.0	
MF9	18.90	F	08/01/2021	8.9	35.9	3	6(1)	2(3)	0(0)	0(0)	0(0)	0(0)	0(0)	50(4)	11(6)	0(0)	88	*	14.0	
MF10	16.70	F	07/31/2021	11.9	41.4	3	2(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(6)	0(6)	0(0)	110	*	12.0	
MF11	14.10	E	07/31/2021	16.1	46.8	3	11(2)	4(5)	1(1)	1(1)	1(1)	0(0)	0(0)	36(5)	75(4)	0(1)	426		20.0	
MF12	10.80	E	07/31/2021	19.2	50.0	3	6(1)	3(4)	0(0)	0(0)	0(0)	0(0)	0(0)	50(4)	31(6)	0(0)	148	*	15.0	
MF13	8.60	F	07/31/2021	20.9	51.7	3	4(0)	2(3)	0(0)	0(0)	0(0)	0(0)	0(0)	50(4)	56(6)	0(0)	54	*	13.0	3.0
MF14	6.00	E	07/31/2021	22.4	52.9	3	8(1)	3(4)	1(1)	0(0)	0(0)	1(1)	0(0)	50(4)	74(4)	0(0)	202		15.0	5.5
MF15	4.00	E	07/31/2021	24.2	54.3	3	9(2)	3(4)	1(1)	0(0)	0(0)	1(1)	0(0)	56(3)	46(6)	0(0)	204		17.0	6.2
WEST FORK NORTH BRANCH CHICAGO RIVER - (95292)																				

na - Qualitative data, Modified Iwb not applicable.
X - IBI extrapolated
* - < 200 Total individuals in sample
** - < 50 Total individuals in sample
● - One or more species excluded from IBI calculation.

Appendix Table A-1. Fish IBI results for data collected in North Branch Chicago River study area during 2021 and 2022.

							Number of						Percent						
Site ID	River Mile	Type	Date	DA sq mi	Wetted Width (ft)	IL IBI Reg.	Native species	Sunfish species	Sucker species	Intolerant species	Benthic Invert. species	Minnow species	Mineral Substrate Spawners	Tolerant Fish (as Species)	Generalist Feeders	Specialized Benthic Invert-ivores	Rel.No. /(0.3km)	IBI	Modified Iwb
Year: 2021																			
WF20	12.50	F	07/30/2021	3.8	20.7	3	3(0)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	67(3)	100(0)	0(0)	16 * *	7.00	
WF21	10.40	F	07/30/2021	7.0	31.5	3	4(1)	2(3)	0(0)	0(0)	0(0)	0(0)	0(0)	25(5)	85(2)	0(0)	26 * *	11.0	
WF22	9.20	D	07/30/2021	9.4	36.9	3	5(1)	3(4)	0(0)	0(0)	0(0)	1(1)	0(0)	80(2)	97(1)	0(0)	102 *	9.00	
WF23	4.90	D	07/30/2021	17.8	48.7	3	7(1)	3(4)	1(1)	0(0)	0(0)	0(0)	0(0)	71(2)	99(1)	0(0)	1169	9.00	
WF24	2.90	D	07/30/2021	24.5	54.5	3	7(1)	3(4)	1(1)	0(0)	0(0)	1(1)	0(0)	86(1)	86(2)	0(0)	176 *	10.0	5.0
WF25	1.30	D	07/30/2021	27.9	56.9	3	10(2)	3(4)	1(1)	0(0)	0(0)	1(1)	0(0)	60(3)	92(1)	0(0)	200 *	12.0	4.6
SKOKIE RIVER - (95403)																			
Year: 2020																			
SR1	21.10	E	07/07/2020	2.7	2.5X	3	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	100(0)	100(0)	0(0)	2 * *	0.00	
SR1	21.10	E	09/01/2020	2.7	2.5X	3	2(1)	2(6)	0(0)	0(0)	0(0)	0(0)	0(0)	100(0)	76(3)	0(0)	50 * *	10.0	
SR2	17.40	E	07/07/2020	7.8	3.8X	3	3(1)	2(6)	0(0)	0(0)	0(0)	0(0)	0(0)	33(5)	75(4)	0(0)	16 * *	16.0	
SR2	17.40	E	09/01/2020	7.8	3.8X	3	4(2)	2(6)	0(0)	0(0)	0(0)	1(1)	0(0)	75(2)	15(6)	0(0)	110 *	17.0	
SR3	14.80	E	07/07/2020	11.5	5.2X	3	6(2)	2(6)	1(4)	0(0)	0(0)	1(1)	0(0)	67(3)	53(6)	0(0)	186 *	22.0	
SR3	14.80	E	09/01/2020	11.5	5.2X	3	8(3)	2(6)	1(4)	0(0)	0(0)	1(1)	0(0)	50(4)	19(6)	0(0)	478	24.0	
SR4	11.30	E	07/07/2020	15.0	8.6X	3	7(2)	4(6)	1(3)	0(0)	0(0)	0(0)	0(0)	71(2)	98(1)	0(0)	232	14.0	
SR4	11.30	E	09/01/2020	15.0	8.6X	3	8(2)	3(6)	1(3)	0(0)	0(0)	0(0)	0(0)	38(5)	60(5)	0(0)	210	21.0	
SR5	8.00	E	07/08/2020	20.6	5.4X	3	7(2)	3(6)	1(4)	0(0)	1(1)	1(1)	0(0)	43(4)	75(4)	4(2)	106 *	24.0	3.6
SR5	8.00	E	09/01/2020	20.6	5.4X	3	5(2)	3(6)	1(4)	0(0)	0(0)	0(0)	0(0)	40(5)	53(6)	0(0)	38 * *	23.0	4.2
SR6	7.40	D	07/08/2020	21.5	8.6X	3	4(1)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	50(4)	72(4)	0(0)	65 *	15.0	3.3
SR6	7.40	D	08/31/2020	21.5	8.6X	3	8(2)	3(6)	1(3)	0(0)	0(0)	1(1)	0(0)	63(3)	56(6)	0(0)	156 *	21.0	5.0

na - Qualitative data, Modified Iwb not applicable.
X - IBI extrapolated
* - < 200 Total individuals in sample
** - < 50 Total individuals in sample
● - One or more species excluded from IBI calculation.

Appendix Table A-1. Fish IBI results for data collected in North Branch Chicago River study area during 2021 and 2022.

Site ID	River Mile	Type	Date	DA sq mi	Wetted Width (ft)	IL IBI Reg.	Number of: Native species	Sunfish species	Sucker species	Intolerant species	Benthic Invert. species	Minnow species	Percent: Mineral Substrate Spawners	Tolerant Fish (as Species)	Generalist Feeders	Specialized Benthic Invert-ivores	Rel.No. /(0.3km)	IBI	Modified Iwb
SR7	3.00	P	07/10/2020	23.7	62.7	3	10(2)	5(6)	0(0)	0(0)	0(0)	1(1)	0(0)	40(4)	89(2)	0(0)	1002	15.0	7.0
SR18	0.50	D	07/08/2020	30.9	16.6	3	9(2)	3(6)	1(2)	0(0)	0(0)	1(1)	0(0)	56(3)	87(2)	0(0)	678	16.0	7.0
SR18	0.50	D	08/31/2020	30.9	16.6	3	11(2)	4(6)	1(2)	0(0)	1(1)	2(1)	0(0)	64(3)	69(4)	0(1)	1419	20.0	8.0

na - Qualitative data, Modified Iwb not applicable.
X - IBI extrapolated
* - < 200 Total individuals in sample
** - < 50 Total individuals in sample
● - One or more species excluded from IBI calculation.

Appendix Table A-1-A: NBWW 2020-21 fish species grand by numbers.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Rel. Number	% by Number	Average Weight (g)	Rel. Weight (kg)	% by Weight
20	003	GIZZARD SHAD	*Dorosoma cepedianum*		2179.0	23.90	15.9	11.312	2.99
77	006	LARGEMOUTH BASS	*Micropterus salmoides*		1607.0	17.63	36.2	11.759	3.11
77	009	BLUEGILL SUNFISH	*Lepomis macrochirus*	P	1046.5	11.48	15.4	21.888	5.79
77	008	GREEN SUNFISH	*Lepomis cyanellus*	T	1000.0	10.97	13.6	13.161	3.48
43	002	GOLDFISH	*Carassius auratus*	T	939.5	10.31	74.4	21.319	5.64
54	002	BLACKSTRIPE TOPMINNOW	*Fundulus notatus*		587.5	6.44	1.8	0.872	0.23
40	016	WHITE SUCKER	*Catostomus commersoni*	T	536.5	5.89	108.8	69.899	18.49
47	004	YELLOW BULLHEAD	*Ameiurus natalis*	T	381.0	4.18	48.8	17.773	4.70
43	001	COMMON CARP	*Cyprinus carpio*	T	355.0	3.89	1040.8	188.920	49.99
43	003	GOLDEN SHINER	*Notemigonus crysoleucas*	T	243.5	2.67	8.2	0.849	0.22
77	015	GREEN SF X BLUEGILL SF	*HYBRID*		50.0	0.55	56.5	1.775	0.47
47	006	BLACK BULLHEAD	*Ameiurus melas*	P	36.0	0.39	104.0	3.775	1.00
34	001	CENTRAL MUDMINNOW	*Umbra limi*	T	35.5	0.39	6.2	0.135	0.04
77	013	PUMPKINSEED SUNFISH	*Lepomis gibbosus*	P	26.5	0.29	31.5	0.905	0.24
43	042	FATHEAD MINNOW	*Pimephales promelas*	T	26.0	0.29	2.6	0.102	0.03
43	043	BLUNTNOSE MINNOW	*Pimephales notatus*	T	16.5	0.18	3.6	0.052	0.01
77	012	REDEAR SUNFISH	*Lepomis microlophus*		14.0	0.15	61.4	0.860	0.23
43	045	COMMON CARP X GOLDFISH	*HYBRID*	T	12.0	0.13	602.1	11.385	3.01
47	013	TADPOLE MADTOM	*Noturus gyrinus*		10.0	0.11	7.5	0.076	0.02
43	013	CREEK CHUB	*Semotilus atromaculatus*	T	4.0	0.04	45.0	0.180	0.05
47	002	CHANNEL CATFISH	*Ictalurus punctatus*		2.0	0.02	430.0	0.860	0.23
57	001	WESTERN MOSQUITOFISH	*Gambusia affinis*		2.0	0.02	2.0	0.004	0.00
77	002	BLACK CRAPPIE	*Pomoxis nigromaculatus*		2.0	0.02	30.0	0.060	0.02
80	021	IOWA DARTER	*Etheostoma exile*		2.0	0.02	2.0	0.004	0.00
95	001	BROOK STICKLEBACK	*Culaea inconstans*		2.0	0.02	10.0	0.020	0.01

Appendix Table A-1-B: NBWW 2020-21 fish species grand by biomass.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Rel. Number	% by Number	Average Weight (g)	Rel. Weight (kg)	% by Weight
43	001	COMMON CARP	*Cyprinus carpio*	T	355.0	3.89	1040.8	188.920	49.99
40	016	WHITE SUCKER	*Catostomus commersoni*	T	536.5	5.89	108.8	69.899	18.49
77	009	BLUEGILL SUNFISH	*Lepomis macrochirus*	P	1046.5	11.48	15.4	21.888	5.79
43	002	GOLDFISH	*Carassius auratus*	T	939.5	10.31	74.4	21.319	5.64
47	004	YELLOW BULLHEAD	*Ameiurus natalis*	T	381.0	4.18	48.8	17.773	4.70
77	008	GREEN SUNFISH	*Lepomis cyanellus*	T	1000.0	10.97	13.6	13.161	3.48
77	006	LARGEMOUTH BASS	*Micropterus salmoides*		1607.0	17.63	36.2	11.759	3.11
43	045	COMMON CARP X GOLDFISH	*HYBRID*	T	12.0	0.13	602.1	11.385	3.01
20	003	GIZZARD SHAD	*Dorosoma cepedianum*		2179.0	23.90	15.9	11.312	2.99
47	006	BLACK BULLHEAD	*Ameiurus melas*	P	36.0	0.39	104.0	3.775	1.00
77	015	GREEN SF X BLUEGILL SF	*HYBRID*		50.0	0.55	56.5	1.775	0.47
77	013	PUMPKINSEED SUNFISH	*Lepomis gibbosus*	P	26.5	0.29	31.5	0.905	0.24
54	002	BLACKSTRIPE TOPMINNOW	*Fundulus notatus*		587.5	6.44	1.8	0.872	0.23
77	012	REDEAR SUNFISH	*Lepomis microlophus*		14.0	0.15	61.4	0.860	0.23
47	002	CHANNEL CATFISH	*Ictalurus punctatus*		2.0	0.02	430.0	0.860	0.23
43	003	GOLDEN SHINER	*Notemigonus crysoleucas*	T	243.5	2.67	8.2	0.849	0.22
43	013	CREEK CHUB	*Semotilus atromaculatus*	T	4.0	0.04	45.0	0.180	0.05
34	001	CENTRAL MUDMINNOW	*Umbra limi*	T	35.5	0.39	6.2	0.135	0.04
43	042	FATHEAD MINNOW	*Pimephales promelas*	T	26.0	0.29	2.6	0.102	0.03
47	013	TADPOLE MADTOM	*Noturus gyrinus*		10.0	0.11	7.5	0.076	0.02
77	002	BLACK CRAPPIE	*Pomoxis nigromaculatus*		2.0	0.02	30.0	0.060	0.02
43	043	BLUNTNOSE MINNOW	*Pimephales notatus*	T	16.5	0.18	3.6	0.052	0.01
95	001	BROOK STICKLEBACK	*Culaea inconstans*		2.0	0.02	10.0	0.020	0.01
57	001	WESTERN MOSQUITOFISH	*Gambusia affinis*		2.0	0.02	2.0	0.004	0.00
80	021	IOWA DARTER	*Etheostoma exile*		2.0	0.02	2.0	0.004	0.00

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF19 River: 95-009 North Branch Chicago River RM: 18.60 Date: 07/09/2020

Time Fished: 1234 Distance: 0.200 Drainge (sq mi): 93.4 Depth: 0

Location: Ust. Dempster St. Lat: 42.04203 Long: -87.78799

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-001	COMMON CARP	O	T	M	G	8	12.0	17.39	36150	96.33	3012.5
43-002	GOLDFISH	O	T	M	G	5	7.5	10.87	525	1.40	70.0
47-004	YELLOW BULLHEAD	I	T	C		3	4.5	6.52	225	0.60	50.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		3	4.5	6.52	4	0.01	1.0
77-006	LARGEMOUTH BASS	C		C	F	2	3.0	4.35	15	0.04	5.0
77-008	GREEN SUNFISH	I	T	C	S	12	18.0	26.09	375	1.00	20.8
77-009	BLUEGILL SUNFISH	I	P	C	S	13	19.5	28.26	232	0.62	11.9

No Species: 7 **Nat. Species:** 5 **Hybrids:** 0 **Total Counted:** 46 **Total Rel. Wt. :** 37527

IBI: 11.0 **MIwb:** 3.6

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF19 River: 95-009 North Branch Chicago River RM: 18.60 Date: 08/31/2020

Time Fished: 2121 Distance: 0.200 Drainge (sq mi): 93.4 Depth: 0

Location: Ust. Dempster St. Lat: 42.04203 Long: -87.78799

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		190	285.0	51.21	1605	3.85	5.6
40-016	WHITE SUCKER	O	T	S	W	64	96.0	17.25	19665	47.16	204.8
43-001	COMMON CARP	O	T	M	G	7	10.5	1.89	16725	40.11	1592.8
43-002	GOLDFISH	O	T	M	G	5	7.5	1.35	810	1.94	108.0
43-043	BLUNTNOSE MINNOW	O	T	C	N	2	3.0	0.54	15	0.04	5.0
47-004	YELLOW BULLHEAD	I	T	C		6	9.0	1.62	975	2.34	108.3
54-002	BLACKSTRIPE TOPMINNOW	I		M		8	12.0	2.16	15	0.04	1.2
77-006	LARGEMOUTH BASS	C		C	F	29	43.5	7.82	345	0.83	7.9
77-008	GREEN SUNFISH	I	T	C	S	16	24.0	4.31	390	0.94	16.2
77-009	BLUEGILL SUNFISH	I	P	C	S	44	66.0	11.86	1155	2.77	17.5

No Species: 10 **Nat. Species:** 8 **Hybrids:** 0 **Total Counted:** 371 **Total Rel. Wt. :** 41700

IBI: 15.0 **MIwb:** 6.3

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID:	MF17	River: 95-291	Middle Fork North Branch Chicago River	RM:	1.80	Date: 07/09/2020

Time Fished:	Distance:	Drainge (sq mi):	Depth:
1077	0.200	57.3	0

Location:	Lat:	Long:
Dst. Glenview Rd.	42.06747	-87.77377

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		44	66.0	44.90	66	4.41	1.0
47-004	YELLOW BULLHEAD	I	T	C		15	22.5	15.31	927	61.92	41.2
47-013	TADPOLE MADTOM	I		C		1	1.5	1.02	7	0.50	5.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		3	4.5	3.06	9	0.60	2.0
77-006	LARGEMOUTH BASS	C		C	F	11	16.5	11.22	37	2.51	2.2
77-008	GREEN SUNFISH	I	T	C	S	16	24.0	16.33	150	10.02	6.2
77-009	BLUEGILL SUNFISH	I	P	C	S	8	12.0	8.16	300	20.04	25.0

No Species: 7 **Nat. Species:** 7 **Hybrids:** 0 **Total Counted:** 98 **Total Rel. Wt. :** 1497

IBI: 16.0 **MIwb:** 5.0

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF17 River: 95-291 Middle Fork North Branch Chicago River RM: 1.80 Date: 08/31/2020

Time Fished: 1387 Distance: 0.200 Drainge (sq mi): 57.3 Depth: 0

Location: Dst. Glenview Rd. Lat: 42.06747 Long: -87.77377

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		83	124.5	38.43	885	9.87	7.1
40-016	WHITE SUCKER	O	T	S	W	18	27.0	8.33	5115	57.02	189.4
43-001	COMMON CARP	O	T	M	G	3	4.5	1.39	135	1.51	30.0
43-002	GOLDFISH	O	T	M	G	1	1.5	0.46	210	2.34	140.0
43-003	GOLDEN SHINER	I	T	M	N	15	22.5	6.94	90	1.00	4.0
47-004	YELLOW BULLHEAD	I	T	C		4	6.0	1.85	390	4.35	65.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		3	4.5	1.39	15	0.17	3.3
77-006	LARGEMOUTH BASS	C		C	F	32	48.0	14.81	300	3.34	6.2
77-008	GREEN SUNFISH	I	T	C	S	27	40.5	12.50	675	7.53	16.6
77-009	BLUEGILL SUNFISH	I	P	C	S	29	43.5	13.43	1110	12.37	25.5
77-013	PUMPKINSEED SUNFISH	I	P	C	S	1	1.5	0.46	45	0.50	30.0

No Species: 11 **Nat. Species:** 9 **Hybrids:** 0 **Total Counted:** 216 **Total Rel. Wt. :** 8970

IBI: 17.0 **MIwb:** 6.4

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID:	MF16	River: 95-291	Middle Fork North Branch Chicago River		RM:	3.00	Date: 07/09/2020	
Time Fished:	858	Distance:	0.200	Drainge (sq mi):	56.1	Depth:	0	
Location:	Ust. E. Lake Rd.				Lat:	42.08246	Long:	-87.77828

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		11	16.5	16.67	28	0.65	1.7
40-016	WHITE SUCKER	O	T	S	W	1	1.5	1.52	1	0.03	1.0
43-001	COMMON CARP	O	T	M	G	1	1.5	1.52	3750	85.44	2500.0
43-002	GOLDFISH	O	T	M	G	3	4.5	4.55	450	10.25	100.0
43-003	GOLDEN SHINER	I	T	M	N	4	6.0	6.06	6	0.14	1.0
47-013	TADPOLE MADTOM	I		C		1	1.5	1.52	7	0.17	5.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		7	10.5	10.61	10	0.24	1.0
77-006	LARGEMOUTH BASS	C		C	F	20	30.0	30.30	30	0.68	1.0
77-008	GREEN SUNFISH	I	T	C	S	11	16.5	16.67	82	1.88	5.0
77-009	BLUEGILL SUNFISH	I	P	C	S	7	10.5	10.61	22	0.51	2.1

No Species: 10 **Nat. Species:** 8 **Hybrids:** 0 **Total Counted:** 66 **Total Rel. Wt. :** 4389

IBI: 22.0 **MIwb:** 4.6

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF16 River: 95-291 Middle Fork North Branch Chicago River RM: 3.00 Date: 08/31/2020

Time Fished: 1442 Distance: 0.200 Drainge (sq mi): 56.1 Depth: 0

Location: Ust. E. Lake Rd. Lat: 42.08246 Long: -87.77828

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		26	39.0	17.45	240	1.18	6.1
40-016	WHITE SUCKER	O	T	S	W	3	4.5	2.01	375	1.85	83.3
43-001	COMMON CARP	O	T	M	G	7	10.5	4.70	18225	89.90	1735.7
43-003	GOLDEN SHINER	I	T	M	N	20	30.0	13.42	60	0.30	2.0
43-043	BLUNTNOSE MINNOW	O	T	C	N	6	9.0	4.03	22	0.11	2.5
47-004	YELLOW BULLHEAD	I	T	C		4	6.0	2.68	420	2.07	70.0
47-013	TADPOLE MADTOM	I		C		1	1.5	0.67	15	0.07	10.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		17	25.5	11.41	30	0.15	1.1
77-006	LARGEMOUTH BASS	C		C	F	20	30.0	13.42	240	1.18	8.0
77-008	GREEN SUNFISH	I	T	C	S	27	40.5	18.12	390	1.92	9.6
77-009	BLUEGILL SUNFISH	I	P	C	S	17	25.5	11.41	120	0.59	4.7
77-015	GREEN SF X BLUEGILL SF					1	1.5	0.67	135	0.67	90.0

No Species: 11 **Nat. Species:** 10 **Hybrids:** 1 **Total Counted:** 149 **Total Rel. Wt. :** 20272

IBI: 20.0 **MIwb:** 4.9

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF15 River: 95-291 Middle Fork North Branch Chicago River RM: 4.00 Date: 07/31/2021

Time Fished: 966 Distance: 0.150 Drainge (sq mi): 24.2 Depth: 0

Location: dst. Winnetka Ave. Lat: 42.09350 Long: -87.77070

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		2	4.0	1.96	160	2.42	40.0
40-016	WHITE SUCKER	O	T	S	W	14	28.0	13.73	3280	49.70	117.1
43-001	COMMON CARP	O	T	M	G	1	2.0	0.98	880	13.33	440.0
43-003	GOLDEN SHINER	I	T	M	N	1	2.0	0.98	40	0.61	20.0
47-004	YELLOW BULLHEAD	I	T	C		5	10.0	4.90	320	4.85	32.0
47-006	BLACK BULLHEAD	I	P	C		2	4.0	1.96	160	2.42	40.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		18	36.0	17.65	100	1.52	2.7
77-006	LARGEMOUTH BASS	C		C	F	37	74.0	36.27	960	14.55	12.9
77-008	GREEN SUNFISH	I	T	C	S	11	22.0	10.78	440	6.67	20.0
77-009	BLUEGILL SUNFISH	I	P	C	S	11	22.0	10.78	260	3.94	11.8

No Species: 10 **Nat. Species:** 9 **Hybrids:** 0 **Total Counted:** 102 **Total Rel. Wt. :** 6600

IBI: 17.0 **MIwb:** 6.2

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF14 River: 95-291 Middle Fork North Branch Chicago River RM: 6.00 Date: 07/31/2021

Time Fished: 1109 Distance: 0.150 Drainge (sq mi): 22.4 Depth: 0

Location: dst. Sunset Dr. Lat: 42.11570 Long: -87.78550

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	WHITE SUCKER	O	T	S	W	26	52.0	25.74	2940	46.96	56.5
43-013	CREEK CHUB	G	T	N	N	2	4.0	1.98	180	2.88	45.0
47-004	YELLOW BULLHEAD	I	T	C		14	28.0	13.86	900	14.38	32.1
47-006	BLACK BULLHEAD	I	P	C		1	2.0	0.99	220	3.51	110.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		8	16.0	7.92	60	0.96	3.7
77-006	LARGEMOUTH BASS	C		C	F	18	36.0	17.82	200	3.19	5.5
77-008	GREEN SUNFISH	I	T	C	S	24	48.0	23.76	1180	18.85	24.5
77-009	BLUEGILL SUNFISH	I	P	C	S	8	16.0	7.92	580	9.27	36.2

No Species: 8 **Nat. Species:** 8 **Hybrids:** 0 **Total Counted:** 101 **Total Rel. Wt. :** 6260

IBI: 15.0 **MIwb:** 5.5

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF13 River: 95-291 Middle Fork North Branch Chicago River RM: 8.60 Date: 07/31/2021

Time Fished: 1939 Distance: 0.150 Drainge (sq mi): 20.9 Depth: 0

Location: ust. IL68 Lat: 42.13940 Long: -87.81050

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
47-004	YELLOW BULLHEAD	I	T	C		14	28.0	51.85	700	87.50	25.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		11	22.0	40.74	20	2.50	0.9
77-006	LARGEMOUTH BASS	C		C	F	1	2.0	3.70	40	5.00	20.0
77-008	GREEN SUNFISH	I	T	C	S	1	2.0	3.70	40	5.00	20.0

No Species: 4 **Nat. Species:** 4 **Hybrids:** 0 **Total Counted:** 27 **Total Rel. Wt. :** 800

IBI: 13.0 **MIwb:** 3.0

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF12 River: 95-291 Middle Fork North Branch Chicago River RM: 10.80 Date: 07/31/2021

Time Fished: 1390 Distance: 0.150 Drainge (sq mi): 19.2 Depth: 0

Location: ust. Carriage Way Lat: 42.15990 Long: -87.82510

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-001	COMMON CARP	O	T	M	G	4	8.0	5.41	1940	58.43	242.5
47-004	YELLOW BULLHEAD	I	T	C		8	16.0	10.81	620	18.67	38.7
47-006	BLACK BULLHEAD	I	P	C		1	2.0	1.35	220	6.63	110.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		44	88.0	59.46	140	4.22	1.5
77-006	LARGEMOUTH BASS	C		C	F	7	14.0	9.46	60	1.81	4.2
77-008	GREEN SUNFISH	I	T	C	S	9	18.0	12.16	300	9.04	16.6
77-009	BLUEGILL SUNFISH	I	P	C	S	1	2.0	1.35	40	1.20	20.0

No Species: 7 **Nat. Species:** 6 **Hybrids:** 0 **Total Counted:** 74 **Total Rel. Wt. :** 3320

IBI: 15.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF11 River: 95-291 Middle Fork North Branch Chicago River RM: 14.10 Date: 07/31/2021

Time Fished: 1384 Distance: 0.150 Drainge (sq mi): 16.1 Depth: 0

Location: dst. IL22 Lat: 42.19920 Long: -87.85320

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		8	16.0	3.76	1120	5.20	70.0
34-001	CENTRAL MUDMINNOW	I	T	C		2	4.0	0.94	20	0.09	5.0
40-016	WHITE SUCKER	O	T	S	W	5	10.0	2.35	2000	9.29	200.0
43-001	COMMON CARP	O	T	M	G	4	8.0	1.88	10400	48.32	1300.0
47-004	YELLOW BULLHEAD	I	T	C		9	18.0	4.23	980	4.55	54.4
47-006	BLACK BULLHEAD	I	P	C		2	4.0	0.94	320	1.49	80.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		19	38.0	8.92	60	0.28	1.5
77-002	BLACK CRAPPIE	I		C	S	1	2.0	0.47	60	0.28	30.0
77-006	LARGEMOUTH BASS	C		C	F	14	28.0	6.57	1240	5.76	44.2
77-008	GREEN SUNFISH	I	T	C	S	46	92.0	21.60	1060	4.92	11.5
77-009	BLUEGILL SUNFISH	I	P	C	S	86	172.0	40.38	3440	15.98	20.0
77-015	GREEN SF X BLUEGILL SF					16	32.0	7.51	820	3.81	25.6
80-021	IOWA DARTER	I		M	D	1	2.0	0.47	4	0.02	2.0

No Species: 12 **Nat. Species:** 11 **Hybrids:** 1 **Total Counted:** 213 **Total Rel. Wt. :** 21524

IBI: 20.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF10 River: 95-291 Middle Fork North Branch Chicago River RM: 16.70 Date: 07/31/2021

Time Fished: 962 Distance: 0.150 Drainge (sq mi): 11.9 Depth: 0

Location: dst. Westleigh St. Lat: 42.23210 Long: -87.86930

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
34-001	CENTRAL MUDMINNOW	I	T	C		1	2.0	1.82	20	20.00	10.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		54	108.0	98.18	80	80.00	0.7

No Species: 2 **Nat. Species:** 2 **Hybrids:** 0 **Total Counted:** 55 **Total Rel. Wt. :** 100

IBI: 12.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF9 River: 95-291 Middle Fork North Branch Chicago River RM: 18.90 Date: 08/01/2021

Time Fished: 1350 Distance: 0.150 Drainge (sq mi): 8.9 Depth: 0

Location: dst. foot bridge in FP Lat: 42.25690 Long: -87.88500

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
34-001	CENTRAL MUDMINNOW	I	T	C		11	22.0	25.00	60	18.75	2.7
43-001	COMMON CARP	O	T	M	G	2	4.0	4.55	40	12.50	10.0
47-004	YELLOW BULLHEAD	I	T	C		1	2.0	2.27	40	12.50	20.0
47-006	BLACK BULLHEAD	I	P	C		1	2.0	2.27	100	31.25	50.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		27	54.0	61.36	50	15.63	0.9
77-006	LARGEMOUTH BASS	C		C	F	1	2.0	2.27	10	3.13	5.0
77-008	GREEN SUNFISH	I	T	C	S	1	2.0	2.27	20	6.25	10.0

No Species: 7 **Nat. Species:** 6 **Hybrids:** 0 **Total Counted:** 44 **Total Rel. Wt. :** 320

IBI: 14.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: MF8 River: 95-291 Middle Fork North Branch Chicago River RM: 21.10 Date: 08/01/2021

Time Fished: 1010 Distance: 0.150 Drainge (sq mi): 5.8 Depth: 0

Location: ust. Rockland Rd. Lat: 42.28080 Long: -87.89850

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
34-001	CENTRAL MUDMINNOW	I	T	C		3	6.0	20.00	20	16.67	3.3
47-004	YELLOW BULLHEAD	I	T	C		3	6.0	20.00	60	50.00	10.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		3	6.0	20.00	20	16.67	3.3
77-009	BLUEGILL SUNFISH	I	P	C	S	6	12.0	40.00	20	16.67	1.6

No Species: 4 **Nat. Species:** 4 **Hybrids:** 0 **Total Counted:** 15 **Total Rel. Wt. :** 120

IBI: 13.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: WF25 River: 95-292 West Fork North Branch Chicago River RM: 1.30 Date: 07/30/2021

Time Fished: 1880 Distance: 0.200 Drainge (sq mi): 27.9 Depth: 0

Location: ust. footbridge Lat: 42.06400 Long: -87.78960

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		1	1.5	0.75	60	0.17	40.0
34-001	CENTRAL MUDMINNOW	I	T	C		1	1.5	0.75	15	0.04	10.0
40-016	WHITE SUCKER	O	T	S	W	2	3.0	1.50	90	0.25	30.0
43-001	COMMON CARP	O	T	M	G	12	18.0	9.02	18210	50.67	1011.6
43-002	GOLDFISH	O	T	M	G	35	52.5	26.32	1800	5.01	34.2
43-003	GOLDEN SHINER	I	T	M	N	1	1.5	0.75	45	0.13	30.0
43-045	COMMON CARP X GOLDFISH	O	T		G	7	10.5	5.26	11175	31.09	1064.2
47-004	YELLOW BULLHEAD	I	T	C		35	52.5	26.32	3165	8.81	60.2
47-006	BLACK BULLHEAD	I	P	C		2	3.0	1.50	450	1.25	150.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		5	7.5	3.76	30	0.08	4.0
77-006	LARGEMOUTH BASS	C		C	F	4	6.0	3.01	30	0.08	5.0
77-008	GREEN SUNFISH	I	T	C	S	15	22.5	11.28	435	1.21	19.3
77-009	BLUEGILL SUNFISH	I	P	C	S	13	19.5	9.77	435	1.21	22.3

No Species: 12 **Nat. Species:** 10 **Hybrids:** 1 **Total Counted:** 133 **Total Rel. Wt. :** 35940

IBI: 12.0 **MIwb:** 4.6

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: WF24 River: 95-292 West Fork North Branch Chicago River RM: 2.90 Date: 07/30/2021

Time Fished: 1317 Distance: 0.200 Drainge (sq mi): 24.5 Depth: 0

Location: dst. Lake Ave. Lat: 42.07890 Long: -87.80250

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	WHITE SUCKER	O	T	S	W	4	6.0	3.42	990	17.81	165.0
43-001	COMMON CARP	O	T	M	G	5	7.5	4.27	60	1.08	8.0
43-002	GOLDFISH	O	T	M	G	11	16.5	9.40	480	8.64	29.0
43-043	BLUNTNOSE MINNOW	O	T	C	N	1	1.5	0.85	7	0.13	5.0
47-004	YELLOW BULLHEAD	I	T	C		42	63.0	35.90	2925	52.63	46.4
54-002	BLACKSTRIPE TOPMINNOW	I		M		13	19.5	11.11	30	0.54	1.5
77-006	LARGEMOUTH BASS	C		C	F	3	4.5	2.56	105	1.89	23.3
77-008	GREEN SUNFISH	I	T	C	S	30	45.0	25.64	735	13.23	16.3
77-009	BLUEGILL SUNFISH	I	P	C	S	8	12.0	6.84	225	4.05	18.7

No Species: 9 **Nat. Species:** 7 **Hybrids:** 0 **Total Counted:** 117 **Total Rel. Wt. :** 5557

IBI: 10.0 **MIwb:** 5.0

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: WF23 River: 95-292 West Fork North Branch Chicago River RM: 4.90 Date: 07/30/2021

Time Fished: 1183 Distance: 0.200 Drainge (sq mi): 17.8 Depth: 0

Location: dst. Willow Rd. Lat: 42.10370 Long: -87.80970

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		4	6.0	0.51	225	0.64	37.5
40-016	WHITE SUCKER	O	T	S	W	2	3.0	0.26	450	1.28	150.0
43-001	COMMON CARP	O	T	M	G	146	219.0	18.74	15840	44.94	72.3
43-002	GOLDFISH	O	T	M	G	552	828.0	70.86	15480	43.91	18.6
43-045	COMMON CARP X GOLDFISH	O	T		G	1	1.5	0.13	210	0.60	140.0
47-004	YELLOW BULLHEAD	I	T	C		22	33.0	2.82	1770	5.02	53.6
47-006	BLACK BULLHEAD	I	P	C		1	1.5	0.13	75	0.21	50.0
77-006	LARGEMOUTH BASS	C		C	F	9	13.5	1.16	105	0.30	7.7
77-008	GREEN SUNFISH	I	T	C	S	28	42.0	3.59	645	1.83	15.3
77-009	BLUEGILL SUNFISH	I	P	C	S	14	21.0	1.80	450	1.28	21.4

No Species: 9 **Nat. Species:** 7 **Hybrids:** 1 **Total Counted:** 779 **Total Rel. Wt. :** 35250

IBI: 9.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: WF22 River: 95-292 West Fork North Branch Chicago River RM: 9.20 Date: 07/30/2021

Time Fished: 1361 Distance: 0.200 Drainge (sq mi): 9.4 Depth: 0

Location: dst. Pfinston Rd/ Lake Cook Lat: 42.15210 Long: -87.84700

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-001	COMMON CARP	O	T	M	G	11	16.5	16.18	10515	90.22	637.2
43-003	GOLDEN SHINER	I	T	M	N	3	4.5	4.41	90	0.77	20.0
47-004	YELLOW BULLHEAD	I	T	C		5	7.5	7.35	285	2.45	38.0
77-006	LARGEMOUTH BASS	C		C	F	1	1.5	1.47	22	0.19	15.0
77-008	GREEN SUNFISH	I	T	C	S	8	12.0	11.76	202	1.74	16.8
77-009	BLUEGILL SUNFISH	I	P	C	S	39	58.5	57.35	450	3.86	7.6
77-015	GREEN SF X BLUEGILL SF					1	1.5	1.47	90	0.77	60.0

No Species: 6 **Nat. Species:** 5 **Hybrids:** 1 **Total Counted:** 68 **Total Rel. Wt. :** 11655

IBI: 9.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: WF21 River: 95-292 West Fork North Branch Chicago River RM: 10.40 Date: 07/30/2021

Time Fished: 1044 Distance: 0.150 Drainge (sq mi): 7.0 Depth: 0

Location: dst. Deerfield Rd. Lat: 42.16640 Long: -87.85700

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
47-004	YELLOW BULLHEAD	I	T	C		1	2.0	7.69	60	63.83	30.0
57-001	WESTERN MOSQUITOFISH	I		N	E	1	2.0	7.69	4	4.26	2.0
77-006	LARGEMOUTH BASS	C		C	F	1	2.0	7.69	10	10.64	5.0
77-009	BLUEGILL SUNFISH	I	P	C	S	10	20.0	76.92	20	21.28	1.0

No Species: 4 **Nat. Species:** 3 **Hybrids:** 0 **Total Counted:** 13 **Total Rel. Wt. :** 94

IBI: 11.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: WF20 River: 95-292 West Fork North Branch Chicago River RM: 12.50 Date: 07/30/2021

Time Fished: 754 Distance: 0.150 Drainge (sq mi): 3.9 Depth: 0

Location: adj. Sounders Rd. Lat: 42.18590 Long: -87.88140

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
47-004	YELLOW BULLHEAD	I	T	C		1	2.0	12.50	6	21.43	3.0
77-008	GREEN SUNFISH	I	T	C	S	6	12.0	75.00	20	71.43	1.6
77-009	BLUEGILL SUNFISH	I	P	C	S	1	2.0	12.50	2	7.14	1.0

No Species: 3 **Nat. Species:** 3 **Hybrids:** 0 **Total Counted:** 8 **Total Rel. Wt. :** 28

IBI: 7.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR18 River: 95-403 Skokie River RM: 0.50 Date: 07/08/2020

Time Fished: 1477 Distance: 0.200 Drainge (sq mi): 30.9 Depth: 0

Location: Dst. I-94 Lat: 42.08853 Long: -87.76192

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		185	277.5	40.93	450	2.11	1.6
40-016	WHITE SUCKER	O	T	S	W	45	67.5	9.96	10950	51.38	162.2
43-001	COMMON CARP	O	T	M	G	1	1.5	0.22	2625	12.32	1750.0
43-003	GOLDEN SHINER	I	T	M	N	13	19.5	2.88	31	0.15	1.6
47-004	YELLOW BULLHEAD	I	T	C		4	6.0	0.88	30	0.14	5.0
47-006	BLACK BULLHEAD	I	P	C		3	4.5	0.66	750	3.52	166.6
54-002	BLACKSTRIPE TOPMINNOW	I		M		4	6.0	0.88	6	0.03	1.0
77-006	LARGEMOUTH BASS	C		C	F	51	76.5	11.28	603	2.83	7.8
77-008	GREEN SUNFISH	I	T	C	S	25	37.5	5.53	615	2.89	16.4
77-009	BLUEGILL SUNFISH	I	P	C	S	118	177.0	26.11	4950	23.23	27.9
77-015	GREEN SF X BLUEGILL SF					3	4.5	0.66	300	1.41	66.6

No Species: 10 **Nat. Species:** 9 **Hybrids:** 1 **Total Counted:** 452 **Total Rel. Wt. :** 21310

IBI: 16.0 **MIwb:** 7.0

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR18 River: 95-403 Skokie River RM: 0.50 Date: 08/31/2020

Time Fished: 2209 Distance: 0.200 Drainge (sq mi): 30.9 Depth: 0

Location: Dst. I-94 Lat: 42.08853 Long: -87.76192

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		354	531.0	37.42	2745	14.80	5.1
40-016	WHITE SUCKER	O	T	S	W	45	67.5	4.76	7200	38.82	106.6
43-001	COMMON CARP	O	T	M	G	4	6.0	0.42	240	1.29	40.0
43-002	GOLDFISH	O	T	M	G	4	6.0	0.42	930	5.01	155.0
43-003	GOLDEN SHINER	I	T	M	N	82	123.0	8.67	330	1.78	2.6
43-043	BLUNTNOSE MINNOW	O	T	C	N	2	3.0	0.21	6	0.03	2.0
47-004	YELLOW BULLHEAD	I	T	C		18	27.0	1.90	1815	9.79	67.2
47-013	TADPOLE MADTOM	I		C		1	1.5	0.11	15	0.08	10.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		12	18.0	1.27	30	0.16	1.6
77-006	LARGEMOUTH BASS	C		C	F	278	417.0	29.39	1575	8.49	3.7
77-008	GREEN SUNFISH	I	T	C	S	36	54.0	3.81	975	5.26	18.0
77-009	BLUEGILL SUNFISH	I	P	C	S	107	160.5	11.31	2580	13.91	16.0
77-013	PUMPKINSEED SUNFISH	I	P	C	S	2	3.0	0.21	60	0.32	20.0
77-015	GREEN SF X BLUEGILL SF					1	1.5	0.11	45	0.24	30.0

No Species: 13 **Nat. Species:** 11 **Hybrids:** 1 **Total Counted:** 946 **Total Rel. Wt. :** 18546

IBI: 20.0 **MIwb:** 8.0

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR7 River: 95-403 Skokie River RM: 3.00 Date: 07/10/2020

Time Fished: 2160 Distance: 0.500 Drainge (sq mi): 23.7 Depth: 0

Location: Skokie Lagoons Lat: 42.11367 Long: -87.77107

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		364	728.0	72.65	3260	11.44	4.4
43-001	COMMON CARP	O	T	M	G	6	12.0	1.20	13800	48.42	1150.0
43-003	GOLDEN SHINER	I	T	M	N	10	20.0	2.00	100	0.35	5.0
47-002	CHANNEL CATFISH			C	F	1	2.0	0.20	860	3.02	430.0
47-004	YELLOW BULLHEAD	I	T	C		1	2.0	0.20	520	1.82	260.0
47-006	BLACK BULLHEAD	I	P	C		1	2.0	0.20	620	2.18	310.0
77-006	LARGEMOUTH BASS	C		C	F	38	76.0	7.58	2620	9.19	34.4
77-008	GREEN SUNFISH	I	T	C	S	2	4.0	0.40	40	0.14	10.0
77-009	BLUEGILL SUNFISH	I	P	C	S	60	120.0	11.98	4780	16.77	39.8
77-012	REDEAR SUNFISH	I		C	E	7	14.0	1.40	860	3.02	61.4
77-013	PUMPKINSEED SUNFISH	I	P	C	S	10	20.0	2.00	720	2.53	36.0
77-015	GREEN SF X BLUEGILL SF					1	2.0	0.20	320	1.12	160.0

No Species: 11 **Nat. Species:** 9 **Hybrids:** 1 **Total Counted:** 501 **Total Rel. Wt. :** 28500

IBI: 15.0 **MIwb:** 7.0

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR6 River: 95-403 Skokie River RM: 7.40 Date: 07/08/2020

Time Fished: 877 Distance: 0.200 Drainge (sq mi): 21.5 Depth: 0

Location: Ust. Lake Cook Rd. Lat: 42.15350 Long: -87.79441

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-001	COMMON CARP	O	T	M	G	1	1.5	2.33	2250	81.08	1500.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		9	13.5	20.93	13	0.49	1.0
77-006	LARGEMOUTH BASS	C		C	F	1	1.5	2.33	1	0.05	1.0
77-008	GREEN SUNFISH	I	T	C	S	23	34.5	53.49	390	14.05	11.3
77-009	BLUEGILL SUNFISH	I	P	C	S	7	10.5	16.28	75	2.70	7.1
77-015	GREEN SF X BLUEGILL SF					2	3.0	4.65	45	1.62	15.0

No Species: 5 **Nat. Species:** 4 **Hybrids:** 1 **Total Counted:** 43 **Total Rel. Wt. :** 2775

IBI: 15.0 **MIwb:** 3.3

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR6 River: 95-403 Skokie River RM: 7.40 Date: 08/31/2020

Time Fished: 1294 Distance: 0.200 Drainge (sq mi): 21.5 Depth: 0

Location: Ust. Lake Cook Rd. Lat: 42.15350 Long: -87.79441

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		16	24.0	15.38	120	1.44	5.0
40-016	WHITE SUCKER	O	T	S	W	7	10.5	6.73	225	2.69	21.4
43-001	COMMON CARP	O	T	M	G	4	6.0	3.85	7005	83.84	1167.5
43-002	GOLDFISH	O	T	M	G	1	1.5	0.96	90	1.08	60.0
43-003	GOLDEN SHINER	I	T	M	N	3	4.5	2.88	15	0.18	3.3
47-006	BLACK BULLHEAD	I	P	C		2	3.0	1.92	240	2.87	80.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		41	61.5	39.42	75	0.90	1.2
77-006	LARGEMOUTH BASS	C		C	F	5	7.5	4.81	30	0.36	4.0
77-008	GREEN SUNFISH	I	T	C	S	14	21.0	13.46	135	1.62	6.4
77-009	BLUEGILL SUNFISH	I	P	C	S	11	16.5	10.58	420	5.03	25.4

No Species: 10 **Nat. Species:** 8 **Hybrids:** 0 **Total Counted:** 104 **Total Rel. Wt. :** 8355

IBI: 21.0 **MIwb:** 5.0

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR5 River: 95-403 Skokie River RM: 8.00 Date: 07/08/2020

Time Fished: 775 Distance: 0.150 Drainge (sq mi): 20.6 Depth: 0

Location: Ust. Clavey Rd. @ Solel Congregation Lat: 42.16116 Long: -87.79958

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	WHITE SUCKER	O	T	S	W	13	26.0	24.53	7100	92.09	273.0
43-042	FATHEAD MINNOW	O	T	C	N	1	2.0	1.89	2	0.03	1.0
47-013	TADPOLE MADTOM	I		C		2	4.0	3.77	30	0.39	7.5
54-002	BLACKSTRIPE TOPMINNOW	I		M		2	4.0	3.77	4	0.05	1.0
77-006	LARGEMOUTH BASS	C		C	F	7	14.0	13.21	14	0.18	1.0
77-008	GREEN SUNFISH	I	T	C	S	21	42.0	39.62	500	6.49	11.9
77-009	BLUEGILL SUNFISH	I	P	C	S	5	10.0	9.43	40	0.52	4.0
77-015	GREEN SF X BLUEGILL SF					2	4.0	3.77	20	0.26	5.0

No Species: 7 **Nat. Species:** 7 **Hybrids:** 1 **Total Counted:** 53 **Total Rel. Wt. :** 7710

IBI: 24.0 **MIwb:** 3.6

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR5 River: 95-403 Skokie River RM: 8.00 Date: 09/01/2020

Time Fished: 910 Distance: 0.150 Drainge (sq mi): 20.6 Depth: 0

Location: Ust. Clavey Rd. @ Solel Congregation Lat: 42.16116 Long: -87.79958

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	WHITE SUCKER	O	T	S	W	1	2.0	5.26	40	8.33	20.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		8	16.0	42.11	30	6.25	1.8
77-006	LARGEMOUTH BASS	C		C	F	1	2.0	5.26	30	6.25	15.0
77-008	GREEN SUNFISH	I	T	C	S	4	8.0	21.05	280	58.33	35.0
77-009	BLUEGILL SUNFISH	I	P	C	S	5	10.0	26.32	100	20.83	10.0

No Species: 5 **Nat. Species:** 5 **Hybrids:** 0 **Total Counted:** 19 **Total Rel. Wt. :** 480

IBI: 23.0 **MIwb:** 4.2

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR4 River: 95-403 Skokie River RM: 11.30 Date: 07/07/2020

Time Fished: 951 Distance: 0.150 Drainge (sq mi): 15.0 Depth: 0

Location: Ust. Half Day Rd. @ Sleepy Hollow Park Lat: 42.20259 Long: -87.82993

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	WHITE SUCKER	O	T	S	W	14	28.0	12.07	1800	39.22	64.2
43-001	COMMON CARP	O	T	M	G	1	2.0	0.86	300	6.54	150.0
43-002	GOLDFISH	O	T	M	G	6	12.0	5.17	400	8.71	33.3
47-004	YELLOW BULLHEAD	I	T	C		10	20.0	8.62	300	6.54	15.0
47-006	BLACK BULLHEAD	I	P	C		1	2.0	0.86	40	0.87	20.0
77-006	LARGEMOUTH BASS	C		C	F	1	2.0	0.86	10	0.22	5.0
77-008	GREEN SUNFISH	I	T	C	S	80	160.0	68.97	1600	34.86	10.0
77-009	BLUEGILL SUNFISH	I	P	C	S	2	4.0	1.72	60	1.31	15.0
77-013	PUMPKINSEED SUNFISH	I	P	C	S	1	2.0	0.86	80	1.74	40.0

No Species: 9 **Nat. Species:** 7 **Hybrids:** 0 **Total Counted:** 116 **Total Rel. Wt. :** 4590

IBI: 14.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR4 River: 95-403 Skokie River RM: 11.30 Date: 09/01/2020

Time Fished: 1084 Distance: 0.150 Drainge (sq mi): 15.0 Depth: 0

Location: Ust. Half Day Rd. @ Sleepy Hollow Park Lat: 42.20259 Long: -87.82993

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		24	48.0	22.86	240	7.50	5.0
40-016	WHITE SUCKER	O	T	S	W	12	24.0	11.43	1360	42.47	56.6
43-002	GOLDFISH	O	T	M	G	1	2.0	0.95	140	4.37	70.0
47-006	BLACK BULLHEAD	I	P	C		1	2.0	0.95	140	4.37	70.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		1	2.0	0.95	2	0.06	1.0
77-006	LARGEMOUTH BASS	C		C	F	40	80.0	38.10	640	19.99	8.0
77-008	GREEN SUNFISH	I	T	C	S	23	46.0	21.90	640	19.99	13.9
77-009	BLUEGILL SUNFISH	I	P	C	S	2	4.0	1.90	20	0.62	5.0
95-001	BROOK STICKLEBACK	I		C		1	2.0	0.95	20	0.62	10.0

No Species: 9 **Nat. Species:** 8 **Hybrids:** 0 **Total Counted:** 105 **Total Rel. Wt. :** 3202

IBI: 21.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR3 River: 95-403 Skokie River RM: 14.80 Date: 07/07/2020

Time Fished: 1045 Distance: 0.150 Drainge (sq mi): 11.5 Depth: 0

Location: Dst. Deerpath Rd. Lat: 42.24691 Long: -87.85350

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	WHITE SUCKER	O	T	S	W	16	32.0	17.20	3400	87.58	106.2
43-042	FATHEAD MINNOW	O	T	C	N	12	24.0	12.90	100	2.58	4.1
47-004	YELLOW BULLHEAD	I	T	C		1	2.0	1.08	40	1.03	20.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		4	8.0	4.30	20	0.52	2.5
77-006	LARGEMOUTH BASS	C		C	F	40	80.0	43.01	92	2.37	1.1
77-008	GREEN SUNFISH	I	T	C	S	20	40.0	21.51	230	5.92	5.7

No Species: 6 **Nat. Species:** 6 **Hybrids:** 0 **Total Counted:** 93 **Total Rel. Wt. :** 3882

IBI: 22.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR3 River: 95-403 Skokie River RM: 14.80 Date: 09/01/2020

Time Fished: 876 Distance: 0.150 Drainge (sq mi): 11.5 Depth: 0

Location: Dst. Deerpath Rd. Lat: 42.24691 Long: -87.85350

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	GIZZARD SHAD	O		M		6	12.0	2.51	100	2.20	8.3
40-016	WHITE SUCKER	O	T	S	W	24	48.0	10.04	2180	48.06	45.4
43-003	GOLDEN SHINER	I	T	M	N	1	2.0	0.42	10	0.22	5.0
47-004	YELLOW BULLHEAD	I	T	C		2	4.0	0.84	220	4.85	55.0
47-006	BLACK BULLHEAD	I	P	C		1	2.0	0.42	40	0.88	20.0
54-002	BLACKSTRIPE TOPMINNOW	I		M		1	2.0	0.42	6	0.13	3.0
77-006	LARGEMOUTH BASS	C		C	F	193	386.0	80.75	1700	37.48	4.4
77-008	GREEN SUNFISH	I	T	C	S	11	22.0	4.60	280	6.17	12.7

No Species: 8 **Nat. Species:** 8 **Hybrids:** 0 **Total Counted:** 239 **Total Rel. Wt. :** 4536

IBI: 24.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR2 River: 95-403 Skokie River RM: 17.40 Date: 07/07/2020

Time Fished: 470 Distance: 0.150 Drainge (sq mi): 7.8 Depth: 0

Location: Ust. IL 176 Lat: 42.28040 Long: -87.86428

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
47-006	BLACK BULLHEAD	I	P	C		1	2.0	12.50	400	90.09	200.0
77-006	LARGEMOUTH BASS	C		C	F	2	4.0	25.00	4	0.90	1.0
77-008	GREEN SUNFISH	I	T	C	S	5	10.0	62.50	40	9.01	4.0

No Species: 3 **Nat. Species:** 3 **Hybrids:** 0 **Total Counted:** 8 **Total Rel. Wt. :** 444

IBI: 16.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR2 River: 95-403 Skokie River RM: 17.40 Date: 09/01/2020

Time Fished: 732 Distance: 0.150 Drainge (sq mi): 7.8 Depth: 0

Location: Ust. IL 176 Lat: 42.28040 Long: -87.86428

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-003	GOLDEN SHINER	I	T	M	N	4	8.0	7.27	26	5.46	3.2
47-004	YELLOW BULLHEAD	I	T	C		2	4.0	3.64	80	16.81	20.0
77-006	LARGEMOUTH BASS	C		C	F	47	94.0	85.45	320	67.23	3.4
77-008	GREEN SUNFISH	I	T	C	S	2	4.0	3.64	50	10.50	12.5

No Species: 4 **Nat. Species:** 4 **Hybrids:** 0 **Total Counted:** 55 **Total Rel. Wt. :** 476

IBI: 17.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR1 River: 95-403 Skokie River RM: 21.10 Date: 07/07/2020

Time Fished: 416 Distance: 0.150 Drainge (sq mi): 2.7 Depth: 0

Location: adj Gillette Plant Lat: 42.33161 Long: -87.88167

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-001	COMMON CARP	O	T	M	G	1	2.0	100.00	2000	100.00	1000.0

No Species: 1 **Nat. Species:** 0 **Hybrids:** 0 **Total Counted:** 1 **Total Rel. Wt. :** 2000

IBI: 0.0 **MIwb:** N/A

Appendix Table B-2. Midwest Biodiversity Institute
Fish Species List

Site ID: SR1 River: 95-403 Skokie River RM: 21.10 Date: 09/01/2020

Time Fished: 667 Distance: 0.150 Drainge (sq mi): 2.7 Depth: 0

Location: adj Gillette Plant Lat: 42.33161 Long: -87.88167

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-001	COMMON CARP	O	T	M	G	1	2.0	4.00	50	17.24	25.0
77-006	LARGEMOUTH BASS	C		C	F	6	12.0	24.00	60	20.69	5.0
77-008	GREEN SUNFISH	I	T	C	S	18	36.0	72.00	180	62.07	5.0

No Species: 3 **Nat. Species:** 2 **Hybrids:** 0 **Total Counted:** 25 **Total Rel. Wt. :** 290

IBI: 10.0 **MIwb:** N/A

APPENDIX B: NORTH BRANCH CHICAGO RIVER 2020-2021 MACROINVERTEBRATE ASSEMBLAGE DATA

B-1: Macroinvertebrate IBI Metrics and Scores
B-2: Macroinvertebrate Taxa Grand (all sites combined)
B-3: Macroinvertebrate Taxa by Site and Sample

Appendix Table B-1. Illinois Macroinvertebrate mIBI metrics and values from the North Branch Chicago River study area in 2020-21.

					Number of					Percent:		
River Mile	Site ID	Sample Date	Drainage Area (sq mi)	Sub-samp	Total Taxa	Coleoptera Taxa	Mayfly Taxa	Intolerant Taxa	MBI	Percent Scrapers	Percent EPT	MIBI
North Branch Chicago River (95-009)												
Year: 2020												
18.60	MF19	09/07/2020	93.41		16(35.0)	0(0.0)	1(9.8)	2(22.2)	6.0(82.0)	0.0(0.0)	0.3(0.5)	21.4
Middle Fork North Branch Chicago River (95-291)												
Year: 2020												
3.00	MF16	07/20/2020	56.15		25(54.0)	0(0.0)	0(0.0)	4(44.4)	7.3(60.7)	3.2(10.8)	2.1(2.9)	24.7
1.80	MF17	09/07/2020	57.31		25(54.0)	0(0.0)	0(0.0)	5(55.6)	7.1(63.9)	0.6(1.9)	0.6(0.8)	25.2
Year: 2021												
21.10	MF8	10/06/2021	5.81		11(24.0)	0(0.0)	0(0.0)	0(0.0)	7.6(55.7)	12.8(43.1)	0.0(0.0)	17.5
18.90	MF9	10/06/2021	8.91		20(43.0)	0(0.0)	2(19.6)	1(11.1)	6.7(70.5)	3.5(11.7)	8.7(11.7)	24.0
16.70	MF10	10/06/2021	11.99		21(46.0)	0(0.0)	1(9.8)	2(22.2)	5.4(91.8)	31.2(100)	13.2(17.9)	41.1
14.10	MF11	10/06/2021	16.13		15(33.0)	0(0.0)	1(9.8)	0(0.0)	5.6(88.5)	0.6(2.0)	12.7(17.1)	21.5
10.80	MF12	10/06/2021	19.23		16(35.0)	0(0.0)	0(0.0)	2(22.2)	6.1(80.3)	30.6(100)	0.3(0.4)	34.0
8.60	MF13	10/06/2021	20.97		18(39.0)	0(0.0)	0(0.0)	2(22.2)	8.3(44.3)	1.3(4.5)	0.0(0.0)	15.7
6.00	MF14	10/06/2021	22.48		29(63.0)	1(20.0)	2(19.6)	0(0.0)	6.3(77.1)	9.8(33.1)	47.0(63.5)	39.5
4.00	MF15	10/06/2021	24.29		27(59.0)	0(0.0)	0(0.0)	2(22.2)	8.0(49.2)	5.0(17.0)	2.0(2.7)	21.4
West Fork North Branch Chicago River (95-292)												
Year: 2021												
12.50	WF20	10/09/2021	3.90		10(22.0)	0(0.0)	0(0.0)	0(0.0)	8.9(34.4)	5.2(17.5)	0.0(0.0)	10.6
10.40	WF21	10/09/2021	7.02		11(24.0)	0(0.0)	0(0.0)	1(11.1)	8.2(45.9)	14.7(49.8)	0.0(0.0)	18.7
9.20	WF22	10/09/2021	9.41		11(24.0)	0(0.0)	0(0.0)	1(11.1)	8.6(39.3)	10.7(36.2)	0.0(0.0)	15.8
4.90	WF23	10/09/2021	17.86		22(48.0)	0(0.0)	1(9.8)	0(0.0)	8.9(34.4)	0.7(2.3)	1.4(1.9)	13.8
2.90	WF24	07/21/2021	24.52		32(70.0)	0(0.0)	2(19.6)	3(33.3)	7.3(60.7)	5.3(17.7)	6.8(9.2)	30.1
1.30	WF25	10/10/2021	27.97		19(41.0)	0(0.0)	1(9.8)	2(22.2)	6.7(70.5)	2.1(7.1)	1.8(2.4)	21.9

Appendix Table B-1. Illinois Macroinvertebrate mIBI metrics and values from the North Branch Chicago River study area in 2020-21.

River Mile	Site ID	Sample Date	Drainage Area (sq mi)	Sub-samp	Number of: Total Taxa	Number of: Coleoptera Taxa	Number of: Mayfly Taxa	Number of: Intolerant Taxa	MBI	Percent: Percent Scrapers	Percent: Percent EPT	MIBI
Skokie River (95-403)												
Year: 2020												
21.10	SR1	09/06/2020	2.78		16(35.0)	0(0.0)	0(0.0)	0(0.0)	5.8(85.3)	0.0(0.0)	0.0(0.0)	17.2
17.40	SR2	09/06/2020	7.87		23(50.0)	1(20.0)	0(0.0)	2(22.2)	6.6(72.1)	0.8(2.5)	0.0(0.0)	23.8
14.80	SR3	09/07/2020	11.56		16(35.0)	1(20.0)	0(0.0)	2(22.2)	5.6(88.5)	1.9(6.6)	0.0(0.0)	24.6
11.30	SR4	09/06/2020	15.07		15(33.0)	0(0.0)	0(0.0)	3(33.3)	5.3(93.4)	0.0(0.0)	0.0(0.0)	22.8
8.00	SR5	09/07/2020	20.67		12(26.0)	0(0.0)	0(0.0)	2(22.2)	4.0(100)	0.0(0.0)	0.0(0.0)	21.2
7.40	SR6	09/07/2020	21.51		11(24.0)	0(0.0)	0(0.0)	2(22.2)	3.7(100)	0.7(2.5)	0.0(0.0)	21.3
0.50	SR18	09/07/2020	30.90		20(43.0)	0(0.0)	0(0.0)	2(22.2)	5.9(83.6)	2.7(9.0)	2.0(2.7)	22.9

Appendix Table B-2. NBWW 2020-21 macroinvertebrate taxa grand report.

Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In
06201	*Hyalella azteca*	F	4	CG		4236	14.80	14
03600	*Oligochaeta*	T	10	CG		4019	14.04	24
06800	*Gammarus sp*	F	3			2237	7.82	10
05800	*Caecidotea sp*	T	6	CG		1896	6.62	13
84470	*Polypedilum (P.) illinoense*	T	6	SH		1277	4.46	8
01801	*Turbellaria*	F	6	PR		1015	3.55	19
22001	*Coenagrionidae*	T	5.5	PR		780	2.72	21
52200	*Cheumatopsyche sp*	F	6	CF	CA	777	2.71	5
95100	*Physella sp*	T	9	SC		674	2.35	13
82710	*Chironomus (C.) sp*	MT	11	CG		474	1.66	2
84450	*Polypedilum (Uresipedilum) flavum*	F	6	SH		430	1.50	7
68700	*Dubiraphia sp*	F	5	CG	CO	394	1.38	1
97601	*Corbicula fluminea*	F	4	CF		364	1.27	12
92300	*Valvata sp*		2	SC		360	1.26	4
98600	*Sphaerium sp*	F	5	CG		353	1.23	10
83040	*Dicrotendipes neomodestus*	F	6	CG		347	1.21	15
98200	*Pisidium sp*	MT	5	CF		290	1.01	17
13400	*Stenacron sp*	F	4	SC	MA	285	1.00	3
83300	*Glyptotendipes (G.) sp*	MT	10	CF		279	0.97	4
98001	*Pisidiidae*		5			266	0.93	4
83000	*Dicrotendipes sp*	F	6	CG		256	0.89	2
84540	*Polypedilum (Tripodura) scalaenum group*	F	6	SH		245	0.86	10
11001	*Baetidae*		4	CG	MA	239	0.83	1
17200	*Caenis sp*	F	6	CG	MA	237	0.83	3
22300	*Argia sp*	F	5	PR		204	0.71	5
93200	*Hydrobiidae*	F	6	SC		201	0.70	10
78655	*Procladius (Holotanypus) sp*	MT	8	PR		175	0.61	19
11130	*Baetis intercalaris*	F	4	CG	MA	157	0.55	4

Appendix Table B-2. continued.

Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In
80420	*Cricotopus (C.) bicinctus*	T	8	SH		136	0.48	9
82820	*Cryptochironomus sp*	F	8	PR		127	0.44	13
84750	*Stictochironomus sp*	F	5			122	0.43	2
79020	*Tanypus neopunctipennis*	T	8	PR		117	0.41	5
52001	*Hydropsychidae*		5.5	CF	CA	108	0.38	1
04664	*Helobdella stagnalis*	T	8	PR		98	0.34	9
82730	*Chironomus (C.) decorus group*	T	11			93	0.32	7
85625	*Rheotanytarsus sp*	F	6	CF		90	0.31	5
85800	*Tanytarsus sp*	F	7	CF		90	0.31	11
84210	*Paratendipes albimanus or P. duplicatus*	F	3	CG		85	0.30	10
74100	*Simulium sp*	F	6	CF		81	0.28	2
04901	*Erpobdellidae*	MT	8	PR		76	0.27	6
69400	*Stenelmis sp*	F	7	SC	CO	78	0.27	2
85500	*Paratanytarsus sp*	F	6	CG		76	0.27	3
77120	*Ablabesmyia mallochi*	F	6	CG		73	0.26	3
82501	*Chironomini*		6	CG		73	0.26	1
84520	*Polypedilum (Tripodura) halterale group*	MT	6	SH		75	0.26	11
77750	*Hayesomyia senata or Thienemannimyia norena*	F	5			69	0.24	7
77500	*Conchapelopia sp*	F	6	PR		65	0.23	5
53800	*Hydroptila sp*	F	2	SC	CA	53	0.19	5
04964	*Erpobdella microstoma*	MT	8	PR		48	0.17	3
21200	*Calopteryx sp*	F	4	PR		44	0.15	4
83158	*Endochironomus nigricans*	MT	6	SH		43	0.15	7
84960	*Pseudochironomus sp*	F	5	CG		42	0.15	1
83002	*Dicrotendipes modestus*	MT	6	CG		40	0.14	3
65800	*Berosus sp*	MT	99.9	PR	CO	35	0.12	2
77355	*Clinotanypus pinguis*	MT	6	PR		34	0.12	2
80510	*Cricotopus (Isocladius) sylvestris group*	T	8	SH		33	0.12	6

Appendix Table B-2. continued.

Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In
83050	*Dicrotendipes lucifer*	MT	6	CG		31	0.11	3
82100	*Thienemanniella sp*		2	CG		28	0.10	2
04666	*Helobdella papillata*	MT	8	PA		27	0.09	7
04930	*Erpobdella sp*	MT	8	PR		27	0.09	1
78200	*Larsia sp*	MT	6	PR		25	0.09	2
80350	*Corynoneura sp*		2	CG		27	0.09	2
74501	*Ceratopogonidae*	T	5	PR		23	0.08	3
96900	*Ferrissia sp*	F	7	SC		19	0.07	2
01320	*Hydra sp*	F	6	PR		15	0.05	1
08200	*Orconectes sp*	F	5	CG		14	0.05	2
28001	*Libellulidae*	MT	4.5	PR		13	0.05	1
82800	*Cladopelma sp*	T	6	CG		15	0.05	5
83400	*Harnischia sp*	F	6	CG		13	0.05	2
04660	*Helobdella sp*	MT	8	PA		11	0.04	1
04935	*Erpobdella punctata punctata*	MT	8	PR		12	0.04	2
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	MI	6	CF		12	0.04	1
84700	*Stenochironomus sp*	F	3	SH		11	0.04	2
08250	*Orconectes (Procericambarus) rusticus*	F	5	CG		8	0.03	1
59550	*Oecetis inconspicua complex sp A (sensu Floyd, 1995)*	F	5	PR	CA	8	0.03	2
71900	*Tipula sp*	F	4	SH		8	0.03	4
82770	*Chironomus (C.) riparius group*	T	11			9	0.03	2
83840	*Microtendipes pedellus group*	F	6	CF		10	0.03	1
85200	*Cladotanytarsus sp*		7	CG		10	0.03	1
85821	*Tanytarsus glabrescens group sp 7*	F	7	CF		8	0.03	2
28500	*Libellula sp*	MT	8	PR		6	0.02	3
77001	*Tanypodinae*		6	PR		7	0.02	1
80410	*Cricotopus (C.) sp*	F	8	SH		6	0.02	3
82141	*Thienemanniella xena*	F	2	CG		5	0.02	2

Appendix Table B-2. continued.

Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In
85265	*Cladotanytarsus vanderwulpi group sp 5*	MI	7	CG		6	0.02	2
04683	*Placobdella multilineata*	F	8	PR		3	0.01	1
28705	*Pachydiplax longipennis*	T	8	PR		3	0.01	1
59400	*Nectopsyche sp*	MI	3	SH	CA	3	0.01	1
59570	*Oecetis nocturna*	F	5	PR	CA	4	0.01	3
60800	*Haliplus sp*	MT	99.9	MH	CO	3	0.01	2
78130	*Labrundinia neopilosella*		4	PR		2	0.01	1
80490	*Cricotopus (Isocladius) intersectus group*	MT	8	SH		2	0.01	1
81650	*Parametriocnemus sp*	F	4	CG		2	0.01	2
81825	*Rheocricotopus (Psilocricotopus) robacki*	F	6	CG		2	0.01	1
82822	*Cryptochironomus eminentia*	F	0			2	0.01	1
82824	*Cryptochironomus ponderosus*	F	0			4	0.01	3
84155	*Paralauterborniella nigrohalteralis*	F	6	CG		4	0.01	1
84790	*Tribelos fuscicorne*	F	5	CG		3	0.01	1
85840	*Tanytarsus sepp*	F	7	CF		2	0.01	2
87540	*Hemerodromia sp*	F	6	PR		2	0.01	1
89001	*Sciomyzidae*	MT	10	PR		2	0.01	1
95501	*Planorbidae*	MT	6.5	SC		4	0.01	1
01900	*Nemertea*	F	99.9			1	0.00	1
27001	*Corduliidae*		4.5	PR		1	0.00	1
43570	*Neoplea sp*	F	99.9	PR		1	0.00	1
59950	*Parapoynx sp*	MI	99.9	SH		1	0.00	1
72700	*Anopheles sp*	F	6	CF		1	0.00	1
78450	*Nilotanypus fimbriatus*	F	6	PR		1	0.00	1
78600	*Pentaneura inconspicua*	F	3	PR		1	0.00	1
78680	*Procladius (Psilotanypus) bellus*	MT	8	PR		1	0.00	1
82121	*Thienemanniella lobapodema*	F	2	CG		1	0.00	1
84315	*Phaenopsectra flavipes*	MT	4	SC		1	0.00	1

Appendix Table B-2. continued.

Taxa Code	Taxa Name	OH Toler-ance	IL Toler-ance	IL Funct. Feeding Group	Taxa Group	Abundance	Percent	Samples Collected In
84460	*Polypedilum (P.) fallax group*	F	6	SH		1	0.00	1
87601	*Dolichopodidae*	MT	5	PR		1	0.00	1
89501	*Ephydridae*	F	8	CG		1	0.00	1
92613	*Cipangopaludina chinensis malleata*	MT	0			1	0.00	1
93900	*Elimia sp*	MI	6	SC		1	0.00	1

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Ust. Dempster St. | **Site ID:** **MF19** | **Subsample:** | RM: 18.60

Collection Date: 09/07/2020 | River Code: 95-009 | River: North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	1
03600	Oligochaeta		10.0	33
04901	Erpobdellidae		8.0	2
05800	Caecidotea sp		6.0	12
06800	Gammarus sp		3.0	38
11130	Baetis intercalaris	MA	4.0	1
22300	Argia sp		5.0	1
77750	Hayesomyia senata or Thienemannimyia norena		5.0	8
80410	Cricotopus (C.) sp		8.0	1
82820	Cryptochironomus sp		8.0	4
83040	Dicrotendipes neomodestus		6.0	4
84210	Paratendipes albimanus or P. duplicatus		3.0	1
84450	Polypedilum (Uresipedilum) flavum		6.0	14
84470	Polypedilum (P.) illinoense		6.0	130
84540	Polypedilum (Tripodura) scalaenum group		6.0	23
85200	Cladotanytarsus sp		7.0	3
85265	Cladotanytarsus vanderwulpi group sp 5		7.0	2
85625	Rheotanytarsus sp		6.0	8
97601	Corbicula fluminea		4.0	6

No. Quantitative Taxa: 19 | Total Taxa: 19

Number of Organisms: 292 | mIBI: 21.35

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Ust. E. Lake Rd.

Site ID: **MF16**

Subsample: RM: 3.00

Collection Date: 07/20/2020 River Code: 95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	5
03600	Oligochaeta		10.0	112
04664	Helobdella stagnalis		8.0	1
04666	Helobdella papillata		8.0	1
05800	Caecidotea sp		6.0	1
06800	Gammarus sp		3.0	38
22001	Coenagrionidae		5.5	8
53800	Hydroptila sp	CA	2.0	6
74501	Ceratopogonidae		5.0	1
77750	Hayesomyia senata or Thienemannimyia norena		5.0	3
78130	Labrundinia neopilosella		4.0	1
78655	Procladius (Holotanypus) sp		8.0	16
80350	Corynoneura sp		2.0	1
80410	Cricotopus (C.) sp		8.0	2
80420	Cricotopus (C.) bicinctus		8.0	1
80510	Cricotopus (Isocladius) sylvestris group		8.0	2
82730	Chironomus (C.) decorus group		11.0	3
82820	Cryptochironomus sp		8.0	4
82824	Cryptochironomus ponderosus		0.0	1
83002	Dicrotendipes modestus		6.0	4
83040	Dicrotendipes neomodestus		6.0	8
83158	Endochironomus nigricans		6.0	2
83300	Glyptotendipes (G.) sp		10.0	1
83400	Harnischia sp		6.0	4
84210	Paratendipes albimanus or P. duplicatus		3.0	1
84450	Polypedilum (Uresipedilum) flavum		6.0	6
84470	Polypedilum (P.) illinoense		6.0	31
84520	Polypedilum (Tripodura) halterale group		6.0	1
84540	Polypedilum (Tripodura) scalaenum group		6.0	3
95100	Physella sp		9.0	3
97601	Corbicula fluminea		4.0	6
98200	Pisidium sp		5.0	4

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 32 Total Taxa: 32

Number of Organisms: 281 mIBI: 24.69

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Dst. Glenview Rd. | **Site ID:** **MF17** | **Subsample:** | RM: 1.80

Collection Date: 09/07/2020 | River Code: 95-291 | River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	4
03600	Oligochaeta		10.0	116
04664	Helobdella stagnalis		8.0	3
04666	Helobdella papillata		8.0	1
04930	Erpobdella sp		8.0	1
04964	Erpobdella microstoma		8.0	5
05800	Caecidotea sp		6.0	1
06800	Gammarus sp		3.0	23
08250	Orconectes (Procericambarus) rusticus		5.0	1
21200	Calopteryx sp		4.0	1
22001	Coenagrionidae		5.5	8
22300	Argia sp		5.0	1
53800	Hydroptila sp	CA	2.0	2
77750	Hayesomyia senata or Thienemannimyia norena		5.0	10
78600	Pentaneura inconspicua		3.0	1
78655	Procladius (Holotanypus) sp		8.0	1
80410	Cricotopus (C.) sp		8.0	1
80420	Cricotopus (C.) bicinctus		8.0	1
82121	Thienemanniella lobapodema		2.0	1
82820	Cryptochironomus sp		8.0	2
83040	Dicrotendipes neomodestus		6.0	9
83050	Dicrotendipes lucifer		6.0	1
83400	Harnischia sp		6.0	1
84210	Paratendipes albimanus or P. duplicatus		3.0	2
84450	Polypedilum (Uresipedilum) flavum		6.0	36
84470	Polypedilum (P.) illinoense		6.0	50
84540	Polypedilum (Tripodura) scalaenum group		6.0	28
85265	Cladotanytarsus vanderwulpi group sp 5		7.0	1
85625	Rheotanytarsus sp		6.0	32
85800	Tanytarsus sp		7.0	1
97601	Corbicula fluminea		4.0	1
98200	Pisidium sp		5.0	6

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 32 | Total Taxa: 32

Number of Organisms: 352 | mIBI: 25.17

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: ust. Rockland Rd. | **Site ID:** **MF8** | **Subsample:** | RM: 21.10

Collection Date: 10/06/2021 River Code: 95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
03600	Oligochaeta		10.0	115
04664	Helobdella stagnalis		8.0	8
22001	Coenagrionidae		5.5	1
71900	Tipula sp		4.0	2
77355	Clinotanypus pinguis		6.0	31
78655	Procladius (Holotanypus) sp		8.0	4
79020	Tanypus neopunctipennis		8.0	37
80510	Cricotopus (Isocladius) sylvestris group		8.0	4
84520	Polypedilum (Tripodura) halterale group		6.0	2
93200	Hydrobiidae		6.0	39
98200	Pisidium sp		5.0	3
98600	Sphaerium sp		5.0	60

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 12 Total Taxa: 12

Number of Organisms: 306 mIBI: 17.54

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. foot bridge in FP

Site ID: **MF9**

Subsample: RM: 18.90

Collection Date: 10/06/2021 River Code: 95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	1
03600	Oligochaeta		10.0	64
06201	Hyalella azteca		4.0	88
11001	Baetidae	MA	4.0	1
17200	Caenis sp	MA	6.0	23
22001	Coenagrionidae		5.5	17
59400	Nectopsyche sp	CA	3.0	1
77120	Ablabesmyia mallochi		6.0	1
77355	Clinotanypus pinguis		6.0	1
78655	Procladius (Holotanypus) sp		8.0	1
79020	Tanypus neopunctipennis		8.0	54
80420	Cricotopus (C.) bicinctus		8.0	2
80510	Cricotopus (Isocladius) sylvestris group		8.0	2
82800	Cladopelma sp		6.0	2
83158	Endochironomus nigricans		6.0	2
84520	Polypedilum (Tripodura) halterale group		6.0	7
84750	Stictochironomus sp		5.0	1
85500	Paratanytarsus sp		6.0	7
85800	Tanytarsus sp		7.0	1
95100	Physella sp		9.0	10
98200	Pisidium sp		5.0	1
98600	Sphaerium sp		5.0	1

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 22 Total Taxa: 22

Number of Organisms: 288 mIBI: 23.95

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. Westleigh St.

Site ID: **MF10**

Subsample: RM: 16.70

Collection Date: 10/06/2021 River Code 95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	3
03600	Oligochaeta		10.0	73
04666	Helobdella papillata		8.0	1
06201	Hyalella azteca		4.0	74
17200	Caenis sp	MA	6.0	45
22001	Coenagrionidae		5.5	12
28500	Libellula sp		8.0	1
43570	Neoplea sp		99.9	1
60800	Haliplus sp	CO	99.9	2
65800	Berosus sp	CO	99.9	3
71900	Tipula sp		4.0	1
78450	Nilotanypus fimbriatus		6.0	1
78655	Procladius (Holotanypus) sp		8.0	5
80420	Cricotopus (C.) bicinctus		8.0	5
80510	Cricotopus (Isocladius) sylvestris group		8.0	1
81650	Parametriocnemus sp		4.0	1
82141	Thienemanniella xena		2.0	1
83040	Dicrotendipes neomodestus		6.0	1
84520	Polypedilum (Tripodura) halterale group		6.0	1
84790	Tribelos fuscicorne		5.0	1
84960	Pseudochironomus sp		5.0	2
92300	Valvata sp		2.0	91
93200	Hydrobiidae		6.0	14
95100	Physella sp		9.0	1
98600	Sphaerium sp		5.0	5

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 25 Total Taxa: 25

Number of Organisms: 346 mIBI: 41.10

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. IL22

Site ID: **MF11**

Subsample:

RM: 14.10

Collection Date: 10/06/2021 River Code 95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	3
03600	Oligochaeta		10.0	50
06201	Hyalella azteca		4.0	180
17200	Caenis sp	MA	6.0	44
22001	Coenagrionidae		5.5	43
28500	Libellula sp		8.0	1
59950	Parapoynx sp		99.9	1
60800	Haliplus sp	CO	99.9	1
78655	Procladius (Holotanypus) sp		8.0	9
79020	Tanypus neopunctipennis		8.0	1
82800	Cladopelma sp		6.0	1
83040	Dicrotendipes neomodestus		6.0	2
83158	Endochironomus nigricans		6.0	8
84520	Polypedilum (Tripodura) halterale group		6.0	1
85500	Paratanytarsus sp		6.0	1
85821	Tanytarsus glabrescens group sp 7		7.0	1
95100	Physella sp		9.0	2

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 17 Total Taxa: 17

Number of Organisms: 349 mIBI: 21.49

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: ust. Carriage Way

Site ID: **MF12**

Subsample: RM: 10.80

Collection Date:10/06/2021 River Code95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	29
03600	Oligochaeta		10.0	122
04664	Helobdella stagnalis		8.0	1
04666	Helobdella papillata		8.0	1
06201	Hyalella azteca		4.0	22
22001	Coenagrionidae		5.5	36
27001	Corduliidae		4.5	1
53800	Hydroptila sp	CA	2.0	1
78655	Procladius (Holotanypus) sp		8.0	1
80420	Cricotopus (C.) bicinctus		8.0	2
83050	Dicrotendipes lucifer		6.0	3
84470	Polypedilum (P.) illinoense		6.0	1
84520	Polypedilum (Tripodura) halterale group		6.0	4
92300	Valvata sp		2.0	94
92613	Cipangopaludina chinensis malleata		0.0	1
93200	Hydrobiidae		6.0	4
95100	Physella sp		9.0	1
98200	Pisidium sp		5.0	2
98600	Sphaerium sp		5.0	1

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 19 Total Taxa: 19

Number of Organisms: 327 mIBI: 34.00

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: ust. IL68

Site ID: **MF13**

Subsample:

RM: 8.60

Collection Date: 10/06/2021 River Code: 95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	34
03600	Oligochaeta		10.0	180
05800	Caecidotea sp		6.0	14
06201	Hyalella azteca		4.0	5
22001	Coenagrionidae		5.5	33
28001	Libellulidae		4.5	2
78655	Procladius (Holotanypus) sp		8.0	5
80420	Cricotopus (C.) bicinctus		8.0	3
80510	Cricotopus (Isocladius) sylvestris group		8.0	1
82141	Thienemanniella xena		2.0	1
82820	Cryptochironomus sp		8.0	2
83040	Dicrotendipes neomodestus		6.0	1
84210	Paratendipes albimanus or P. duplicatus		3.0	1
84520	Polypedilum (Tripodura) halterale group		6.0	10
85800	Tanytarsus sp		7.0	1
93200	Hydrobiidae		6.0	3
93900	Elimia sp		6.0	1
97601	Corbicula fluminea		4.0	4
98001	Pisidiidae		5.0	1

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 19 Total Taxa: 19

Number of Organisms: 302 mIBI: 15.71

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. Sunset Dr.

Site ID: **MF14**

Subsample: RM: 6.00

Collection Date: 10/06/2021 River Code 95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	11
03600	Oligochaeta		10.0	32
04664	Helobdella stagnalis		8.0	1
05800	Caecidotea sp		6.0	19
06201	Hyalella azteca		4.0	4
11130	Baetis intercalaris	MA	4.0	6
13400	Stenacron sp	MA	4.0	4
21200	Calopteryx sp		4.0	1
22001	Coenagrionidae		5.5	16
22300	Argia sp		5.0	2
52200	Cheumatopsyche sp	CA	6.0	128
59570	Oecetis nocturna	CA	5.0	1
68700	Dubiraphia sp	CO	5.0	1
71900	Tipula sp		4.0	1
74100	Simulium sp		6.0	2
77500	Conchapelopia sp		6.0	2
77750	Hayesomyia senata or Thienemannimyia norena		5.0	1
78655	Procladius (Holotanypus) sp		8.0	4
82820	Cryptochironomus sp		8.0	1
82824	Cryptochironomus ponderosus		0.0	1
83158	Endochironomus nigricans		6.0	1
83840	Microtendipes pedellus group		6.0	5
84450	Polypedilum (Uresipedilum) flavum		6.0	6
84460	Polypedilum (P.) fallax group		6.0	1
85625	Rheotanytarsus sp		6.0	5
85800	Tanytarsus sp		7.0	2
85821	Tanytarsus glabrescens group sp 7		7.0	5
93200	Hydrobiidae		6.0	24
95501	Planorbidae		6.5	1
97601	Corbicula fluminea		4.0	1
98200	Pisidium sp		5.0	4
98600	Sphaerium sp		5.0	3

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 32 Total Taxa: 32

Number of Organisms: 296 mIBI: 39.46

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. Winnetka Ave. | **Site ID:** **MF15** | **Subsample:** | RM: 4.00

Collection Date:10/06/2021 River Code:95-291 River: Middle Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	1
03600	Oligochaeta		10.0	155
04664	Helobdella stagnalis		8.0	1
04901	Erpobdellidae		8.0	1
05800	Caecidotea sp		6.0	1
06201	Hyalella azteca		4.0	14
21200	Calopteryx sp		4.0	1
22001	Coenagrionidae		5.5	19
52200	Cheumatopsyche sp	CA	6.0	1
59550	Oecetis inconspicua complex sp A (sensu Floyd, 1995)	CA	5.0	4
59570	Oecetis nocturna	CA	5.0	1
74501	Ceratopogonidae		5.0	2
77500	Conchapelopia sp		6.0	1
78655	Procladius (Holotanypus) sp		8.0	16
80420	Cricotopus (C.) bicinctus		8.0	1
82100	Thienemanniella sp		2.0	1
82730	Chironomus (C.) decorus group		11.0	1
82820	Cryptochironomus sp		8.0	2
83040	Dicrotendipes neomodestus		6.0	14
84155	Paralauterborniella nigrohalteralis		6.0	1
84520	Polypedilum (Tripodura) halterale group		6.0	1
84540	Polypedilum (Tripodura) scalaenum group		6.0	2
84700	Stenochironomus sp		3.0	1
84750	Stictochironomus sp		5.0	18
85800	Tanytarsus sp		7.0	9
87601	Dolichopodidae		5.0	1
89501	Ephydridae		8.0	1
93200	Hydrobiidae		6.0	15
97601	Corbicula fluminea		4.0	8
98200	Pisidium sp		5.0	5

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 30 Total Taxa: 30

Number of Organisms: 299 mIBI: 21.44

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: adj. Sounders Rd.

Site ID: **WF20**

Subsample:

RM: 12.50

Collection Date: 10/09/2021 River Code 95-292 River: West Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
03600	Oligochaeta		10.0	227
04664	Helobdella stagnalis		8.0	1
04666	Helobdella papillata		8.0	1
06201	Hyalella azteca		4.0	30
22001	Coenagrionidae		5.5	20
28705	Pachydiplax longipennis		8.0	1
78655	Procladius (Holotanypus) sp		8.0	1
82800	Cladopelma sp		6.0	1
83158	Endochironomus nigricans		6.0	1
95100	Physella sp		9.0	16
98200	Pisidium sp		5.0	9

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 11 Total Taxa: 11

Number of Organisms: 308 mIBI: 10.57

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. Deerfield Rd.

Site ID: **WF21**

Subsample:

RM: 10.40

Collection Date: 10/09/2021 River Code 95-292 River: West Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	27
03600	Oligochaeta		10.0	219
04664	Helobdella stagnalis		8.0	1
71900	Tipula sp		4.0	1
82501	Chironomini		6.0	1
82710	Chironomus (C.) sp		11.0	1
92300	Valvata sp		2.0	42
93200	Hydrobiidae		6.0	2
95100	Physella sp		9.0	3
97601	Corbicula fluminea		4.0	3
98200	Pisidium sp		5.0	14
98600	Sphaerium sp		5.0	5

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 12 Total Taxa: 12

Number of Organisms: 319 mIBI: 18.68

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. Pfinston Rd/ Lake Cook

Site ID: **WF22**

Subsample: RM: 9.20

Collection Date:10/09/2021 River Code95-292 River: West Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant	Taxa Code	Taxa	Feed Grp	Tol.	Quant
01801	Turbellaria		6.0	23					
01900	Nemertea		99.9	1					
03600	Oligochaeta		10.0	262					
06201	Hyalella azteca		4.0	3					
22001	Coenagrionidae		5.5	2					
78655	Procladius (Holotanypus) sp		8.0	1					
82770	Chironomus (C.) riparius group		11.0	8					
83000	Dicrotendipes sp		6.0	5					
83300	Glyptotendipes (G.) sp		10.0	1					
85840	Tanytarsus sepp		7.0	1					
92300	Valvata sp		2.0	38					
98200	Pisidium sp		5.0	11					

No. Quantitative Taxa: 12 Total Taxa: 12

Number of Organisms: 356 mIBI: 15.80

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. Willow Rd.

Site ID: **WF23**

Subsample: RM: 4.90

Collection Date:10/09/2021 River Code 95-292 River: West Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
03600	Oligochaeta		10.0	164
04660	Helobdella sp		8.0	2
04664	Helobdella stagnalis		8.0	1
04666	Helobdella papillata		8.0	1
04901	Erpobdellidae		8.0	1
05800	Caecidotea sp		6.0	4
06201	Hyalella azteca		4.0	27
11130	Baetis intercalaris	MA	4.0	1
22001	Coenagrionidae		5.5	1
52200	Cheumatopsyche sp	CA	6.0	2
59570	Oecetis nocturna	CA	5.0	1
78655	Procladius (Holotanypus) sp		8.0	2
80420	Cricotopus (C.) bicinctus		8.0	1
81650	Parametriocnemus sp		4.0	1
82730	Chironomus (C.) decorus group		11.0	3
82820	Cryptochironomus sp		8.0	3
82822	Cryptochironomus eminentia		0.0	2
83040	Dicrotendipes neomodestus		6.0	5
83158	Endochironomus nigricans		6.0	2
83300	Glyptotendipes (G.) sp		10.0	53
84540	Polypedilum (Tripodura) scalaenum group		6.0	2
85800	Tanytarsus sp		7.0	2
85840	Tanytarsus sepp		7.0	1
93200	Hydrobiidae		6.0	1
96900	Ferrissia sp		7.0	1
98600	Sphaerium sp		5.0	5

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 26 Total Taxa: 26

Number of Organisms: 289 mIBI: 13.77

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: dst. Lake Ave.

Site ID: **WF24**

Subsample:

RM: 2.90

Collection Date: 07/21/2021 River Code: 95-292 River: West Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01320	Hydra sp		6.0	15
03600	Oligochaeta		10.0	100
04935	Erpobdella punctata punctata		8.0	1
04964	Erpobdella microstoma		8.0	5
05800	Caecidotea sp		6.0	3
06201	Hyalella azteca		4.0	1
08200	Orconectes sp		5.0	1
11130	Baetis intercalaris	MA	4.0	1
13400	Stenacron sp	MA	4.0	2
22001	Coenagrionidae		5.5	2
52200	Cheumatopsyche sp	CA	6.0	17
53800	Hydroptila sp	CA	2.0	2
74100	Simulium sp		6.0	5
77120	Ablabesmyia mallochi		6.0	9
77500	Conchapelopia sp		6.0	6
77750	Hayesomyia senata or Thienemannimyia norena		5.0	3
78655	Procladius (Holotanypus) sp		8.0	3
80420	Cricotopus (C.) bicinctus		8.0	2
81825	Rheocricotopus (Psilocricotopus) robacki		6.0	1
82100	Thienemanniella sp		2.0	1
82730	Chironomus (C.) decorus group		11.0	2
82820	Cryptochironomus sp		8.0	3
83040	Dicrotendipes neomodestus		6.0	1
83050	Dicrotendipes lucifer		6.0	1
84210	Paratendipes albimanus or P. duplicatus		3.0	1
84450	Polypedilum (Uresipedilum) flavum		6.0	52
84470	Polypedilum (P.) illinoense		6.0	19
84540	Polypedilum (Tripodura) scalaenum group		6.0	18
85625	Rheotanytarsus sp		6.0	14
85800	Tanytarsus sp		7.0	5
87540	Hemerodromia sp		6.0	1
93200	Hydrobiidae		6.0	6
95100	Physella sp		9.0	2
96900	Ferrissia sp		7.0	5
97601	Corbicula fluminea		4.0	7
98001	Pisidiidae		5.0	4
98200	Pisidium sp		5.0	3

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 37 Total Taxa: 37

Number of Organisms: 324 mIBI: 30.07

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: ust. footbridge

Site ID: **WF25**

Subsample: RM: 1.30

Collection Date: 10/10/2021 River Code: 95-292 River: West Fork North Branch Chicago River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
03600	Oligochaeta		10.0	113
04666	Helobdella papillata		8.0	3
06201	Hyalella azteca		4.0	90
06800	Gammarus sp		3.0	10
13400	Stenacron sp	MA	4.0	5
22001	Coenagrionidae		5.5	29
22300	Argia sp		5.0	4
77750	Hayesomyia senata or Thienemannimyia norena		5.0	3
78655	Procladius (Holotanypus) sp		8.0	4
79020	Tanypus neopunctipennis		8.0	3
80350	Corynoneura sp		2.0	10
82730	Chironomus (C.) decorus group		11.0	1
82770	Chironomus (C.) riparius group		11.0	1
82800	Cladopelma sp		6.0	1
83000	Dicrotendipes sp		6.0	2
84470	Polypedilum (P.) illinoense		6.0	1
84520	Polypedilum (Tripodura) halterale group		6.0	1
85625	Rheotanytarsus sp		6.0	1
85800	Tanytarsus sp		7.0	2
95100	Physella sp		9.0	1
97601	Corbicula fluminea		4.0	1

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 21 Total Taxa: 21

Number of Organisms: 286 mIBI: 21.85

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: adj Gillette Plant | Site ID: SR1 | Subsample: | RM: 21.10

Collection Date: 09/06/2020 | River Code: 95-403 | River: Skokie River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
03600	Oligochaeta		10.0	57
04683	Placobdella multilineata		8.0	3
04964	Erpobdella microstoma		8.0	5
05800	Caecidotea sp		6.0	2
06201	Hyalella azteca		4.0	162
08200	Orconectes sp		5.0	2
22001	Coenagrionidae		5.5	61
28500	Libellula sp		8.0	2
65800	Berosus sp	CO	99.9	1
72700	Anopheles sp		6.0	1
77001	Tanypodinae		6.0	2
78200	Larsia sp		6.0	19
79020	Tanypus neopunctipennis		8.0	21
80510	Cricotopus (Isocladius) sylvestris group		8.0	1
82710	Chironomus (C.) sp		11.0	1
83040	Dicrotendipes neomodestus		6.0	6
85800	Tanytarsus sp		7.0	3
98200	Pisidium sp		5.0	2

No. Quantitative Taxa: 18 | Total Taxa: 18

Number of Organisms: 351 | mIBI: 17.18

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Ust. IL 176

Site ID: **SR2**

Subsample: RM: 17.40

Collection Date: 09/06/2020 River Code: 95-403 River: Skokie River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	2
03600	Oligochaeta		10.0	93
04901	Erpobdellidae		8.0	3
05800	Caecidotea sp		6.0	19
06800	Gammarus sp		3.0	86
22001	Coenagrionidae		5.5	5
69400	Stenelmis sp	CO	7.0	1
74501	Ceratopogonidae		5.0	1
77120	Ablabesmyia mallochi		6.0	1
77500	Conchapelopia sp		6.0	1
78655	Procladius (Holotanypus) sp		8.0	10
82730	Chironomus (C.) decorus group		11.0	7
82800	Cladopelma sp		6.0	1
82820	Cryptochironomus sp		8.0	1
83040	Dicrotendipes neomodestus		6.0	1
84210	Paratendipes albimanus or P. duplicatus		3.0	6
84450	Polypedilum (Uresipedilum) flavum		6.0	1
84470	Polypedilum (P.) illinoense		6.0	12
84520	Polypedilum (Tripodura) halterale group		6.0	1
84540	Polypedilum (Tripodura) scalaenum group		6.0	1
85500	Paratanytarsus sp		6.0	2
85800	Tanytarsus sp		7.0	2
89001	Sciomyzidae		10.0	2
95100	Physella sp		9.0	1
97601	Corbicula fluminea		4.0	3
98200	Pisidium sp		5.0	2
98600	Sphaerium sp		5.0	2

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 27 Total Taxa: 27

Number of Organisms: 267 mIBI: 23.84

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Dst. Deerpath Rd. | **Site ID:** **SR3** | **Subsample:** | RM: 14.80

Collection Date: 09/07/2020 | River Code 95-403 | River: Skokie River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	2
03600	Oligochaeta		10.0	33
04935	Erpobdella punctata punctata		8.0	5
06800	Gammarus sp		3.0	75
21200	Calopteryx sp		4.0	1
22001	Coenagrionidae		5.5	11
69400	Stenelmis sp	CO	7.0	2
78655	Procladius (Holotanypus) sp		8.0	9
82730	Chironomus (C.) decorus group		11.0	3
82820	Cryptochironomus sp		8.0	3
83002	Dicrotendipes modestus		6.0	3
83040	Dicrotendipes neomodestus		6.0	65
84210	Paratendipes albimanus or P. duplicatus		3.0	1
84315	Phaenopsectra flavipes		4.0	1
84540	Polypedilum (Tripodura) scalaenum group		6.0	2
95100	Physella sp		9.0	3
98200	Pisidium sp		5.0	39
98600	Sphaerium sp		5.0	51

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 18 | Total Taxa: 18

Number of Organisms: 309 | mIBI: 24.61

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Ust. Half Day Rd. @ Sleepy Hollow Park

Site ID: **SR4**

Subsample: RM: 11.30

Collection Date 09/06/2020 River Code 95-403 River: Skokie River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	8
03600	Oligochaeta		10.0	18
04901	Erpobdellidae		8.0	4
05800	Caecidotea sp		6.0	111
06800	Gammarus sp		3.0	64
77500	Conchapelopia sp		6.0	5
78200	Larsia sp		6.0	1
82820	Cryptochironomus sp		8.0	2
83040	Dicrotendipes neomodestus		6.0	5
83820	Microtendipes "caelum" (sensu Simpson & Bode, 1980)		6.0	9
84210	Paratendipes albimanus or P. duplicatus		3.0	21
84520	Polypedilum (Tripodura) halterale group		6.0	1
84540	Polypedilum (Tripodura) scalaenum group		6.0	7
84700	Stenochironomus sp		3.0	1
85800	Tanytarsus sp		7.0	3
98200	Pisidium sp		5.0	84

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 16 Total Taxa: 16

Number of Organisms: 344 mIBI: 22.82

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Ust. Clavey Rd. @ Solel Congregation

Site ID: **SR5**

Subsample:

RM: 8.00

Collection Date: 09/07/2020 River Code: 95-403 River: Skokie River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	17
03600	Oligochaeta		10.0	7
04901	Erpobdellidae		8.0	1
05800	Caecidotea sp		6.0	5
06800	Gammarus sp		3.0	142
22001	Coenagrionidae		5.5	1
77750	Hayesomyia senata or Thienemannimyia norena		5.0	1
82820	Cryptochironomus sp		8.0	2
83040	Dicrotendipes neomodestus		6.0	2
84210	Paratendipes albimanus or P. duplicatus		3.0	6
97601	Corbicula fluminea		4.0	93
98001	Pisidiidae		5.0	27
98200	Pisidium sp		5.0	8

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 13 Total Taxa: 13

Number of Organisms: 312 mIBI: 21.17

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Ust. Lake Cook Rd.

Site ID: **SR6**

Subsample: RM: 7.40

Collection Date: 09/07/2020 River Code: 95-403 River: Skokie River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	11
03600	Oligochaeta		10.0	10
05800	Caecidotea sp		6.0	4
06800	Gammarus sp		3.0	218
22001	Coenagrionidae		5.5	1
78655	Procladius (Holotanypus) sp		8.0	3
82820	Cryptochironomus sp		8.0	1
83002	Dicrotendipes modestus		6.0	1
83040	Dicrotendipes neomodestus		6.0	1
84210	Paratendipes albimanus or P. duplicatus		3.0	1
95100	Physella sp		9.0	2
98200	Pisidium sp		5.0	3
98600	Sphaerium sp		5.0	14

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 13 Total Taxa: 13

Number of Organisms: 270 mIBI: 21.25

Appendix Table B-2. Macroinvertebrate taxa collected in the 2020-21 North Branch Chicago River study area.

Site: Dst. I-94

Site ID: **SR18**

Subsample:

RM: 0.50

Collection Date: 09/07/2020 River Code: 95-403 River: Skokie River

Taxa Code	Taxa	Taxa Grp	Tol.	Quant
01801	Turbellaria		6.0	24
03600	Oligochaeta		10.0	40
06201	Hyalella azteca		4.0	26
06800	Gammarus sp		3.0	30
22001	Coenagrionidae		5.5	8
22300	Argia sp		5.0	1
52001	Hydropsychidae	CA	5.5	1
52200	Cheumatopsyche sp	CA	6.0	1
53800	Hydroptila sp	CA	2.0	3
59550	Oecetis inconspicua complex sp A (sensu Floyd, 1995)	CA	5.0	1
78655	Procladius (Holotanypus) sp		8.0	2
78680	Procladius (Psilotanypus) bellus		8.0	1
80490	Cricotopus (Isocladius) intersectus group		8.0	2
82824	Cryptochironomus ponderosus		0.0	2
83158	Endochironomus nigricans		6.0	16
83300	Glyptotendipes (G.) sp		10.0	1
84450	Polypedilum (Uresipedilum) flavum		6.0	63
84470	Polypedilum (P.) illinoense		6.0	38
84540	Polypedilum (Tripodura) scalaenum group		6.0	6
93200	Hydrobiidae		6.0	4
95100	Physella sp		9.0	1
97601	Corbicula fluminea		4.0	17
98001	Pisidiidae		5.0	13

Taxa Code	Taxa	Feed Grp	Tol.	Quant

No. Quantitative Taxa: 23 Total Taxa: 23

Number of Organisms: 301 mIBI: 22.93

APPENDIX C: NORTH BRANCH CHICAGO RIVER 2020-2021 HABITAT DATA

D-1: North Branch Chicago River Survey Area 2020-2021 QHEI Metrics and Scores
D-2: QHEI Field Sheets 2020-2021

Appendix Table C-1. NBWW 2020-21 survey area QHEI metrics table.

Site ID	River Mile	Drain. Area (mi^2.)	QHEI	Substrate	Cover	Channel	Riparian	Pool	Riffle	Gradient (ft/mi)	Gradient Score
North Branch Chicago River - 2020											
MF19	18.6	93.4	48.5	9.5	11.0	11.0	7.0	6.0	0.0	1.36	4
Middle Fork North Branch Chicago River - 2020											
MF16	3.0	56.2	38.5	0.0	12.0	10.0	7.5	5.0	0.0	2.27	4
MF17	1.8	57.3	45.8	10.0	12.0	7.0	7.8	5.0	0.0	2.27	4
Middle Fork North Branch Chicago River - 2021											
MF8	21.1	5.8	29.0	2.0	11.0	6.0	4.0	2.0	0.0	4.2	4
MF9	18.9	8.9	31.5	0.0	11.0	5.0	8.5	3.0	0.0	1.92	4
MF10	16.7	12.0	41.0	7.0	12.0	6.0	9.0	3.0	0.0	2.59	4
MF11	14.1	16.1	44.0	6.0	13.0	6.0	8.0	7.0	0.0	2.44	4
MF12	10.8	19.2	45.5	6.0	16.0	6.0	4.5	7.0	0.0	3.6	6
MF13	8.6	21.0	60.0	9.0	14.0	9.5	7.5	9.0	1.0	8.2	10
MF14	6.0	22.5	64.5	14.0	17.0	15.0	0.0	10.0	2.5	4.93	6
MF15	4.0	24.3	55.5	8.5	12.0	12.0	9.5	9.0	0.5	1.92	4
West Fork North Branch Chicago River - 2021											
WF20	12.5	3.9	30.5	0.0	11.0	6.0	6.5	1.0	0.0	6.6	6
WF21	10.4	7.0	42.0	12.5	5.0	9.0	5.5	4.0	2.0	3.42	4
WF22	9.2	9.4	46.5	9.0	17.0	6.0	2.5	6.0	0.0	3.42	6
WF23	4.9	17.9	41.0	4.0	13.0	5.0	6.0	7.0	0.0	3.8	6
WF24	2.9	24.5	66.0	13.5	16.0	12.5	5.5	10.0	4.5	2.1	4
WF25	1.3	28.0	48.0	6.0	13.0	10.0	5.0	9.0	1.0	2.1	4
Skokie River - 2020											
SR1	21.1	2.8	37.0	0.0	12.0	7.0	6.0	4.0	0.0	10.5	8
SR2	17.4	7.9	38.0	5.5	11.0	7.0	5.5	5.0	0.0	4.17	4
SR3	14.8	11.6	48.0	7.0	13.0	10.0	5.0	7.0	0.0	3.37	6
SR4	11.3	15.1	52.5	12.0	14.0	10.5	5.0	5.0	0.0	4.9	6
SR5	8.0	20.7	46.8	5.0	15.0	7.0	6.8	7.0	0.0	4.74	6
SR6	7.4	21.5	39.5	5.0	14.0	7.0	6.5	3.0	0.0	1.44	4
SR7	3.0	23.7	38.0	0.0	17.0	6.0	7.0	4.0	0.0	1.44	4
SR18	0.5	30.9	41.5	4.0	14.0	8.0	6.5	7.0	0.0	0.92	2
		Excellent	≥81.3								
		Good	69.3-81.0								
		Fair	50.1-69.0								
		Poor	25-50								
		Very Poor	<25								

MBI Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 30.5

River Code: 95-292 **RM:** 12.5 **Stream:** W Fk N Br Chicago R
Site Code: WF20 **Project Code:** NBWW2 **Location:** Adj Saunders Rd
Date: 7-30-21 **Scorer:** PMD **Latitude:** 42.18624 **Longitude:** -87.88178

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☐ -GRAVEL [7]		
☐ ☐ -Lg BOULD [10]			☐ ☐ -SAND [6]		
☐ ☐ -BOULDER [9]			☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]			☐ ☐ -DETRITUS [3]		
☐ ☐ -HARDPAN [4]			☐ ☐ -ARTIFICIAL [0]		
☑ ☑ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2]
(High Quality Only, Score 5 or >) ☑ -3 or Less [0]

SUBSTRATE ORIGIN Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1]
☐ -TILLS [1]
☑ -WETLANDS [0]
☐ -HARDPAN [0]
☐ -SANDSTONE [0]
☐ -RIP / RAP [0]
☐ -LACUSTRINE [0]
☐ -SHALE [-1]
☐ -COAL FINES [-2]

SUBSTRATE QUALITY Check ONE (OR 2 & AVERAGE)
SILT: ☑ -SILT HEAVY [-2] ☐ -SILT MODERATE [-1] ☐ -SILT NORMAL [0] ☐ -SILT FREE [1]
EMBEDDEDNESS: ☑ -EXTENSIVE [-2] ☐ -MODERATE [-1] ☐ -NORMAL [0] ☐ -NONE [1]

COMMENTS:

Substrate: 0 (Max 20)

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

0 UNDERCUT BANKS [1]
0 OVERHANGING VEGETATION [1]
3 SHALLOWS (IN SLOW WATER) [1]
0 ROOTMATS [1]
0 POOLS > 70 cm [2]
1 ROOTWADS [1]
0 BOULDERS [1]
0 OXBOWS, BACKWATERS [1]
3 AQUATIC MACROPHYTES [1]
3 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
☐ -EXTENSIVE > 75% [11]
☑ -MODERATE 25 - 75% [7]
☐ -SPARSE 5 - 25% [3]
☐ -NEARLY ABSENT < 5% [1]

COMMENTS:

Cover: 11 (Max 20)

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☐ -HIGH [4] ☐ -MODERATE [3] ☑ -LOW [2] ☐ -NONE [1]

DEVELOPMENT: ☐ -EXCELLENT [7] ☐ -GOOD [5] ☐ -FAIR [3] ☑ -POOR [1]

CHANNELIZATION: ☐ -NONE [6] ☐ -RECOVERED [4] ☐ -RECOVERING [3] ☑ -RECENT OR NO RECOVERY [1] ☐ -IMPOUNDED [-1]

STABILITY: ☐ -HIGH [3] ☑ -MODERATE [2] ☐ -LOW [1]

MODIFICATIONS / OTHER: ☐ -SNAGGING ☐ -RELOCATION ☐ -CANOPY REMOVAL ☐ -DREDGING ☐ -ONE SIDE CHANNEL MODIFICATIONS ☐ -IMPOUNDMENT ☐ -ISLAND ☐ -LEVEED ☐ -BANK SHAPING

COMMENTS:

Channel: 6 (Max 20)

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH L R (Per Bank)
☐ ☐ -VERY WIDE > 100m [5]
☐ ☐ -WIDE > 50m [4]
☑ ☑ -MODERATE 10 - 50m [3]
☐ ☐ -NARROW 5 - 10m [2]
☐ ☐ -VERY NARROW < 5m [1]
☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* L R (Most Predominant Per Bank)
☐ ☐ -FOREST, SWAMP [3]
☐ ☐ -SHRUB OR OLD FIELD [2]
☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
☐ ☐ -FENCED PASTURE [1]
☐ ☐ -CONSERVATION TILLAGE [1]
☐ ☐ -URBAN OR INDUSTRIAL [0]
☐ ☐ -OPEN PASTURE, ROWCROP [0]
☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION L R (Per Bank)
☑ ☑ -NONE / LITTLE [3]
☑ ☑ -MODERATE [2]
☐ ☐ -HEAVY / SEVERE [1]

COMMENTS:

Riparian: 6.5 (Max 10)

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
☐ - 1m [6]
☐ - 0.7m [4]
☑ - 0.4 to 0.7m [2]
☐ - 0.2 to 0.4m [1]
☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☐ -POOL WIDTH > RIFFLE WIDTH [2]
☐ -POOL WIDTH = RIFFLE WIDTH [1]
☑ -POOL WIDTH < RIFFLE WIDTH [0]
☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
☐ -EDDIES [1]
☐ -FAST [1]
☐ -MODERATE [1]
☐ -SLOW [1]
☑ -NONE [-1]
☐ -TORRENTIAL [-1]
☐ -INTERSTITIAL [-1]
☐ -INTERMITTENT [-2]
☐ -VERY FAST [1]

COMMENTS:

Pool / Current: 1 (Max 12)

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
☐ -*Best Areas > 10cm [2]
☐ -Best Areas 5 - 10cm [1]
☐ -Best Areas < 5cm [0]
☑ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
☐ - MAX > 50 cm [2]
☐ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
☐ -STABLE (e.g., Cobble, Boulder) [2]
☐ -MOD. STABLE (e.g., Large Gravel) [1]
☐ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
☐ -NONE [2]
☐ -LOW [1]
☐ -MODERATE [0]
☐ -EXTENSIVE [-1]

COMMENTS:

Riffle / Run: 0 (Max 8)

6.) GRADIENT (ft / mi): 6.6 DRAINAGE AREA (sq.mi.): 3.9 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

Gradient: 6 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Subjective Rating (1-10) ☐

Aesthetic Rating (1-10) ☐

Gradient: ☐ -Low ☐ -Moderate ☐ -High

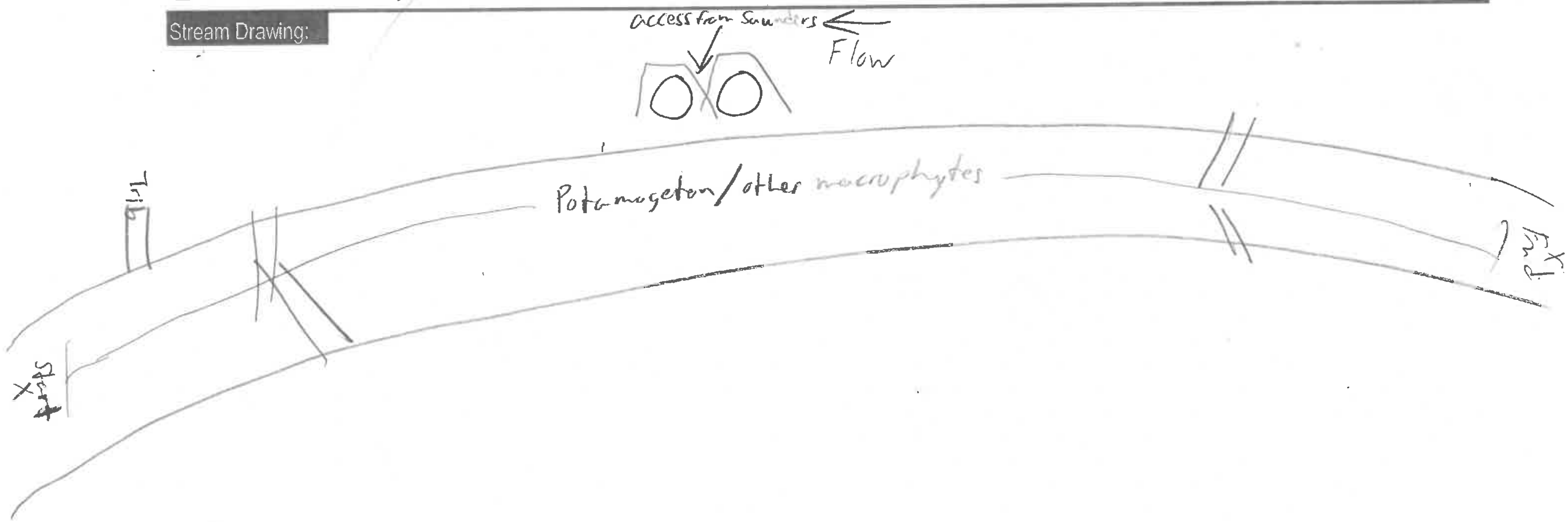
First Sampling Pass	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
	F	150	CTB	Normal	50

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far: .
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ____

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 42

River Code: 95-292 **RM:** 10.4 **Stream:** W Fk N Br Chicago R
Site Code: WF2 **Project Code:** MBWW21 **Location:** DST Deerfield Rd
Date: 7-30-21 **Scorer:** PMD **Latitude:** 42.16572 **Longitude:** -87.85696

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent)

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
[ ] [ ] -BLDR/SLBS [10]			[ ] [x] -GRAVEL [7]		
[ ] [ ] -Lg BOULD [10]			[x] [ ] -SAND [6]		
[ ] [ ] -BOULDER [9]			[ ] [ ] -BEDROCK [5]		
[ ] [ ] -COBBLE [8]			[ ] [ ] -DETRITUS [3]		
[ ] [ ] -HARDPAN [4]			[ ] [ ] -ARTIFICIAL [0]		
[ ] [ ] -MUCK [2]			[ ] [ ] -SILT [2]		

NUMBER OF SUBSTRATE TYPES: [ ] -4 or More [2]
(High Quality Only, Score 5 or >) [x] -3 or Less [0]

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
[ ] -LIMESTONE [1]
[x] -TILLS [1]
[ ] -WETLANDS [0]
[ ] -HARDPAN [0]
[ ] -SANDSTONE [0]
[ ] -RIP/RAP [0]
[ ] -LACUSTRINE [0]
[ ] -SHALE [-1]
[ ] -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)
SILT: [ ] -SILT HEAVY [-2]; [x] -SILT MODERATE [-1]; [ ] -SILT NORMAL [0]; [ ] -SILT FREE [1]
EMBEDDEDNESS: [ ] -EXTENSIVE [-2]; [x] -MODERATE [-1]; [x] -NORMAL [0]; [ ] -NONE [1]

Substrate: 12.5 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

___ UNDERCUT BANKS [1]
___ OVERHANGING VEGETATION [1]
3 SHALLOWS (IN SLOW WATER) [1]
___ ROOTMATS [1]
___ POOLS > 70 cm [2]
___ ROOTWADS [1]
___ BOULDERS [1]
___ OXBOWS, BACKWATERS [1]
___ AQUATIC MACROPHYTES [1]
1 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
[ ] -EXTENSIVE > 75% [11]
[ ] -MODERATE 25 - 75% [7]
[x] -SPARSE 5 - 25% [3]
[ ] -NEARLY ABSENT < 5% [1]

Cover: 5 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: [ ] -HIGH [4]; [ ] -MODERATE [3]; [ ] -LOW [2]; [x] -NONE [1]
DEVELOPMENT: [ ] -EXCELLENT [7]; [ ] -GOOD [5]; [x] -FAIR [3]; [ ] -POOR [1]
CHANNELIZATION: [ ] -NONE [6]; [ ] -RECOVERED [4]; [x] -RECOVERING [3]; [ ] -RECENT OR NO RECOVERY [1]; [ ] -IMPOUNDED [-1]
STABILITY: [ ] -HIGH [3]; [x] -MODERATE [2]; [ ] -LOW [1]
MODIFICATIONS / OTHER: [ ] -SNAGGING; [ ] -RELOCATION; [ ] -CANOPY REMOVAL; [ ] -DREDGING; [ ] -ONE SIDE CHANNEL MODIFICATIONS; [ ] -IMPOUNDMENT; [ ] -ISLAND; [ ] -LEVEED; [ ] -BANK SHAPING

Channel: 9. (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH — L R (Per Bank)
[ ] [ ] -VERY WIDE > 100m [5]
[ ] [ ] -WIDE > 50m [4]
[ ] [ ] -MODERATE 10 - 50m [3]
[x] [x] -NARROW 5 - 10m [2]
[ ] [ ] -VERY NARROW < 5m [1]
[ ] [ ] -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* — L R (Most Predominant Per Bank)
[ ] [ ] -FOREST, SWAMP [3]
[ ] [ ] -SHRUB OR OLD FIELD [2]
[x] [x] -RESIDENTIAL, PARK, NEW FIELD [1]
[ ] [ ] -FENCED PASTURE [1]
[ ] [ ] -CONSERVATION TILLAGE [1]
[ ] [ ] -URBAN OR INDUSTRIAL [0]
[ ] [ ] -OPEN PASTURE, ROWCROP [0]
[ ] [ ] -MINING / CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
[x] [x] -NONE / LITTLE [3]
[x] [x] -MODERATE [2]
[ ] [ ] -HEAVY / SEVERE [1]

Riparian: 5.5 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
[ ] - 1m [6]
[ ] - 0.7m [4]
[ ] - 0.4 to 0.7m [2]
[x] - 0.2 to 0.4m [1]
[ ] - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
[x] -POOL WIDTH > RIFFLE WIDTH [2]
[ ] -POOL WIDTH = RIFFLE WIDTH [1]
[ ] -POOL WIDTH < RIFFLE WIDTH [0]
[ ] -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
[ ] -EDDIES [1]
[ ] -FAST [1]
[ ] -MODERATE [1]
[x] -SLOW [1]
[ ] -NONE [-1]
[ ] -TORRENTIAL [-1]
[ ] -INTERSTITIAL [-1]
[ ] -INTERMITTENT [-2]
[ ] -VERY FAST [1]

Pool / Current: 4 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH
[ ] -*Best Areas > 10cm [2]
[x] -Best Areas 5 - 10cm [1]
[ ] -Best Areas < 5cm [0]
[ ] -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
[ ] - MAX > 50 cm [2]
[x] - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
[ ] -STABLE (e.g., Cobble, Boulder) [2]
[ ] -MOD. STABLE (e.g., Large Gravel) [1]
[x] -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
[ ] -NONE [2]
[ ] -LOW [1]
[x] -MODERATE [0]
[ ] -EXTENSIVE [-1]

Riffle / Run: 2 (Max 8)

COMMENTS: 3.42

6.) GRADIENT (ft / mi): ~~6.80~~ 3.42 DRAINAGE AREA (sq.mi.): 7.02 % POOL: ___ % GLIDE: ___ % RIFFLE: ___ % RUN: ___

Gradient Score from Table 2 of Users Manual based on gradient and drainage area

Gradient: ~~6~~ 4 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N)

If Not, Explain:

Lat / Long (Beg):

Lat / Long (Mid):

Lat / Long (End):

Lat / Long (X-Loc):

Subjective Rating (1-10)

Aesthetic Rating (1-10)

Gradient:

☐ -Low ☐ -Moderate ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	F	150	C7B	Normal	60

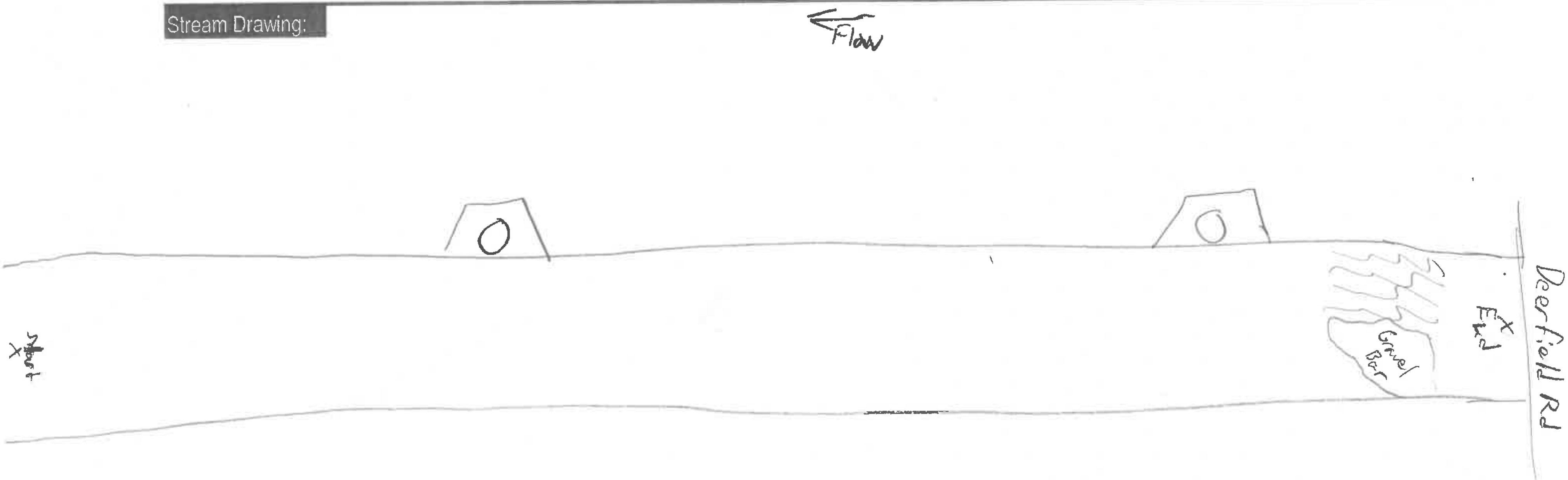
Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other:

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 46.5

River Code: 95-242 RM: 9.63 9.2 (VR) Stream: WFK N Br Chicago R
Site Code: WF22 Project Code: NBWW21 Location: DST Pfingsten Rd/Lake Cook Rd
Date: 7-30-21 Scorer: PMO Latitude: 42.15161 Longitude: -87.84602

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☑ ☐ -GRAVEL [7]		
☐ ☐ -Lg BOULD [10]			☐ ☑ -SAND [6]		
☐ ☐ -BOULDER [9]			☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]			☐ ☐ -DETRITUS [3]		
☐ ☐ -HARDPAN [4]			☐ ☐ -ARTIFICIAL [0]		
☐ ☐ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2] / ☑ -3 or Less [0]
(High Quality Only, Score 5 or >)

SUBSTRATE ORIGIN (Check ONE (OR 2 & AVERAGE)): ☐ -LIMESTONE [1]; ☐ -TILLS [1]; ☑ -WETLANDS [0]; ☐ -HARDPAN [0]; ☐ -SANDSTONE [0]; ☐ -RIP / RAP [0]; ☐ -LACUSTRINE [0]; ☐ -SHALE [-1]; ☐ -COAL FINES [-2]

SUBSTRATE QUALITY (Check ONE (OR 2 & AVERAGE)):
SILT: ☑ -SILT HEAVY [-2]; ☐ -SILT MODERATE [-1]; ☐ -SILT NORMAL [0]; ☐ -SILT FREE [1]
EMBEDDEDNESS: ☑ -EXTENSIVE [-2]; ☐ -MODERATE [-1]; ☐ -NORMAL [0]; ☐ -NONE [1]

Substrate: 9 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)
(Structure) TYPE: Score All That Occur

2 UNDERCUT BANKS [1]; 2 POOLS > 70 cm [2]; 0 OXBOWS, BACKWATERS [1]
2 OVERHANGING VEGETATION [1]; 3 ROOTWADS [1]; 3 AQUATIC MACROPHYTES [1]
2 SHALLOWS (IN SLOW WATER) [1]; 1 BOULDERS [1]; 3 LOGS OR WOODY DEBRIS [1]
1 ROOTMATS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE) ☐ -EXTENSIVE > 75% [11]; ☑ -MODERATE 25 - 75% [7]; ☐ -SPARSE 5 - 25% [3]; ☐ -NEARLY ABSENT < 5% [1]

Cover: 17 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☐ -HIGH [4]; ☐ -MODERATE [3]; ☑ -LOW [2]; ☐ -NONE [1]
DEVELOPMENT: ☐ -EXCELLENT [7]; ☐ -GOOD [5]; ☐ -FAIR [3]; ☑ -POOR [1]
CHANNELIZATION: ☐ -NONE [6]; ☐ -RECOVERED [4]; ☐ -RECOVERING [3]; ☑ -RECENT OR NO RECOVERY [1]; ☐ -IMPOUNDED [-1]
STABILTIY: ☐ -HIGH [3]; ☑ -MODERATE [2]; ☐ -LOW [1]
MODIFICATIONS / OTHER: ☐ -SNAGGING; ☐ -RELOCATION; ☐ -CANOPY REMOVAL; ☐ -DREDGING; ☐ -ONE SIDE CHANNEL MODIFICATIONS; ☐ -IMPOUNDMENT; ☐ -ISLAND; ☐ -LEVEED; ☐ -BANK SHAPING

Channel: 6 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank) River Right Looking Downstream

RIPARIAN WIDTH (L R, Per Bank): ☐ ☐ -VERY WIDE > 100m [5]; ☐ ☐ -WIDE > 50m [4]; ☐ ☐ -MODERATE 10 - 50m [3]; ☐ ☐ -NARROW 5 - 10m [2]; ☑ ☑ -VERY NARROW < 5m [1]; ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY (PAST 100 Meter RIPARIAN) (L R, Most Predominant Per Bank): ☐ ☐ -FOREST, SWAMP [3]; ☐ ☐ -SHRUB OR OLD FIELD [2]; ☐ ☐ -RESIDENTIAL, PARK, NEW FIELD [1]; ☐ ☐ -FENCED PASTURE [1]; ☐ ☐ -CONSERVATION TILLAGE [1]; ☑ ☑ -URBAN OR INDUSTRIAL [0]; ☐ ☐ -OPEN PASTURE, ROWCROP [0]; ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION (L R, Per Bank): ☐ ☐ -NONE / LITTLE [3]; ☑ ☑ -MODERATE [2]; ☑ ☑ -HEAVY / SEVERE [1]

Riparian: 2.5 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!): ☐ -1m [6]; ☑ - 0.7m [4]; ☐ - 0.4 to 0.7m [2]; ☐ - 0.2 to 0.4m [1]; ☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE): ☐ -POOL WIDTH > RIFFLE WIDTH [2]; ☑ -POOL WIDTH = RIFFLE WIDTH [1]; ☐ -POOL WIDTH < RIFFLE WIDTH [0]; ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply): ☐ -EDDIES [1]; ☐ -FAST [1]; ☐ -MODERATE [1]; ☑ -SLOW [1]; ☐ -NONE [-1]; ☐ -TORRENTIAL [-1]; ☐ -INTERSTITIAL [-1]; ☐ -INTERMITTENT [-2]; ☐ -VERY FAST [1]

Pool / Current: 6 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH: ☐ -*Best Areas > 10cm [2]; ☐ -Best Areas 5 - 10cm [1]; ☐ -Best Areas < 5cm [0]; ☑ -NO RIFFLE [Entire Metric = 0]
RUN DEPTH: ☐ - MAX > 50 cm [2]; ☐ - MAX < 50 cm [1]
RIFFLE / RUN SUBSTRATE: ☐ -STABLE (e.g., Cobble, Boulder) [2]; ☐ -MOD. STABLE (e.g., Large Gravel) [1]; ☐ -UNSTABLE (Fine Gravel, Sand) [0]
RIFFLE / RUN EMBEDDEDNESS: ☐ -NONE [2]; ☐ -LOW [1]; ☐ -MODERATE [0]; ☐ -EXTENSIVE [-1]

Riffle / Run: 0 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 3.42 ~~6.80~~ DRAINAGE AREA (sq.mi.): 9.41 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

Gradient: ~~8~~ 6 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Subjective Rating (1-10): ☐

Aesthetic Rating (1-10): ☐

Gradient: ☐ -Low ☐ -Moderate ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	D	200	CTB	Normal	40

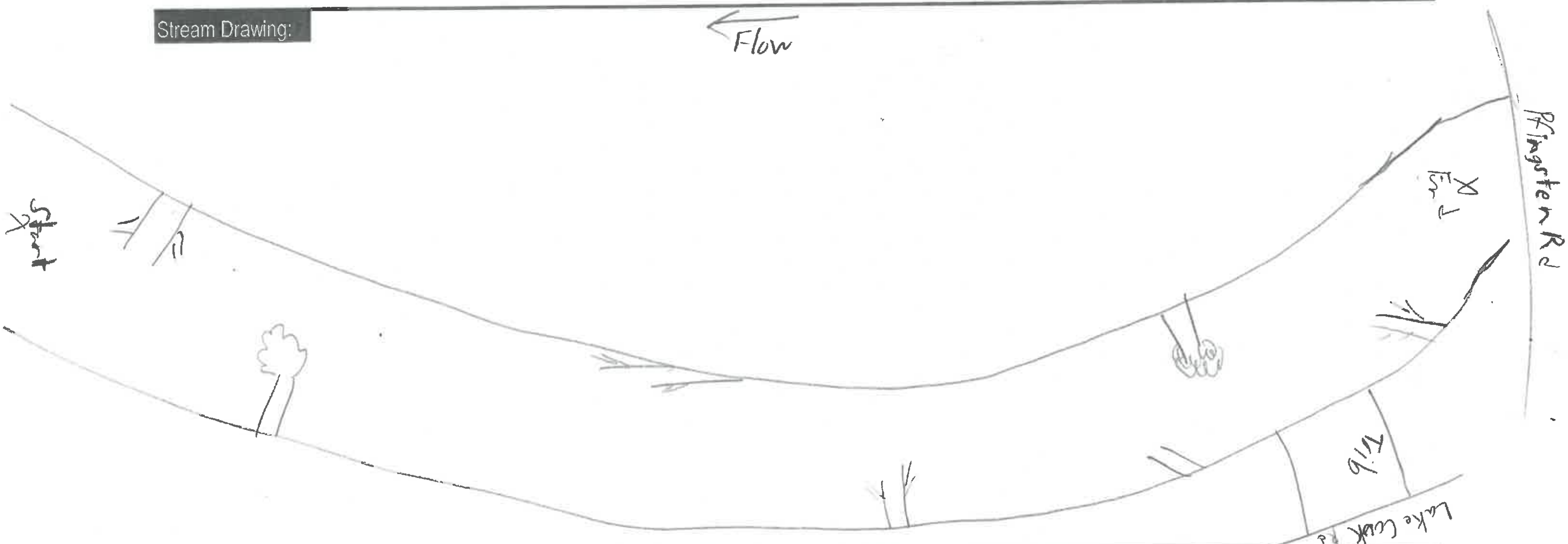
Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other: ____

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 41

River Code: 95-292 **RM:** 4.76 4.9 **Stream:** W FK N Br Chicago R
Site Code: WF23 **Project Code:** NBWW21 **Location:** DST Willow Rd
Date: 7-30-21 **Scorer:** RMD **Latitude:** 42.10279 **Longitude:** -87.80994

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent)

TYPE / POOL / RIFFLE:
- ☐ ☐ -BLDR/SLBS [10]
- ☐ ☐ -Lg BOULD [10]
- ☐ ☐ -BOULDER [9]
- ☐ ☐ -COBBLE [8]
- ☐ ☐ -HARDPAN [4]
- ☑ ☐ -MUCK [2] — Pool: X
- ☐ ☑ -GRAVEL [7]
- ☐ ☑ -SAND [6] — Pool: X
- ☐ ☐ -BEDROCK [5]
- ☐ ☐ -DETRITUS [3]
- ☐ ☐ -ARTIFICIAL [0]
- ☐ ☐ -SILT [2]

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2] ☑ -3 or Less [0]
(High Quality Only, Score 5 or >)

SUBSTRATE ORIGIN (Check ONE (OR 2 & AVERAGE)):
☐ -LIMESTONE [1] ☐ -TILLS [1] ☑ -WETLANDS [0] ☐ -HARDPAN [0] ☐ -SANDSTONE [0] ☐ -RIP / RAP [0] ☐ -LACUSTRINE [0] ☐ -SHALE [-1] ☐ -COAL FINES [-2]

SUBSTRATE QUALITY (Check ONE (OR 2 & AVERAGE)):
SILT: ☑ -SILT HEAVY [-2] ☐ -SILT MODERATE [-1] ☐ -SILT NORMAL [0] ☐ -SILT FREE [1]
EMBEDDEDNESS: ☑ -EXTENSIVE [-2] ☐ -MODERATE [-1] ☐ -NORMAL [0] ☐ -NONE [1]

Substrate: 4 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur
- 0 UNDERCUT BANKS [1]
- 0 OVERHANGING VEGETATION [1]
- 3 SHALLOWS (IN SLOW WATER) [1]
- 0 ROOTMATS [1]
- 2 POOLS > 70 cm [2]
- 0 ROOTWADS [1]
- 0 BOULDERS [1]
- 3 OXBOWS, BACKWATERS [1]
- 2 AQUATIC MACROPHYTES [1]
- 1 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
☐ -EXTENSIVE > 75% [11] ☑ -MODERATE 25 - 75% [7] ☐ -SPARSE 5 - 25% [3] ☐ -NEARLY ABSENT < 5% [1]

Cover: 13 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☐ -HIGH [4] ☐ -MODERATE [3] ☑ -LOW [2] ☐ -NONE [1]
DEVELOPMENT: ☐ -EXCELLENT [7] ☐ -GOOD [5] ☐ -FAIR [3] ☑ -POOR [1]
CHANNELIZATION: ☐ -NONE [6] ☐ -RECOVERED [4] ☐ -RECOVERING [3] ☑ -RECENT OR NO RECOVERY [1] ☐ -IMPOUNDED [-1]
STABILTIY: ☐ -HIGH [3] ☐ -MODERATE [2] ☑ -LOW [1]
MODIFICATIONS / OTHER: ☐ -SNAGGING ☐ -RELOCATION ☐ -CANOPY REMOVAL ☐ -DREDGING ☐ -ONE SIDE CHANNEL MODIFICATIONS ☐ -IMPOUNDMENT ☐ -ISLAND ☐ -LEVEED ☐ -BANK SHAPING

Channel: 5 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH (L R, Per Bank):
☐ ☐ -VERY WIDE > 100m [5]
☐ ☐ -WIDE > 50m [4]
☑ ☑ -MODERATE 10 - 50m [3]
☐ ☐ -NARROW 5 - 10m [2]
☐ ☐ -VERY NARROW < 5m [1]
☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY (PAST 100 Meter RIPARIAN) (L R, Most Predominant Per Bank):
☐ ☐ -FOREST, SWAMP [3]
☐ ☐ -SHRUB OR OLD FIELD [2]
☐ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
☐ ☐ -FENCED PASTURE [1]
☐ ☐ -CONSERVATION TILLAGE [1]
☑ ☐ -URBAN OR INDUSTRIAL [0]
☐ ☐ -OPEN PASTURE, ROWCROP [0]
☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION (L R, Per Bank):
☑ ☑ -NONE / LITTLE [3]
☑ ☑ -MODERATE [2]
☐ ☐ -HEAVY / SEVERE [1]

Riparian: 6 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!): ☑ - 1m [6] ☐ - 0.7m [4] ☐ - 0.4 to 0.7m [2] ☐ - 0.2 to 0.4m [1] ☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE): ☐ -POOL WIDTH > RIFFLE WIDTH [2] ☐ -POOL WIDTH = RIFFLE WIDTH [1] ☑ -POOL WIDTH < RIFFLE WIDTH [0] ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply): ☐ -EDDIES [1] ☐ -FAST [1] ☐ -MODERATE [1] ☑ -SLOW [1] ☐ -NONE [-1] ☐ -TORRENTIAL [-1] ☐ -INTERSTITIAL [-1] ☐ -INTERMITTENT [-2] ☐ -VERY FAST [1]

Pool / Current: 7 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH: ☐ -*Best Areas > 10cm [2] ☐ -Best Areas 5 - 10cm [1] ☐ -Best Areas < 5cm [0] ☑ -NO RIFFLE [Entire Metric = 0]
RUN DEPTH: ☐ - MAX > 50 cm [2] ☐ - MAX < 50 cm [1]
RIFFLE / RUN SUBSTRATE: ☐ -STABLE (e.g., Cobble, Boulder) [2] ☐ -MOD. STABLE (e.g., Large Gravel) [1] ☐ -UNSTABLE (Fine Gravel, Sand) [0]
RIFFLE / RUN EMBEDDEDNESS: ☐ -NONE [2] ☐ -LOW [1] ☐ -MODERATE [0] ☐ -EXTENSIVE [-1]

Riffle / Run: 0 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 3.80 DRAINAGE AREA (sq.mi.): 17.86 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient Score from Table 2 of Users Manual based on gradient and drainage area

Gradient: 6 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Subjective Rating (1-10): ☐

Aesthetic Rating (1-10): ☐

Gradient: ☐ -Low ☐ -Moderate ☐ -High

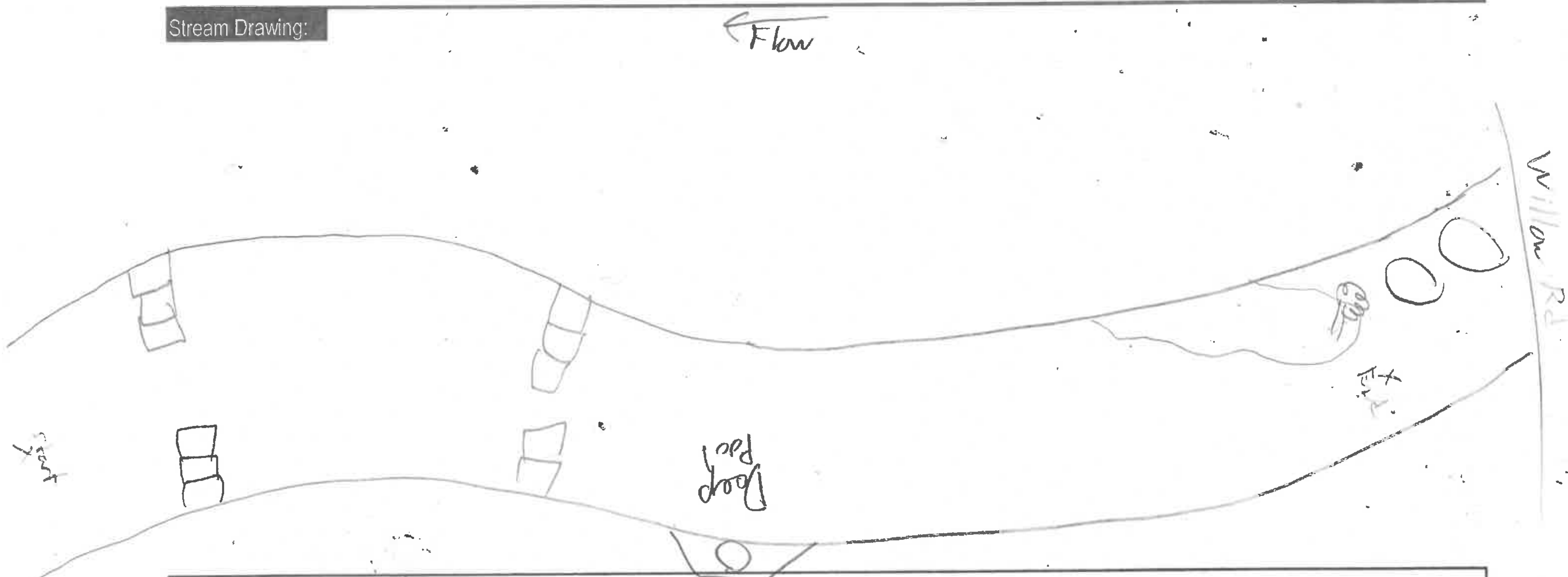
	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	D	200	Cloudy	Normal	100

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ____

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Midwest Biodiversity Institute — Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 66

River Code:	95-292	RM:	~~2.73~~ 2.9 (VN)	Stream:	WFk N Br Chicago R
Site Code:	WF24	Project Code:	NBWW21	Location:	DS Lake Ave @ Sleepy Hollow Park
Date:	Aug 7-30-21	Scorer:	PMD	Latitude:	42.07891
				Longitude:	-87.80365

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☑ -GRAVEL [7]	X	X
☐ ☐ -Lg BOULD [10]			☑ ☐ -SAND [6]	X	
☐ ☐ -BOULDER [9]	X	X	☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]	X	X	☐ ☐ -DETRITUS [3]		
☐ ☐ -HARDPAN [4]	X		☐ ☐ -ARTIFICIAL [0]		
☐ ☐ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☑ -4 or More [2] ☐ -3 or Less [0]
(High Quality Only, Score 5 or >)

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
- ☐ -LIMESTONE [1]
- ☑ -TILLS [1]
- ☑ -WETLANDS [0]
- ☐ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☐ -RIP / RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)

SILT:
- ☐ -SILT HEAVY [-2]
- ☑ -SILT MODERATE [-1]
- ☐ -SILT NORMAL [0]
- ☐ -SILT FREE [1]

EMBEDDEDNESS:
- ☐ -EXTENSIVE [-2]
- ☑ -MODERATE [-1]
- ☐ -NORMAL [0]
- ☐ -NONE [1]

Substrate: 13.5 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

Score	Type	Score	Type	Score	Type
2	UNDERCUT BANKS [1]	1	POOLS > 70 cm [2]	0	OXBOWS, BACKWATERS [1]
1	OVERHANGING VEGETATION [1]	2	ROOTWADS [1]	0	AQUATIC MACROPHYTES [1]
3	SHALLOWS (IN SLOW WATER) [1]	2	BOULDERS [1]	2	LOGS OR WOODY DEBRIS [1]
1	ROOTMATS [1]				

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
- ☐ -EXTENSIVE > 75% [11]
- ☑ -MODERATE 25 - 75% [7]
- ☐ -SPARSE 5 - 25% [3]
- ☐ -NEARLY ABSENT < 5% [1]

Cover: 16 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY
- ☐ -HIGH [4]
- ☑ -MODERATE [3]
- ☐ -LOW [2]
- ☐ -NONE [1]

DEVELOPMENT
- ☐ -EXCELLENT [7]
- ☑ -GOOD [5]
- ☑ -FAIR [3]
- ☐ -POOR [1]

CHANNELIZATION
- ☐ -NONE [6]
- ☑ -RECOVERED [4]
- ☑ -RECOVERING [3]
- ☐ -RECENT OR NO RECOVERY [1]
- ☐ -IMPOUNDED [-1]

STABILITY
- ☐ -HIGH [3]
- ☑ -MODERATE [2]
- ☐ -LOW [1]

MODIFICATIONS / OTHER
- ☐ -SNAGGING
- ☐ -RELOCATION
- ☐ -CANOPY REMOVAL
- ☐ -DREDGING
- ☐ -ONE SIDE CHANNEL MODIFICATIONS
- ☐ -IMPOUNDMENT
- ☐ -ISLAND
- ☐ -LEVEED
- ☐ -BANK SHAPING

Channel: 12.5 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH — L R (Per Bank)
- ☐ ☐ -VERY WIDE > 100m [5]
- ☐ ☐ -WIDE > 50m [4]
- ☐ ☐ -MODERATE 10 - 50m [3]
- ☑ ☑ -NARROW 5 - 10m [2]
- ☐ ☐ -VERY NARROW < 5m [1]
- ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* — L R (Most Predominant Per Bank)
- ☐ ☐ -FOREST, SWAMP [3]
- ☐ ☐ -SHRUB OR OLD FIELD [2]
- ☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ -FENCED PASTURE [1]
- ☐ ☐ -CONSERVATION TILLAGE [1]
- ☐ ☐ -URBAN OR INDUSTRIAL [0]
- ☐ ☐ -OPEN PASTURE, ROWCROP [0]
- ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
- ☑ ☑ -NONE / LITTLE [3]
- ☑ ☑ -MODERATE [2]
- ☐ ☐ -HEAVY / SEVERE [1]

Riparian: 5.5 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
- ☑ - 1m [6]
- ☐ - 0.7m [4]
- ☐ - 0.4 to 0.7m [2]
- ☐ - 0.2 to 0.4m [1]
- ☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
- ☑ -POOL WIDTH > RIFFLE WIDTH [2]
- ☐ -POOL WIDTH = RIFFLE WIDTH [1]
- ☐ -POOL WIDTH < RIFFLE WIDTH [0]
- ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
- ☐ -EDDIES [1]
- ☐ -FAST [1]
- ☑ -MODERATE [1]
- ☑ -SLOW [1]
- ☐ -NONE [-1]
- ☐ -TORRENTIAL [-1]
- ☐ -INTERSTITIAL [-1]
- ☐ -INTERMITTENT [-2]
- ☐ -VERY FAST [1]

Pool / Current: 10 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
- ☐ -*Best Areas > 10cm [2]
- ☑ -Best Areas 5 - 10cm [1]
- ☐ -Best Areas < 5cm [0]
- ☐ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
- ☐ - MAX > 50 cm [2]
- ☑ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
- ☑ -STABLE (e.g., Cobble, Boulder) [2]
- ☐ -MOD. STABLE (e.g., Large Gravel) [1]
- ☐ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ -NONE [2]
- ☑ -LOW [1]
- ☑ -MODERATE [0]
- ☐ -EXTENSIVE [-1]

Riffle / Run: 4.5 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 2.10 DRAINAGE AREA (sq.mi.): 24.52

% POOL: ____ % GLIDE: ____
% RIFFLE: ____ % RUN: ____

Gradient: 4 (Max 10)

*Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N)

If Not, Explain:

Lat / Long (Beg):

Lat / Long (Mid):

Lat / Long (End):

Lat / Long (X-Loc):

Subjective Rating (1-10)

Aesthetic Rating (1-10)

First Sampling Pass	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
	D	200	CTB	Normal	

Gradient: ☐ -Low ☐ -Moderate ☐ -High

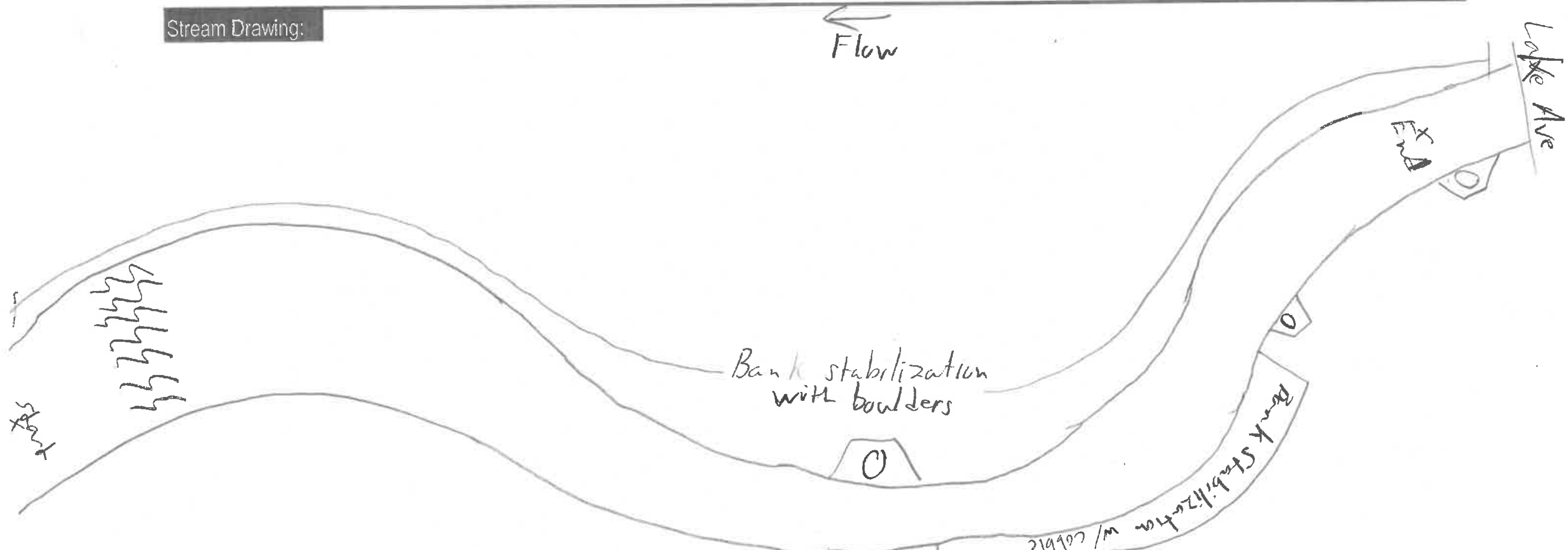
Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other:

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

MBI Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 48

River Code: 95-292 RM: 1.25 1.3 Stream: W F-K N Br Chicago R
Site Code: WF25 Project Code: NBWW21 Location: WST Foot Bridge
Date: 7-30-21 Scorer: Pmp Latitude: 42.06345 Longitude: -87.78887

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE		POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☐ -GRAVEL [7]	X	X
☐ ☐ -Lg BOULD [10]			☑ ☐ -SAND [6]	X	X
☐ ☐ -BOULDER [9]			☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]	X		☐ ☐ -DETRITUS [3]		
☐ ☑ -HARDPAN [4]	X		☐ ☐ -ARTIFICIAL [0]		
☐ ☐ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2]
(High Quality Only, Score 5 or >) ☑ -3 or Less [0]

SUBSTRATE ORIGIN
Check ONE (OR 2 & AVERAGE)
- ☐ -LIMESTONE [1]
- ☐ -TILLS [1]
- ☑ -WETLANDS [0]
- ☐ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☐ -RIP / RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

SUBSTRATE QUALITY
Check ONE (OR 2 & AVERAGE)
- SILT: ☑ -SILT HEAVY [-2]
- ☐ -SILT MODERATE [-1]
- ☐ -SILT NORMAL [0]
- ☐ -SILT FREE [1]
- EMBEDDEDNESS: ☑ -EXTENSIVE [-2]
- ☐ -MODERATE [-1]
- ☐ -NORMAL [0]
- ☐ -NONE [1]

Substrate: 6 Max 20

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

0 UNDERCUT BANKS [1]	3 POOLS > 70 cm [2]	0 OXBOWS, BACKWATERS [1]
1 OVERHANGING VEGETATION [1]	0 ROOTWADS [1]	3 AQUATIC MACROPHYTES [1]
3 SHALLOWS (IN SLOW WATER) [1]	0 BOULDERS [1]	2 LOGS OR WOODY DEBRIS [1]
0 ROOTMATS [1]		

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
- ☐ -EXTENSIVE > 75% [11]
- ☑ -MODERATE 25 - 75% [7]
- ☐ -SPARSE 5 - 25% [3]
- ☐ -NEARLY ABSENT < 5% [1]

Cover: 13 Max 20

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ -HIGH [4]	☐ -EXCELLENT [7]	☐ -NONE [6]	☐ -HIGH [3]
☐ -MODERATE [3]	☐ -GOOD [5]	☐ -RECOVERED [4]	☑ -MODERATE [2]
☑ -LOW [2]	☑ -FAIR [3]	☑ -RECOVERING [3]	☐ -LOW [1]
☐ -NONE [1]	☐ -POOR [1]	☐ -RECENT OR NO RECOVERY [1]	
		☐ -IMPOUNDED [-1]	

MODIFICATIONS / OTHER
- ☐ -SNAGGING ☐ -IMPOUNDMENT
- ☐ -RELOCATION ☐ -ISLAND
- ☐ -CANOPY REMOVAL ☐ -LEVEED
- ☐ -DREDGING ☐ -BANK SHAPING
- ☐ -ONE SIDE CHANNEL MODIFICATIONS

Channel: 10 Max 20

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH
L R (Per Bank)
- ☐ ☐ -VERY WIDE > 100m [5]
- ☐ ☐ -WIDE > 50m [4]
- ☐ ☐ -MODERATE 10 - 50m [3]
- ☑ ☑ -NARROW 5 - 10m [2]
- ☐ ☐ -VERY NARROW < 5m [1]
- ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)*
L R (Most Predominant Per Bank)
- ☐ ☐ -FOREST, SWAMP [3]
- ☐ ☐ -SHRUB OR OLD FIELD [2]
- ☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ -FENCED PASTURE [1]

L R
- ☐ ☐ -CONSERVATION TILLAGE [1]
- ☐ ☐ -URBAN OR INDUSTRIAL [0]
- ☐ ☐ -OPEN PASTURE, ROWCROP [0]
- ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION
L R (Per Bank)
- ☐ ☐ -NONE / LITTLE [3]
- ☑ ☑ -MODERATE [2]
- ☐ ☐ -HEAVY / SEVERE [1]

Riparian: 6 Max 10

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH
(Check 1 ONLY!)
- ☑ - 1m [6]
- ☐ - 0.7m [4]
- ☐ - 0.4 to 0.7m [2]
- ☐ - 0.2 to 0.4m [1]
- ☐ - < 0.2m [POOL = 0]

MORPHOLOGY
(Check 1 or 2 & AVERAGE)
- ☐ -POOL WIDTH > RIFFLE WIDTH [2]
- ☑ -POOL WIDTH = RIFFLE WIDTH [1]
- ☐ -POOL WIDTH < RIFFLE WIDTH [0]
- ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!)
(Check All That Apply)
- ☐ -EDDIES [1] ☐ -TORRENTIAL [-1]
- ☐ -FAST [1] ☐ -INTERSTITIAL [-1]
- ☑ -MODERATE [1] ☐ -INTERMITTENT [-2]
- ☑ -SLOW [1] ☐ -VERY FAST [1]
- ☐ -NONE [-1]

Pool / Current: 9 Max 12

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
- ☐ -*Best Areas > 10cm [2]
- ☑ -Best Areas 5 - 10cm [1]
- ☐ -Best Areas < 5cm [0]
- ☐ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
- ☐ - MAX > 50 cm [2]
- ☑ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ -STABLE (e.g., Cobble, Boulder) [2]
- ☐ -MOD. STABLE (e.g., Large Gravel) [1]
- ☑ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ -NONE [2]
- ☐ -LOW [1]
- ☐ -MODERATE [0]
- ☑ -EXTENSIVE [-1]

Riffle / Run: 1 Max 8

COMMENTS:

6.) GRADIENT (ft / mi): 2.10 DRAINAGE AREA (sq.mi.): 27.97 % POOL: % GLIDE:
% RIFFLE: % RUN:

Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

Gradient: 4 Max 10

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ______

If Not, Explain: ______

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Subjective Rating (1-10)	Aesthetic Rating (1-10)
5	4

Gradient: ☐ -Low ☐ -Moderate ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	D	300	CTB	Normal	90

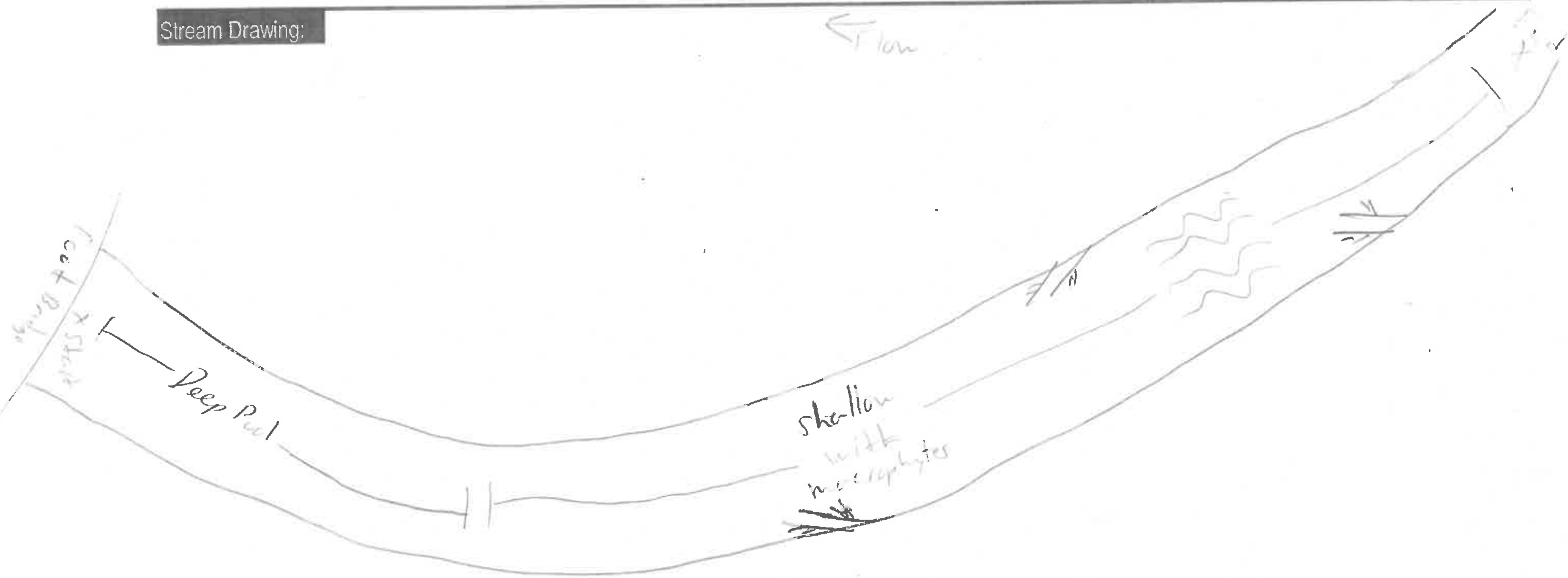
Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other: ______

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Qualitative Habitat Evaluation Index Field Sheet

Midwest Biodiversity Institute

QHEI Score: 29

River Code: 95-291 RM: ~~17.4~~ 21.1 Stream: MFk NBr Chicago R
Site Code: MF08 Project Code: NBWW21 Location: W57 Rockland Rd
Date: 8-1-21 Scorer: PMD Latitude: 42.28013 Longitude: -87.89854

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent)

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☐ -GRAVEL [7]		
☐ ☐ -Lg BOULD [10]			☐ ☐ -SAND [6]		
☐ ☐ -BOULDER [9]	X		☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]			☐ ☐ -DETRITUS [3]		
☑ ☐ -HARDPAN [4]			☐ ☑ -ARTIFICIAL [0]	X	
☐ ☐ -MUCK [2]			☐ ☑ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2] ☑ -3 or Less [0]
(High Quality Only, Score 5 or >)

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1] ☐ -TILLS [1] ☑ -WETLANDS [0] ☐ -HARDPAN [0] ☐ -SANDSTONE [0] ☐ -RIP / RAP [0] ☐ -LACUSTRINE [0] ☐ -SHALE [-1] ☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)
SILT: ☑ -SILT HEAVY [-2] ☐ -SILT MODERATE [-1] ☐ -SILT NORMAL [0] ☐ -SILT FREE [1]
EMBEDDEDNESS: ☑ -EXTENSIVE [-2] ☐ -MODERATE [-1] ☐ -NORMAL [0] ☐ -NONE [1]

Substrate: 2 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur
0 UNDERCUT BANKS [1]
0 OVERHANGING VEGETATION [1]
3 SHALLOWS (IN SLOW WATER) [1]
0 ROOTMATS [1]
0 POOLS > 70 cm [2]
0 ROOTWADS [1]
1 BOULDERS [1]
0 OXBOWS, BACKWATERS [1]
3 AQUATIC MACROPHYTES [1]
2 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
☐ -EXTENSIVE > 75% [11]
☑ -MODERATE 25 - 75% [7]
☐ -SPARSE 5 - 25% [3]
☐ -NEARLY ABSENT < 5% [1]

Cover: 11 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☐ -HIGH [4] ☐ -MODERATE [3] ☑ -LOW [2] ☐ -NONE [1]
DEVELOPMENT: ☐ -EXCELLENT [7] ☐ -GOOD [5] ☐ -FAIR [3] ☑ -POOR [1]
CHANNELIZATION: ☐ -NONE [6] ☐ -RECOVERED [4] ☐ -RECOVERING [3] ☑ -RECENT OR NO RECOVERY [1] ☐ -IMPOUNDED [-1]
STABILITY: ☐ -HIGH [3] ☑ -MODERATE [2] ☐ -LOW [1]
MODIFICATIONS / OTHER: ☐ -SNAGGING ☐ -RELOCATION ☐ -CANOPY REMOVAL ☐ -DREDGING ☐ -ONE SIDE CHANNEL MODIFICATIONS ☐ -IMPOUNDMENT ☐ -ISLAND ☐ -LEVEED ☐ -BANK SHAPING

Channel: 6 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank) River Right Looking Downstream

RIPARIAN WIDTH (L R, Per Bank): ☐ ☐ -VERY WIDE > 100m [5] ☐ ☐ -WIDE > 50m [4] ☐ ☐ -MODERATE 10 - 50m [3] ☑ ☑ -NARROW 5 - 10m [2] ☐ ☐ -VERY NARROW < 5m [1] ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* (L R, Most Predominant Per Bank): ☐ ☐ -FOREST, SWAMP [3] ☐ ☐ -SHRUB OR OLD FIELD [2] ☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1] ☐ ☐ -FENCED PASTURE [1] ☐ ☐ -CONSERVATION TILLAGE [1] ☑ ☑ -URBAN OR INDUSTRIAL [0] ☐ ☐ -OPEN PASTURE, ROWCROP [0] ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION (L R, Per Bank): ☐ ☐ -NONE / LITTLE [3] ☑ ☑ -MODERATE [2] ☐ ☐ -HEAVY / SEVERE [1]

Riparian: 4 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!): ☐ - 1m [6] ☐ - 0.7m [4] ☐ - 0.4 to 0.7m [2] ☑ - 0.2 to 0.4m [1] ☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE): ☐ -POOL WIDTH > RIFFLE WIDTH [2] ☐ -POOL WIDTH = RIFFLE WIDTH [1] ☑ -POOL WIDTH < RIFFLE WIDTH [0] ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply): ☐ -EDDIES [1] ☐ -FAST [1] ☐ -MODERATE [1] ☑ -SLOW [1] ☐ -NONE [-1] ☐ -TORRENTIAL [-1] ☐ -INTERSTITIAL [-1] ☐ -INTERMITTENT [-2] ☐ -VERY FAST [1]

Pool / Current: 2 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH: ☐ -*Best Areas > 10cm [2] ☐ -Best Areas 5 - 10cm [1] ☐ -Best Areas < 5cm [0] ☑ -NO RIFFLE [Entire Metric = 0]
RUN DEPTH: ☐ - MAX > 50 cm [2] ☐ - MAX < 50 cm [1]
RIFFLE / RUN SUBSTRATE: ☐ -STABLE (e.g., Cobble, Boulder) [2] ☐ -MOD. STABLE (e.g., Large Gravel) [1] ☐ -UNSTABLE (Fine Gravel, Sand) [0]
RIFFLE / RUN EMBEDDEDNESS: ☐ -NONE [2] ☐ -LOW [1] ☐ -MODERATE [0] ☐ -EXTENSIVE [-1]

Riffle / Run: 0 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 4.20 DRAINAGE AREA (sq.mi.): 5.81 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient: 4 (Max 10)
Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N)

Lat / Long (Beg):
Lat / Long (Mid):
Lat / Long (End):
Lat / Long (X-Loc):

If Not, Explain: Oil/gas sheen on surface of the water

Subjective Rating (1-10)	Aesthetic Rating (1-10)
4	4

Gradient:
☐ -Low ☐ -Moderate ☐ -High

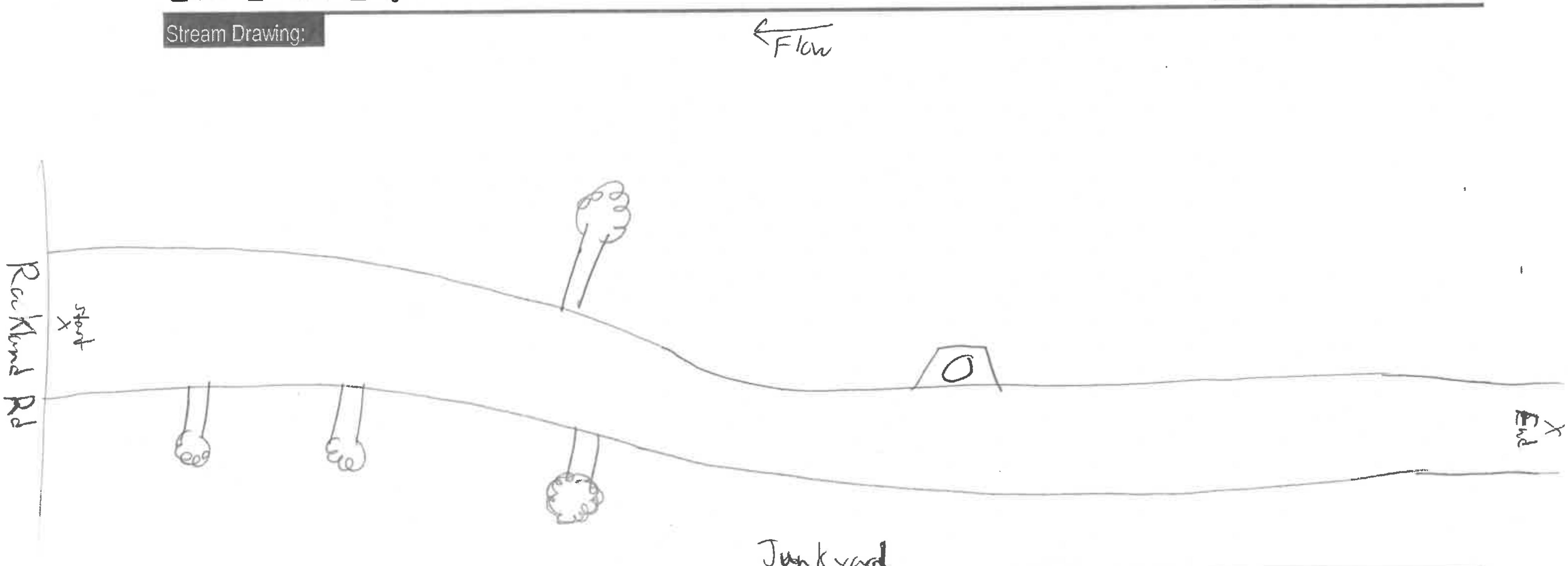
	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	F	150	CTB	Normal	95

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other:

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 31.5

River Code: 95-291 RM: ~~15.23~~ 18.9 Stream: M Fk N Br Chicago R
Site Code: MF09 Project Code: NBWW21 Location: DST Foot Bridge @ FP
Date: 8-1-21 Scorer: PMD Latitude: 42.25635 Longitude: -87.88459

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent)

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☐ -GRAVEL [7]		
☐ ☐ -Lg BOULD [10]			☐ ☐ -SAND [6]	X	
☐ ☐ -BOULDER [9]	X		☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]			☐ ☐ -DETRITUS [3]		
☐ ☐ -HARDPAN [4]	X		☐ ☐ -ARTIFICIAL [0]		
☑ ☑ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☐ 4 or More [2]
(High Quality Only, Score 5 or >) ☑ 3 or Less [0]

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
- ☐ -LIMESTONE [1]
- ☐ -TILLS [1]
- ☑ -WETLANDS [0]
- ☐ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☐ -RIP / RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)
- SILT: ☑ -SILT HEAVY [-2]; ☐ -SILT MODERATE [-1]; ☐ -SILT NORMAL [0]; ☐ -SILT FREE [1]
- EMBEDDEDNESS: ☑ -EXTENSIVE [-2]; ☐ -MODERATE [-1]; ☐ -NORMAL [0]; ☐ -NONE [1]

Substrate: 0 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur
- 0 UNDERCUT BANKS [1]
- 0 OVERHANGING VEGETATION [1]
- 3 SHALLOWS (IN SLOW WATER) [1]
- 0 ROOTMATS [1]
- 0 POOLS > 70 cm [2]
- 0 ROOTWADS [1]
- 1 BOULDERS [1]
- 0 OXBOWS, BACKWATERS [1]
- 3 AQUATIC MACROPHYTES [1]
- 2 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
- ☐ -EXTENSIVE > 75% [11]
- ☑ -MODERATE 25 - 75% [7]
- ☐ -SPARSE 5 - 25% [3]
- ☐ -NEARLY ABSENT < 5% [1]

Cover: 11 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☐ -HIGH [4]; ☐ -MODERATE [3]; ☐ -LOW [2]; ☑ -NONE [1]

DEVELOPMENT: ☐ -EXCELLENT [7]; ☐ -GOOD [5]; ☐ -FAIR [3]; ☑ -POOR [1]

CHANNELIZATION: ☐ -NONE [6]; ☐ -RECOVERED [4]; ☐ -RECOVERING [3]; ☑ -RECENT OR NO RECOVERY [1]; ☐ -IMPOUNDED [-1]

STABILITY: ☐ -HIGH [3]; ☑ -MODERATE [2]; ☐ -LOW [1]

MODIFICATIONS / OTHER: ☐ -SNAGGING; ☐ -RELOCATION; ☐ -CANOPY REMOVAL; ☐ -DREDGING; ☐ -ONE SIDE CHANNEL MODIFICATIONS; ☐ -IMPOUNDMENT; ☐ -ISLAND; ☐ -LEVEED; ☐ -BANK SHAPING

Channel: 5 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank) River Right Looking Downstream

RIPARIAN WIDTH — L R (Per Bank)
- ☑ ☑ -VERY WIDE > 100m [5]
- ☑ ☐ -WIDE > 50m [4]
- ☐ ☐ -MODERATE 10 - 50m [3]
- ☐ ☐ -NARROW 5 - 10m [2]
- ☐ ☐ -VERY NARROW < 5m [1]
- ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* — L R (Most Predominant Per Bank)
- ☐ ☐ -FOREST, SWAMP [3]
- ☑ ☑ -SHRUB OR OLD FIELD [2]
- ☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ -FENCED PASTURE [1]
- ☐ ☐ -CONSERVATION TILLAGE [1]
- ☐ ☐ -URBAN OR INDUSTRIAL [0]
- ☐ ☐ -OPEN PASTURE, ROWCROP [0]
- ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
- ☐ ☐ -NONE / LITTLE [3]
- ☑ ☑ -MODERATE [2]
- ☐ ☐ -HEAVY / SEVERE [1]

Riparian: 8.5 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
- ☐ - 1m [6]
- ☐ - 0.7m [4]
- ☑ - 0.4 to 0.7m [2]
- ☐ - 0.2 to 0.4m [1]
- ☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
- ☐ -POOL WIDTH > RIFFLE WIDTH [2]
- ☐ -POOL WIDTH = RIFFLE WIDTH [1]
- ☑ -POOL WIDTH < RIFFLE WIDTH [0]
- ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
- ☐ -EDDIES [1]
- ☐ -FAST [1]
- ☐ -MODERATE [1]
- ☑ -SLOW [1]
- ☐ -NONE [-1]
- ☐ -TORRENTIAL [-1]
- ☐ -INTERSTITIAL [-1]
- ☐ -INTERMITTENT [-2]
- ☐ -VERY FAST [1]

Pool / Current: 3 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
- ☐ -*Best Areas > 10cm [2]
- ☐ -Best Areas 5 - 10cm [1]
- ☐ -Best Areas < 5cm [0]
- ☑ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
- ☐ - MAX > 50 cm [2]
- ☐ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ -STABLE (e.g., Cobble, Boulder) [2]
- ☐ -MOD. STABLE (e.g., Large Gravel) [1]
- ☐ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ -NONE [2]
- ☐ -LOW [1]
- ☐ -MODERATE [0]
- ☐ -EXTENSIVE [-1]

Riffle / Run: 0 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 1.92 DRAINAGE AREA (sq.mi.): 8.91 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient: 4 (Max 10)

Gradient Score from Table 2 of Users Manual based on gradient and drainage area

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other: ____

Subjective Rating (1-10): 4

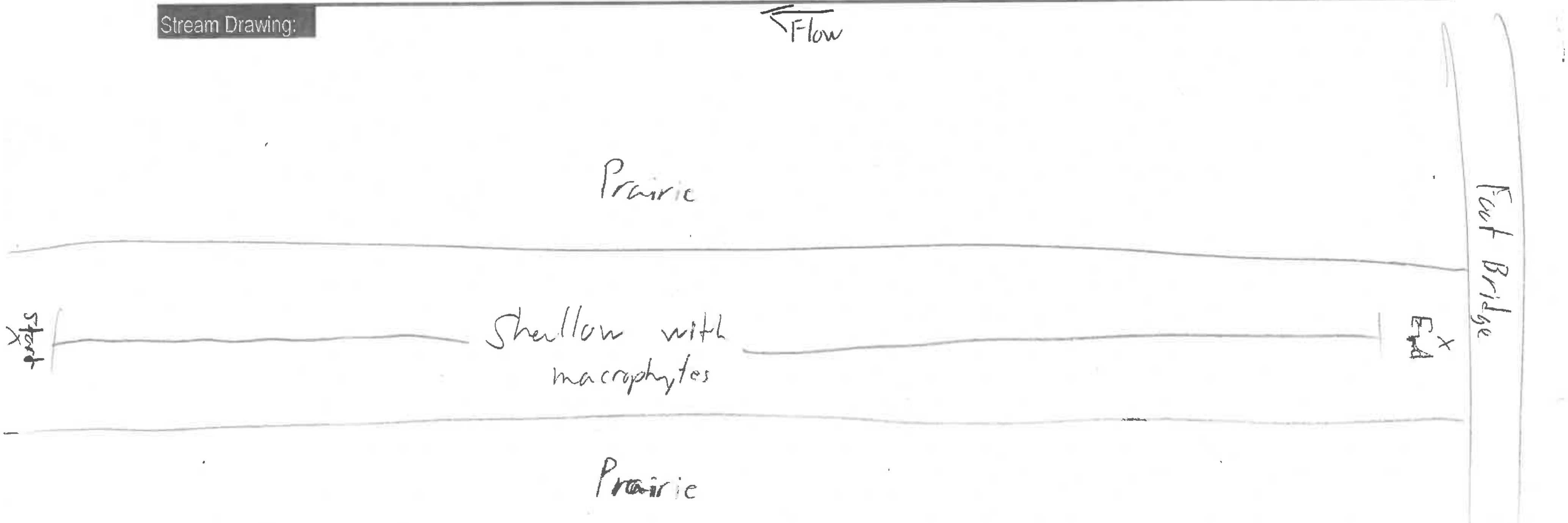
Aesthetic Rating (1-10): 4

Gradient: ☐ -Low ☐ -Moderate ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	F	150	CTB	Normal	100

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 41

River Code: 95-291 RM: ~~73.12~~ 16.1 Stream: M Fk N Br Chicago R
Site Code: MF10 Project Code: NRWW21 Location: DST West Leigh St
Date: 7-31-21 Scorer: PMD Latitude: 42.23196 Longitude: -87.86841

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent)

TYPE / POOL / RIFFLE

- ☐ ☐ -BLDR/SLBS [10]
- ☐ ☐ -Lg BOULD [10]
- ☐ ☐ -BOULDER [9]
- ☐ ☐ -COBBLE [8]
- ☑ ☐ -HARDPAN [4]
- ☐ ☐ -MUCK [2]
- ☐ ☑ -GRAVEL [7]
- ☐ ☐ -SAND [6] X
- ☐ ☐ -BEDROCK [5]
- ☐ ☐ -DETRITUS [3]
- ☐ ☐ -ARTIFICIAL [0]
- ☐ ☐ -SILT [2]

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)

- ☐ -LIMESTONE [1]
- ☐ -TILLS [1]
- ☑ -WETLANDS [0]
- ☐ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☐ -RIP / RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)

SILT:
- ☑ -SILT HEAVY [-2]
- ☐ -SILT MODERATE [-1]
- ☐ -SILT NORMAL [0]
- ☐ -SILT FREE [1]

EMBEDDEDNESS:
- ☑ -EXTENSIVE [-2]
- ☐ -MODERATE [-1]
- ☐ -NORMAL [0]
- ☐ -NONE [1]

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2] ☑ -3 or Less [0]
(High Quality Only, Score 5 or >)

COMMENTS:

Substrate: 7 (Max 20)

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

- 0 UNDERCUT BANKS [1]
- 0 OVERHANGING VEGETATION [1]
- 3 SHALLOWS (IN SLOW WATER) [1]
- 2 ROOTMATS [1]
- 0 POOLS > 70 cm [2]
- 1 ROOTWADS [1]
- 0 BOULDERS [1]
- 0 OXBOWS, BACKWATERS [1]
- 3 AQUATIC MACROPHYTES [1]
- 1 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)

- ☐ -EXTENSIVE > 75% [11]
- ☑ -MODERATE 25 - 75% [7]
- ☐ -SPARSE 5 - 25% [3]
- ☐ -NEARLY ABSENT < 5% [1]

COMMENTS:

Cover: 12 (Max 20)

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY
- ☐ -HIGH [4]
- ☐ -MODERATE [3]
- ☑ -LOW [2]
- ☐ -NONE [1]

DEVELOPMENT
- ☐ -EXCELLENT [7]
- ☐ -GOOD [5]
- ☐ -FAIR [3]
- ☑ -POOR [1]

CHANNELIZATION
- ☐ -NONE [6]
- ☐ -RECOVERED [4]
- ☐ -RECOVERING [3]
- ☑ -RECENT OR NO RECOVERY [1]
- ☐ -IMPOUNDED [-1]

STABILTIY
- ☐ -HIGH [3]
- ☑ -MODERATE [2]
- ☐ -LOW [1]

MODIFICATIONS / OTHER
- ☐ -SNAGGING
- ☐ -RELOCATION
- ☐ -CANOPY REMOVAL
- ☐ -DREDGING
- ☐ -ONE SIDE CHANNEL MODIFICATIONS
- ☐ -IMPOUNDMENT
- ☐ -ISLAND
- ☐ -LEVEED
- ☐ -BANK SHAPING

COMMENTS:

Channel: 10 (Max 20)

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH — L R (Per Bank)
- ☑ ☑ -VERY WIDE > 100m [5]
- ☐ ☐ -WIDE > 50m [4]
- ☐ ☐ -MODERATE 10 - 50m [3]
- ☐ ☐ -NARROW 5 - 10m [2]
- ☐ ☐ -VERY NARROW < 5m [1]
- ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY (PAST 100 Meter RIPARIAN) — L R (Most Predominant Per Bank)
- ☑ ☑ -FOREST, SWAMP [3]
- ☐ ☐ -SHRUB OR OLD FIELD [2]
- ☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ -FENCED PASTURE [1]
- ☐ ☐ -CONSERVATION TILLAGE [1]
- ☐ ☐ -URBAN OR INDUSTRIAL [0]
- ☐ ☐ -OPEN PASTURE, ROWCROP [0]
- ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
- ☐ ☐ -NONE / LITTLE [3]
- ☑ ☑ -MODERATE [2]
- ☐ ☐ -HEAVY / SEVERE [1]

COMMENTS:

Riparian: 9 (Max 10)

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
- ☐ - 1m [6]
- ☐ - 0.7m [4]
- ☑ - 0.4 to 0.7m [2]
- ☐ - 0.2 to 0.4m [1]
- ☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
- ☐ -POOL WIDTH > RIFFLE WIDTH [2]
- ☐ -POOL WIDTH = RIFFLE WIDTH [1]
- ☑ -POOL WIDTH < RIFFLE WIDTH [0]
- ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
- ☐ -EDDIES [1]
- ☐ -FAST [1]
- ☐ -MODERATE [1]
- ☑ -SLOW [1]
- ☐ -NONE [-1]
- ☐ -TORRENTIAL [-1]
- ☐ -INTERSTITIAL [-1]
- ☐ -INTERMITTENT [-2]
- ☐ -VERY FAST [1]

COMMENTS:

Pool / Current: 3 (Max 12)

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
- ☐ -*Best Areas > 10cm [2]
- ☐ -Best Areas 5 - 10cm [1]
- ☐ -Best Areas < 5cm [0]
- ☑ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
- ☐ - MAX > 50 cm [2]
- ☐ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ -STABLE (e.g., Cobble, Boulder) [2]
- ☐ -MOD. STABLE (e.g., Large Gravel) [1]
- ☐ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ -NONE [2]
- ☐ -LOW [1]
- ☐ -MODERATE [0]
- ☐ -EXTENSIVE [-1]

COMMENTS:

Riffle / Run: 0 (Max 8)

6.) GRADIENT (ft / mi): 2.59 DRAINAGE AREA (sq.mi.): 11.99 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient: 4 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate species

Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg): ____

Lat / Long (Mid): ____

Lat / Long (End): ____

Lat / Long (X-Loc): ____

Subjective Rating (1-10) ☐

Aesthetic Rating (1-10) ☐

Gradient: ☐ -Low ☐ -Moderate ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	F	150	CTB	Normal	90%

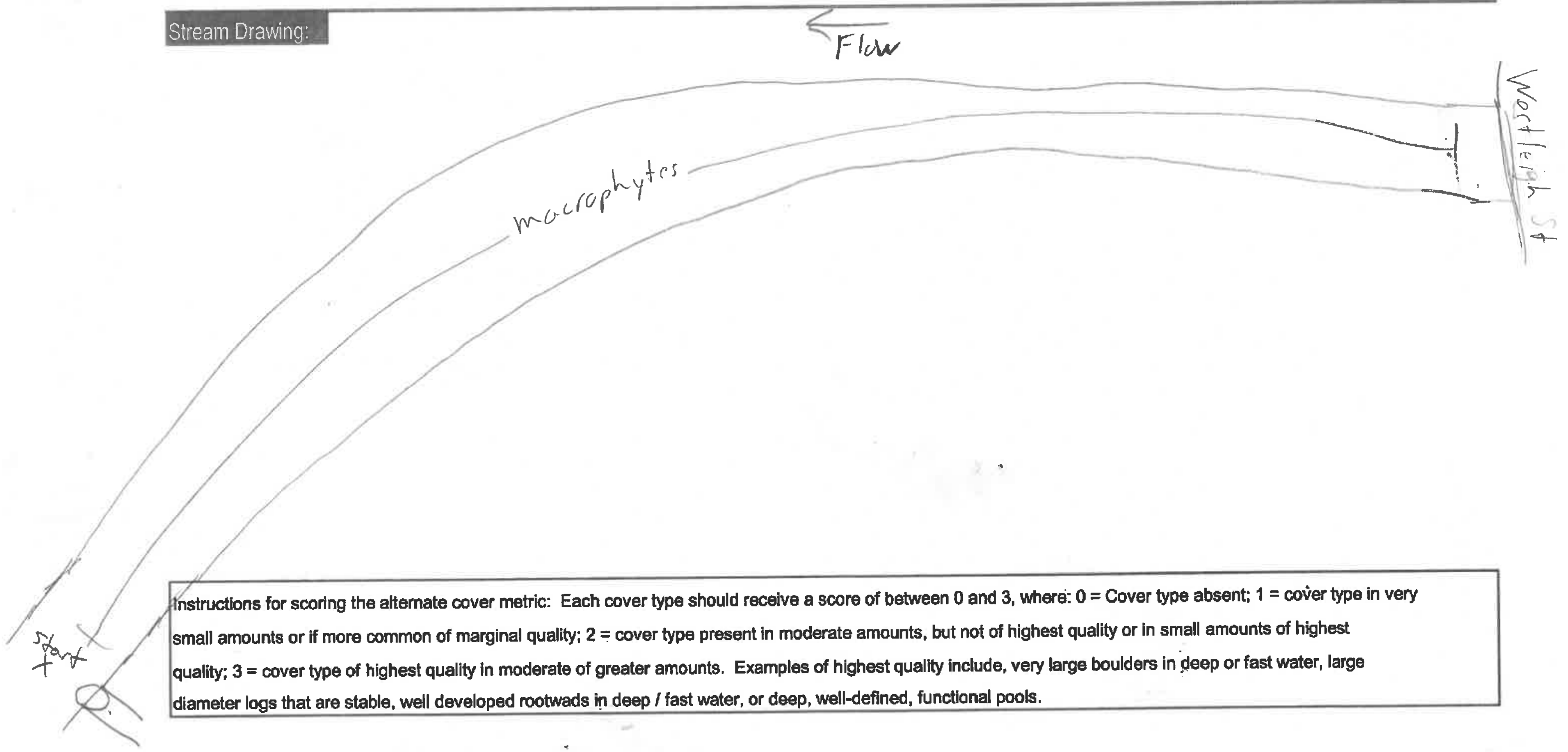
Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other: ____

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Qualitative Habitat Evaluation Index Field Sheet

Midwest Biodiversity Institute

QHEI Score: 44

River Code: 95-291 RM: ~~10.56~~ 14.1 Stream: M FK N Br Chicago R
Site Code: MF11 Project Code: NBWW21 Location: DST IL 22
Date: 7-31-21 Scorer: PMD Latitude: 42.19861 Longitude: -87.85362

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE	SUBSTRATE ORIGIN	SUBSTRATE QUALITY
☐ ☐ -BLDR/SLBS [10]			☐ ☐ -GRAVEL [7]			Check ONE (OR 2 & AVERAGE)	Check ONE (OR 2 & AVERAGE)
☐ ☐ -Lg BOULD [10]			☐ ☑ -SAND [6]			☐ -LIMESTONE [1]	SILT: ☑ -SILT HEAVY [-2]
☐ ☐ -BOULDER [9]			☐ ☐ -BEDROCK [5]			☐ -TILLS [1]	☐ -SILT MODERATE [-1]
☐ ☐ -COBBLE [8]			☐ ☐ -DETRITUS [3]			☑ -WETLANDS [0]	☐ -SILT NORMAL [0]
☑ ☐ -HARDPAN [4]			☐ ☐ -ARTIFICIAL [0]			☐ -HARDPAN [0]	☐ -SILT FREE [1]
☐ ☐ -MUCK [2]			☐ ☐ -SILT [2]			☐ -SANDSTONE [0]	EMBEDDEDNESS: ☑ -EXTENSIVE [-2]
						☐ -RIP / RAP [0]	☐ -MODERATE [-1]
						☐ -LACUSTRINE [0]	☐ -NORMAL [0]
						☐ -SHALE [-1]	☐ -NONE [1]
						☐ -COAL FINES [-2]	

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2]
(High Quality Only, Score 5 or >) ☑ -3 or Less [0]

COMMENTS:

Substrate: 6 (Max 20)

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

0 UNDERCUT BANKS [1]	3 POOLS > 70 cm [2]	0 OXBOWS, BACKWATERS [1]
0 OVERHANGING VEGETATION [1]	3 ROOTWADS [1]	3 AQUATIC MACROPHYTES [1]
3 SHALLOWS (IN SLOW WATER) [1]	0 BOULDERS [1]	2 LOGS OR WOODY DEBRIS [1]
0 ROOTMATS [1]		

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
☐ -EXTENSIVE > 75% [11]
☑ -MODERATE 25 - 75% [7]
☐ -SPARSE 5 - 25% [3]
☐ -NEARLY ABSENT < 5% [1]

COMMENTS:

Cover: 13 (Max 20)

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS / OTHER	
☐ -HIGH [4]	☐ -EXCELLENT [7]	☐ -NONE [6]	☐ -HIGH [3]	☐ -SNAGGING	☐ -IMPOUNDMENT
☐ -MODERATE [3]	☐ -GOOD [5]	☐ -RECOVERED [4]	☑ -MODERATE [2]	☐ -RELOCATION	☐ -ISLAND
☑ -LOW [2]	☐ -FAIR [3]	☐ -RECOVERING [3]	☐ -LOW [1]	☐ -CANOPY REMOVAL	☐ -LEVEED
☐ -NONE [1]	☑ -POOR [1]	☑ -RECENT OR NO RECOVERY [1]		☐ -DREDGING	☐ -BANK SHAPING
		☐ -IMPOUNDED [-1]		☐ -ONE SIDE CHANNEL MODIFICATIONS	

COMMENTS:

Channel: 6 (Max 20)

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH L R (Per Bank)	FLOOD PLAIN QUALITY (PAST 100 Meter RIPARIAN) L R (Most Predominant Per Bank)	L R	BANK EROSION L R (Per Bank)
☑ ☑ -VERY WIDE > 100m [5]	☐ ☐ -FOREST, SWAMP [3]	☐ ☐ -CONSERVATION TILLAGE [1]	☐ ☐ -NONE / LITTLE [3]
☐ ☐ -WIDE > 50m [4]	☑ ☑ -SHRUB OR OLD FIELD [2]	☐ ☐ -URBAN OR INDUSTRIAL [0]	☑ ☑ -MODERATE [2]
☐ ☐ -MODERATE 10 - 50m [3]	☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]	☐ ☐ -OPEN PASTURE, ROWCROP [0]	☑ ☑ -HEAVY / SEVERE [1]
☐ ☐ -NARROW 5 - 10m [2]	☐ ☐ -FENCED PASTURE [1]	☐ ☐ -MINING / CONSTRUCTION [0]	
☐ ☐ -VERY NARROW < 5m [1]			
☐ ☐ -NONE [0]			

COMMENTS:

Riparian: 8 (Max 10)

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)	MORPHOLOGY (Check 1 or 2 & AVERAGE)	CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)	
☑ - 1m [6]	☐ -POOL WIDTH > RIFFLE WIDTH [2]	☐ -EDDIES [1]	☐ -TORRENTIAL [-1]
☐ - 0.7m [4]	☐ -POOL WIDTH = RIFFLE WIDTH [1]	☐ -FAST [1]	☐ -INTERSTITIAL [-1]
☐ - 0.4 to 0.7m [2]	☑ -POOL WIDTH < RIFFLE WIDTH [0]	☐ -MODERATE [1]	☐ -INTERMITTENT [-2]
☐ - 0.2 to 0.4m [1]	☐ -IMPOUNDED [-1]	☑ -SLOW [1]	☐ -VERY FAST [1]
☐ - < 0.2m [POOL = 0]		☐ -NONE [-1]	

COMMENTS:

Pool / Current: 7 (Max 12)

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ -*Best Areas > 10cm [2]	☐ - MAX > 50 cm [2]	☐ -STABLE (e.g., Cobble, Boulder) [2]	☐ -NONE [2]
☐ -Best Areas 5 - 10cm [1]	☐ - MAX < 50 cm [1]	☐ -MOD. STABLE (e.g., Large Gravel) [1]	☐ -LOW [1]
☐ -Best Areas < 5cm [0]		☐ -UNSTABLE (Fine Gravel, Sand) [0]	☐ -MODERATE [0]
☑ -NO RIFFLE [Entire Metric = 0]			☐ -EXTENSIVE [-1]

COMMENTS:

Riffle / Run: 0 (Max 8)

6.) GRADIENT (ft / mi): 2.44 DRAINAGE AREA (sq.mi.): 16.13 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

Gradient: 4 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N)

If Not, Explain:

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other:

Subjective Rating (1-10)	Aesthetic Rating (1-10)
5	4

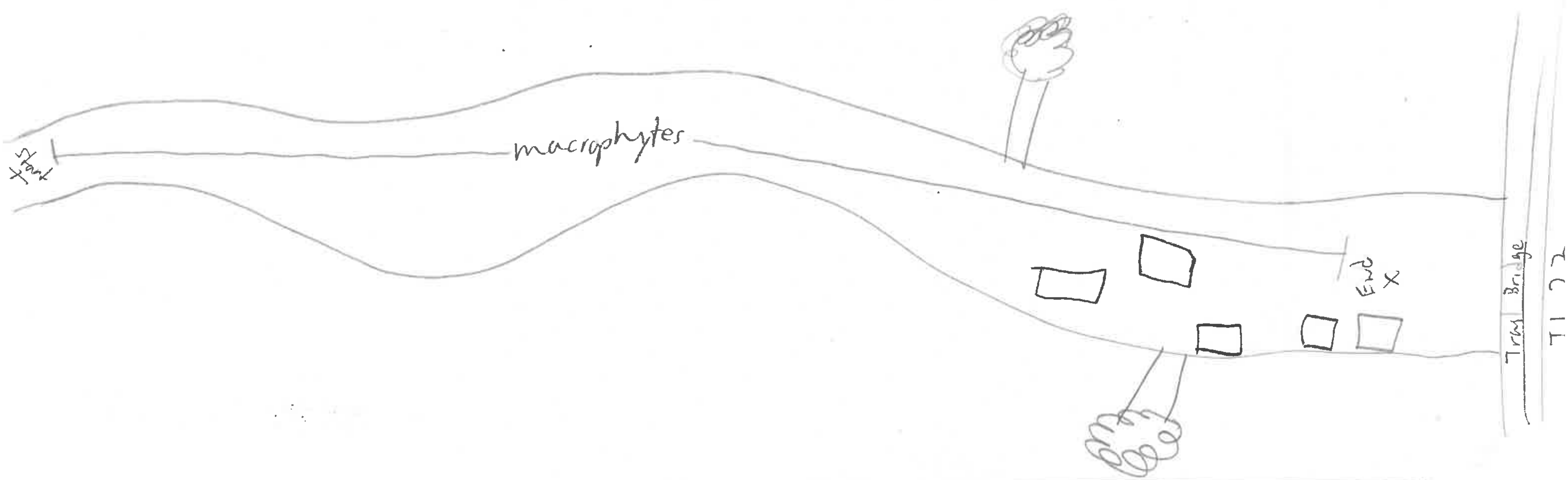
	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	E	150	CTB	Normal	100

Gradient: ☐ -Low ☐ -Moderate ☐ -High

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Stream Drawing:

Flow



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

MBI Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 45.5

River Code: 95-291 RM: ~~7.17~~ 10.8 Stream: M Fk N Br Chicago R
Site Code: MF12 Project Code: NBWW21 Location: US T Carriage Way
Date: 7-31-21 Scorer: PMD Latitude: 42.15927 Longitude: -87.82470

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☐ -GRAVEL [7]	X	
☐ ☐ -Lg BOULD [10]			☐ ☑ -SAND [6]	X	
☐ ☐ -BOULDER [9]			☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]			☐ ☐ -DETRITUS [3]		
☑ ☐ -HARDPAN [4]			☐ ☐ -ARTIFICIAL [0]		
☐ ☐ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2] ☑ -3 or Less [0]
(High Quality Only, Score 5 or >)

SUBSTRATE ORIGIN
Check ONE (OR 2 & AVERAGE)
- ☐ -LIMESTONE [1]
- ☐ -TILLS [1]
- ☑ -WETLANDS [0]
- ☐ -HARDPAN [0]
- ☐ -SANDSTONE [0]
- ☐ -RIP / RAP [0]
- ☐ -LACUSTRINE [0]
- ☐ -SHALE [-1]
- ☐ -COAL FINES [-2]

SUBSTRATE QUALITY
Check ONE (OR 2 & AVERAGE)
- SILT: ☑ -SILT HEAVY [-2]; ☐ -SILT MODERATE [-1]; ☐ -SILT NORMAL [0]; ☐ -SILT FREE [1]
- EMBEDDEDNESS: ☑ -EXTENSIVE [-2]; ☐ -MODERATE [-1]; ☐ -NORMAL [0]; ☐ -NONE [1]

Substrate: 6 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

1 UNDERCUT BANKS [1]	2 POOLS > 70 cm [2]	0 OXBOWS, BACKWATERS [1]
2 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	3 AQUATIC MACROPHYTES [1]
3 SHALLOWS (IN SLOW WATER) [1]	0 BOULDERS [1]	2 LOGS OR WOODY DEBRIS [1]
1 ROOTMATS [1]		

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
- ☐ -EXTENSIVE > 75% [11]
- ☑ -MODERATE 25 - 75% [7]
- ☐ -SPARSE 5 - 25% [3]
- ☐ -NEARLY ABSENT < 5% [1]

Cover: 16 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ -HIGH [4]	☐ -EXCELLENT [7]	☐ -NONE [6]	☑ -HIGH [3]
☐ -MODERATE [3]	☐ -GOOD [5]	☐ -RECOVERED [4]	☐ -MODERATE [2]
☐ -LOW [2]	☐ -FAIR [3]	☐ -RECOVERING [3]	☐ -LOW [1]
☑ -NONE [1]	☑ -POOR [1]	☑ -RECENT OR NO RECOVERY [1]	
		☐ -IMPOUNDED [-1]	

MODIFICATIONS / OTHER
- ☐ -SNAGGING ☐ -IMPOUNDMENT
- ☐ -RELOCATION ☐ -ISLAND
- ☐ -CANOPY REMOVAL ☐ -LEVEED
- ☐ -DREDGING ☐ -BANK SHAPING
- ☐ -ONE SIDE CHANNEL MODIFICATIONS

Channel: 6 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH
L R (Per Bank)
- ☐ ☐ -VERY WIDE > 100m [5]
- ☐ ☐ -WIDE > 50m [4]
- ☐ ☐ -MODERATE 10 - 50m [3]
- ☑ ☑ -NARROW 5 - 10m [2]
- ☐ ☐ -VERY NARROW < 5m [1]
- ☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)*
L R (Most Predominant Per Bank)
- ☐ ☐ -FOREST, SWAMP [3]
- ☐ ☐ -SHRUB OR OLD FIELD [2]
- ☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ -FENCED PASTURE [1]

L R
- ☐ ☐ -CONSERVATION TILLAGE [1]
- ☐ ☐ -URBAN OR INDUSTRIAL [0]
- ☐ ☐ -OPEN PASTURE, ROWCROP [0]
- ☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION
L R (Per Bank)
- ☐ ☐ -NONE / LITTLE [3]
- ☑ ☑ -MODERATE [2]
- ☑ ☑ -HEAVY / SEVERE [1]

Riparian: 4.5 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
- ☑ - 1m [6]
- ☐ - 0.7m [4]
- ☐ - 0.4 to 0.7m [2]
- ☐ - 0.2 to 0.4m [1]
- ☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
- ☐ -POOL WIDTH > RIFFLE WIDTH [2]
- ☐ -POOL WIDTH = RIFFLE WIDTH [1]
- ☑ -POOL WIDTH < RIFFLE WIDTH [0]
- ☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
- ☐ -EDDIES [1] ☐ -TORRENTIAL [-1]
- ☐ -FAST [1] ☐ -INTERSTITIAL [-1]
- ☐ -MODERATE [1] ☐ -INTERMITTENT [-2]
- ☑ -SLOW [1] ☐ -VERY FAST [1]
- ☐ -NONE [-1]

Pool / Current: 7 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
- ☐ -*Best Areas > 10cm [2]
- ☐ -Best Areas 5 - 10cm [1]
- ☐ -Best Areas < 5cm [0]
- ☑ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
- ☐ - MAX > 50 cm [2]
- ☐ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ -STABLE (e.g., Cobble, Boulder) [2]
- ☐ -MOD. STABLE (e.g., Large Gravel) [1]
- ☐ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ -NONE [2]
- ☐ -LOW [1]
- ☐ -MODERATE [0]
- ☐ -EXTENSIVE [-1]

Riffle / Run: 0 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 3.60 DRAINAGE AREA (sq.mi.): 19.23 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient: 6 (Max 10)

*Best areas must be large enough to support a population of riffle-obligate species

Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Subjective Rating (1-10) ☐

Aesthetic Rating (1-10) ☐

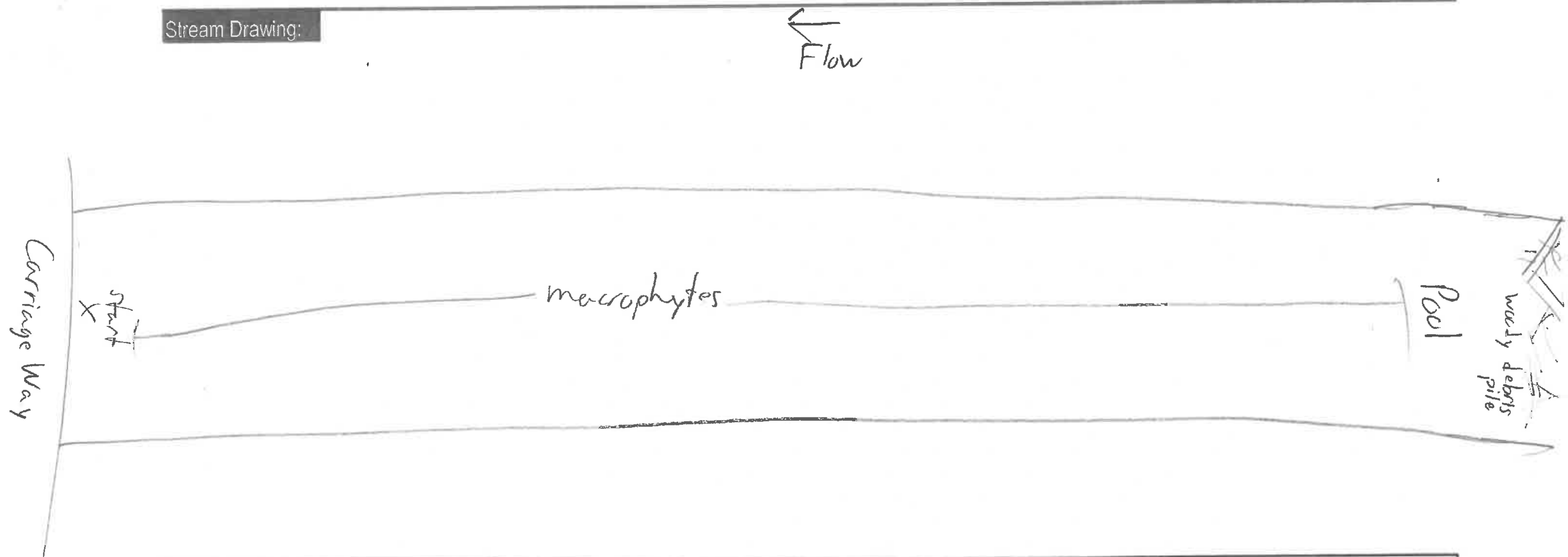
Gradient:
☐ -Low ☐ -Moderate ☐ -High

First Sampling Pass	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
	E	150	C/B	Normal	95

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ____

Stream Drawing:



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Qualitative Habitat Evaluation Index Field Sheet

Midwest Biodiversity Institute

QHEI Score: 60

River Code: 95-291 RM: 5.0 8.4 Stream: N Fk N Br Chicago R
Site Code: MF13 Project Code: NBWW21 Location: UST IL-68
Date: 7-31-21 Scorer: PMD Latitude: 42.13879 Longitude: -87.81029

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE		POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☑ -GRAVEL [7]	X	X
☐ ☐ -Lg BOULD [10]			☑ ☐ -SAND [6]	X	X
☐ ☐ -BOULDER [9]			☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]	X		☐ ☐ -DETRITUS [3]	X	
☐ ☐ -HARDPAN [4]	X		☐ ☐ -ARTIFICIAL [0]		
☐ ☐ -MUCK [2]	X		☐ ☐ -SILT [2]	X	

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2]
(High Quality Only, Score 5 or >) ☑ -3 or Less [0]

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1]
☐ -TILLS [1]
☑ -WETLANDS [0]
☐ -HARDPAN [0]
☐ -SANDSTONE [0]
☐ -RIP / RAP [0]
☐ -LACUSTRINE [0]
☐ -SHALE [-1]
☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)
SILT: ☑ -SILT HEAVY [-2]; ☐ -SILT MODERATE [-1]; ☐ -SILT NORMAL [0]; ☐ -SILT FREE [1]
EMBEDDEDNESS: ☑ -EXTENSIVE [-2]; ☐ -MODERATE [-1]; ☐ -NORMAL [0]; ☐ -NONE [1]

Substrate: 9 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

0	UNDERCUT BANKS [1]	2	POOLS > 70 cm [2]	0	OXBOWS, BACKWATERS [1]
0	OVERHANGING VEGETATION [1]	2	ROOTWADS [1]	3	AQUATIC MACROPHYTES [1]
3	SHALLOWS (IN SLOW WATER) [1]	0	BOULDERS [1]	2	LOGS OR WOODY DEBRIS [1]
2	ROOTMATS [1]				

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
☐ -EXTENSIVE > 75% [11]
☑ -MODERATE 25 - 75% [7]
☐ -SPARSE 5 - 25% [3]
☐ -NEARLY ABSENT < 5% [1]

Cover: 14 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☐ -HIGH [4]; ☑ -MODERATE [3]; ☑ -LOW [2]; ☐ -NONE [1]

DEVELOPMENT: ☐ -EXCELLENT [7]; ☐ -GOOD [5]; ☑ -FAIR [3]; ☐ -POOR [1]

CHANNELIZATION: ☐ -NONE [6]; ☐ -RECOVERED [4]; ☑ -RECOVERING [3]; ☐ -RECENT OR NO RECOVERY [1]; ☐ -IMPOUNDED [-1]

STABILTIY: ☐ -HIGH [3]; ☐ -MODERATE [2]; ☑ -LOW [1]

MODIFICATIONS / OTHER: ☐ -SNAGGING; ☐ -RELOCATION; ☐ -CANOPY REMOVAL; ☐ -DREDGING; ☐ -ONE SIDE CHANNEL MODIFICATIONS; ☐ -IMPOUNDMENT; ☐ -ISLAND; ☐ -LEVEED; ☐ -BANK SHAPING

Channel: 9.5 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH — L R (Per Bank)
☐ ☐ -VERY WIDE > 100m [5]
☑ ☑ -WIDE > 50m [4]
☐ ☐ -MODERATE 10 - 50m [3]
☐ ☐ -NARROW 5 - 10m [2]
☐ ☐ -VERY NARROW < 5m [1]
☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* — L R (Most Predominant Per Bank)
☐ ☑ -FOREST, SWAMP [3]
☐ ☐ -SHRUB OR OLD FIELD [2]
☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
☐ ☐ -FENCED PASTURE [1]
☐ ☐ -CONSERVATION TILLAGE [1]
☐ ☐ -URBAN OR INDUSTRIAL [0]
☐ ☐ -OPEN PASTURE, ROWCROP [0]
☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION — L R (Per Bank)
☐ ☐ -NONE / LITTLE [3]
☑ ☑ -MODERATE [2]
☑ ☑ -HEAVY / SEVERE [1]

Riparian: 7.5 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
☑ - 1m [6]
☐ - 0.7m [4]
☐ - 0.4 to 0.7m [2]
☐ - 0.2 to 0.4m [1]
☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☑ -POOL WIDTH > RIFFLE WIDTH [2]
☐ -POOL WIDTH = RIFFLE WIDTH [1]
☐ -POOL WIDTH < RIFFLE WIDTH [0]
☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
☐ -EDDIES [1]
☐ -FAST [1]
☐ -MODERATE [1]
☑ -SLOW [1]
☐ -NONE [-1]
☐ -TORRENTIAL [-1]
☐ -INTERSTITIAL [-1]
☐ -INTERMITTENT [-2]
☐ -VERY FAST [1]

Pool / Current: 9 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
☐ -*Best Areas > 10cm [2]
☑ -Best Areas 5 - 10cm [1]
☐ -Best Areas < 5cm [0]
☐ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
☐ - MAX > 50 cm [2]
☑ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
☐ -STABLE (e.g., Cobble, Boulder) [2]
☐ -MOD. STABLE (e.g., Large Gravel) [1]
☑ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
☐ -NONE [2]
☐ -LOW [1]
☐ -MODERATE [0]
☑ -EXTENSIVE [-1]

Riffle / Run: 1 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 8.20 DRAINAGE AREA (sq.mi.): 26.97 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient: 10 (Max 10)

Gradient Score from Table 2 of Users Manual based on gradient and drainage area

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Subjective Rating (1-10): 5

Aesthetic Rating (1-10): 5

Gradient:
☐ -Low ☐ -Moderate ☐ -High

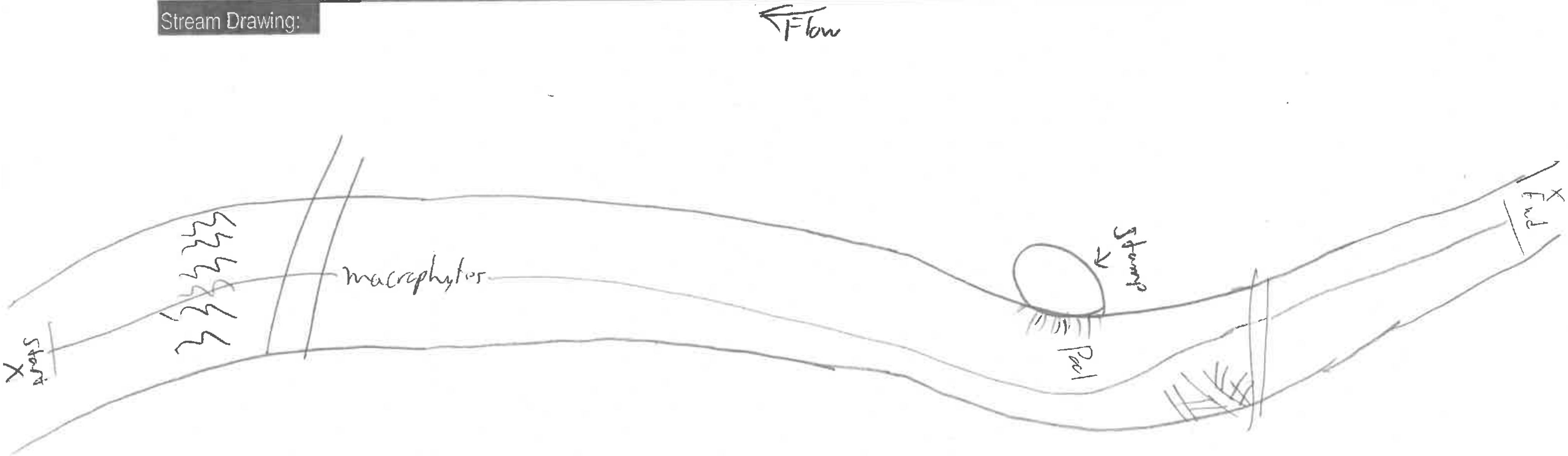
	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	F	150	CTB	Normal	25

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐

Other: ____

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 64.5

River Code: 95-291 RM: 2.39 (0.0) Stream: M Fk N Br Chicago R
Site Code: MF14 Project Code: NBWW21 Location: DST Sunset Dr
Date: 7-31-21 Scorer: PMD Latitude: 42.11541 Longitude: -87.78472

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent)

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☑ -GRAVEL [7]	X	X
☐ ☐ -Lg BOULD [10]			☑ ☐ -SAND [6]	X	X
☐ ☐ -BOULDER [9]	X		☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]	X	X	☐ ☐ -DETRITUS [3]		
☐ ☐ -HARDPAN [4]	X		☐ ☐ -ARTIFICIAL [0]		
☐ ☐ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☑ -4 or More [2] ☐ -3 or Less [0]
(High Quality Only, Score 5 or >)

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1]
☑ -TILLS [1]
☐ -WETLANDS [0]
☐ -HARDPAN [0]
☐ -SANDSTONE [0]
☐ -RIP / RAP [0]
☐ -LACUSTRINE [0]
☐ -SHALE [-1]
☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)
SILT: ☐ -SILT HEAVY [-2] ☑ -SILT MODERATE [-1] ☐ -SILT NORMAL [0] ☐ -SILT FREE [1]
EMBEDDEDNESS: ☐ -EXTENSIVE [-2] ☑ -MODERATE [-1] ☐ -NORMAL [0] ☐ -NONE [1]

Substrate: 14 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur
1 UNDERCUT BANKS [1]
1 OVERHANGING VEGETATION [1]
3 SHALLOWS (IN SLOW WATER) [1]
1 ROOTMATS [1]
1 POOLS > 70 cm [2]
2 ROOTWADS [1]
1 BOULDERS [1]
0 OXBOWS, BACKWATERS [1]
3 AQUATIC MACROPHYTES [1]
2 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
☐ -EXTENSIVE > 75% [11]
☑ -MODERATE 25 - 75% [7]
☐ -SPARSE 5 - 25% [3]
☐ -NEARLY ABSENT < 5% [1]

Cover: 17 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☑ -HIGH [4] ☐ -MODERATE [3] ☐ -LOW [2] ☐ -NONE [1]
DEVELOPMENT: ☐ -EXCELLENT [7] ☑ -GOOD [5] ☐ -FAIR [3] ☐ -POOR [1]
CHANNELIZATION: ☐ -NONE [6] ☑ -RECOVERED [4] ☐ -RECOVERING [3] ☐ -RECENT OR NO RECOVERY [1] ☐ -IMPOUNDED [-1]
STABILITY: ☐ -HIGH [3] ☑ -MODERATE [2] ☐ -LOW [1]
MODIFICATIONS / OTHER: ☐ -SNAGGING ☐ -RELOCATION ☐ -CANOPY REMOVAL ☐ -DREDGING ☐ -ONE SIDE CHANNEL MODIFICATIONS ☐ -IMPOUNDMENT ☐ -ISLAND ☐ -LEVEED ☐ -BANK SHAPING

Channel: 15 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

River Right Looking Downstream

RIPARIAN WIDTH (L R, Per Bank)
☐ ☐ -VERY WIDE > 100m [5]
☐ ☐ -WIDE > 50m [4]
☐ ☐ -MODERATE 10 - 50m [3]
☑ ☑ -NARROW 5 - 10m [2]
☐ ☐ -VERY NARROW < 5m [1]
☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* (L R, Most Predominant Per Bank)
☐ ☐ -FOREST, SWAMP [3]
☐ ☐ -SHRUB OR OLD FIELD [2]
☑ ☑ -RESIDENTIAL, PARK, NEW FIELD [1]
☐ ☐ -FENCED PASTURE [1]
☐ ☐ -CONSERVATION TILLAGE [1]
☐ ☐ -URBAN OR INDUSTRIAL [0]
☐ ☐ -OPEN PASTURE, ROWCROP [0]
☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION (L R, Per Bank)
☐ ☐ -NONE / LITTLE [3]
☑ ☑ -MODERATE [2]
☑ ☑ -HEAVY / SEVERE [1]

Riparian: 0 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
☑ - 1m [6]
☐ - 0.7m [4]
☐ - 0.4 to 0.7m [2]
☐ - 0.2 to 0.4m [1]
☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☑ -POOL WIDTH > RIFFLE WIDTH [2]
☐ -POOL WIDTH = RIFFLE WIDTH [1]
☐ -POOL WIDTH < RIFFLE WIDTH [0]
☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
☐ -EDDIES [1]
☐ -FAST [1]
☑ -MODERATE [1]
☑ -SLOW [1]
☐ -NONE [-1]
☐ -TORRENTIAL [-1]
☐ -INTERSTITIAL [-1]
☐ -INTERMITTENT [-2]
☐ -VERY FAST [1]

Pool / Current: 10 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
☐ -*Best Areas > 10cm [2]
☑ -Best Areas 5 - 10cm [1]
☐ -Best Areas < 5cm [0]
☐ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
☐ - MAX > 50 cm [2]
☑ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
☐ -STABLE (e.g., Cobble, Boulder) [2]
☑ -MOD. STABLE (e.g., Large Gravel) [1]
☑ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
☐ -NONE [2]
☐ -LOW [1]
☑ -MODERATE [0]
☐ -EXTENSIVE [-1]

Riffle / Run: 2.5 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 4.93 DRAINAGE AREA (sq.mi.): 22.48 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient: 6 (Max 10)

Gradient Score from Table 2 of Users Manual based on gradient and drainage area

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg):	
Lat / Long (Mid):	
Lat / Long (End):	
Lat / Long (X-Loc):	

Subjective Rating (1-10): 7

Aesthetic Rating (1-10): 7

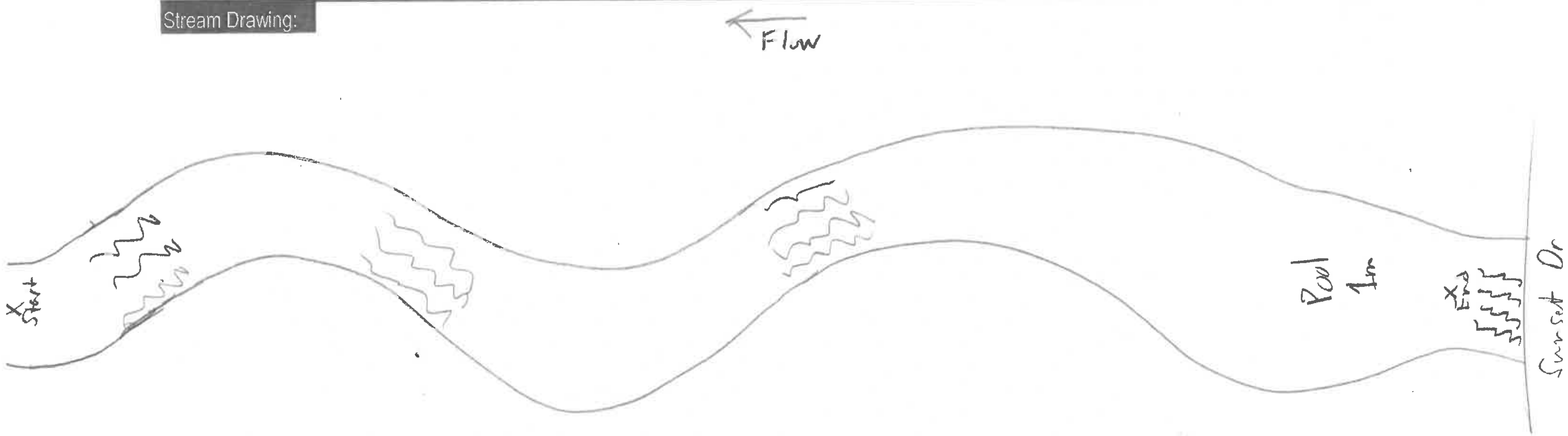
Gradient: ☐ -Low ☐ -Moderate ☐ -High

	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	E	150	CTB	Normal	30

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):
- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ____

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

MBI Midwest Biodiversity Institute

Qualitative Habitat Evaluation Index Field Sheet

QHEI Score: 55.5

River Code: 95-291 RM: 0.43 Stream: M Fk N Br Chicago River
Site Code: MF15 Project Code: NBWW21 Location: DST Winnetka Ave
Date: 7-31-21 Scorer: PMD Latitude: 42.09294 Longitude: -87.77116

1.) SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent

TYPE	POOL	RIFFLE	TYPE	POOL	RIFFLE
☐ ☐ -BLDR/SLBS [10]			☐ ☐ -GRAVEL [7]	X	
☐ ☐ -Lg BOULD [10]			☐ ☑ -SAND [6]		
☐ ☐ -BOULDER [9]			☐ ☐ -BEDROCK [5]		
☐ ☐ -COBBLE [8]			☐ ☐ -DETRITUS [3]		
☑ ☐ -HARDPAN [4]			☐ ☐ -ARTIFICIAL [0]		
☐ ☐ -MUCK [2]			☐ ☐ -SILT [2]		

NUMBER OF SUBSTRATE TYPES: ☐ -4 or More [2]
(High Quality Only, Score 5 or >) ☑ -3 or Less [0]

SUBSTRATE ORIGIN — Check ONE (OR 2 & AVERAGE)
☐ -LIMESTONE [1]
☑ -TILLS [1]
☐ -WETLANDS [0]
☐ -HARDPAN [0]
☐ -SANDSTONE [0]
☐ -RIP / RAP [0]
☐ -LACUSTRINE [0]
☐ -SHALE [-1]
☐ -COAL FINES [-2]

SUBSTRATE QUALITY — Check ONE (OR 2 & AVERAGE)
SILT: ☐ -SILT HEAVY [-2]; ☑ -SILT MODERATE [-1]; ☐ -SILT NORMAL [0]; ☐ -SILT FREE [1]
EMBEDDEDNESS: ☑ -EXTENSIVE [-2]; ☑ -MODERATE [-1]; ☐ -NORMAL [0]; ☐ -NONE [1]

Substrate: 8.5 (Max 20)

COMMENTS:

2.) INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur

1 UNDERCUT BANKS [1]
1 OVERHANGING VEGETATION [1]
3 SHALLOWS (IN SLOW WATER) [1]
2 ROOTMATS [1]
1 POOLS > 70 cm [2]
1 ROOTWADS [1]
0 BOULDERS [1]
0 OXBOWS, BACKWATERS [1]
1 AQUATIC MACROPHYTES [1]
1 LOGS OR WOODY DEBRIS [1]

AMOUNT: (Check ONLY one or check 2 and AVERAGE)
☐ -EXTENSIVE > 75% [11]
☐ -MODERATE 25 - 75% [7]
☑ -SPARSE 5 - 25% [3]
☐ -NEARLY ABSENT < 5% [1]

Cover: 12 (Max 20)

COMMENTS:

3.) CHANNEL MORPHOLOGY: (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY: ☐ -HIGH [4]; ☑ -MODERATE [3]; ☐ -LOW [2]; ☐ -NONE [1]

DEVELOPMENT: ☐ -EXCELLENT [7]; ☑ -GOOD [5]; ☑ -FAIR [3]; ☐ -POOR [1]

CHANNELIZATION: ☐ -NONE [6]; ☐ -RECOVERED [4]; ☑ -RECOVERING [3]; ☐ -RECENT OR NO RECOVERY [1]; ☐ -IMPOUNDED [-1]

STABILITY: ☐ -HIGH [3]; ☑ -MODERATE [2]; ☐ -LOW [1]

MODIFICATIONS / OTHER: ☐ -SNAGGING; ☐ -RELOCATION; ☐ -CANOPY REMOVAL; ☐ -DREDGING; ☐ -ONE SIDE CHANNEL MODIFICATIONS; ☐ -IMPOUNDMENT; ☐ -ISLAND; ☐ -LEVEED; ☐ -BANK SHAPING

Channel: 12 (Max 20)

COMMENTS:

4.) RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank) River Right Looking Downstream

RIPARIAN WIDTH (L R, Per Bank)
☑ ☑ -VERY WIDE > 100m [5]
☐ ☐ -WIDE > 50m [4]
☐ ☐ -MODERATE 10 - 50m [3]
☐ ☐ -NARROW 5 - 10m [2]
☐ ☐ -VERY NARROW < 5m [1]
☐ ☐ -NONE [0]

FLOOD PLAIN QUALITY *(PAST 100 Meter RIPARIAN)* (L R, Most Predominant Per Bank)
☑ ☑ -FOREST, SWAMP [3]
☐ ☐ -SHRUB OR OLD FIELD [2]
☐ ☐ -RESIDENTIAL, PARK, NEW FIELD [1]
☐ ☐ -FENCED PASTURE [1]
☐ ☐ -CONSERVATION TILLAGE [1]
☐ ☐ -URBAN OR INDUSTRIAL [0]
☐ ☐ -OPEN PASTURE, ROWCROP [0]
☐ ☐ -MINING / CONSTRUCTION [0]

BANK EROSION (L R, Per Bank)
☐ ☐ -NONE / LITTLE [3]
☑ ☑ -MODERATE [2]
☑ ☑ -HEAVY / SEVERE [1]

Riparian: 9.5 (Max 10)

COMMENTS:

5.) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX. DEPTH (Check 1 ONLY!)
☑ - 1m [6]
☐ - 0.7m [4]
☐ - 0.4 to 0.7m [2]
☐ - 0.2 to 0.4m [1]
☐ - < 0.2m [POOL = 0]

MORPHOLOGY (Check 1 or 2 & AVERAGE)
☑ -POOL WIDTH > RIFFLE WIDTH [2]
☐ -POOL WIDTH = RIFFLE WIDTH [1]
☐ -POOL WIDTH < RIFFLE WIDTH [0]
☐ -IMPOUNDED [-1]

CURRENT VELOCITY (POOLS & RIFFLES!) (Check All That Apply)
☐ -EDDIES [1]
☐ -FAST [1]
☐ -MODERATE [1]
☑ -SLOW [1]
☐ -NONE [-1]
☐ -TORRENTIAL [-1]
☐ -INTERSTITIAL [-1]
☐ -INTERMITTENT [-2]
☐ -VERY FAST [1]

Pool / Current: 9 (Max 12)

COMMENTS:

CHECK ONE OR CHECK 2 AND ADVERAGE

RIFFLE DEPTH
☐ -*Best Areas > 10cm [2]
☐ -Best Areas 5 - 10cm [1]
☑ -Best Areas < 5cm [0]
☐ -NO RIFFLE [Entire Metric = 0]

RUN DEPTH
☐ - MAX > 50 cm [2]
☑ - MAX < 50 cm [1]

RIFFLE / RUN SUBSTRATE
☐ -STABLE (e.g., Cobble, Boulder) [2]
☐ -MOD. STABLE (e.g., Large Gravel) [1]
☑ -UNSTABLE (Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
☐ -NONE [2]
☐ -LOW [1]
☑ -MODERATE [0]
☑ -EXTENSIVE [-1]

Riffle / Run: 0.5 (Max 8)

COMMENTS:

6.) GRADIENT (ft / mi): 1.92 DRAINAGE AREA (sq.mi.): 24.29 % POOL: % GLIDE: % RIFFLE: % RUN:

Gradient: 4 (Max 10)

Gradient Score from Table 2 of Users Manual based on gradient and drainage area.

*Best areas must be large enough to support a population of riffle-obligate species

Is Sampling Reach Representative of the Stream? (Y/ N) ____

If Not, Explain: ____

Lat / Long (Beg): ____

Lat / Long (Mid): ____

Lat / Long (End): ____

Lat / Long (X-Loc): ____

Subjective Rating (1-10)	Aesthetic Rating (1-10)
6	6

Gradient: ☐ -Low ☐ -Moderate ☐ -High

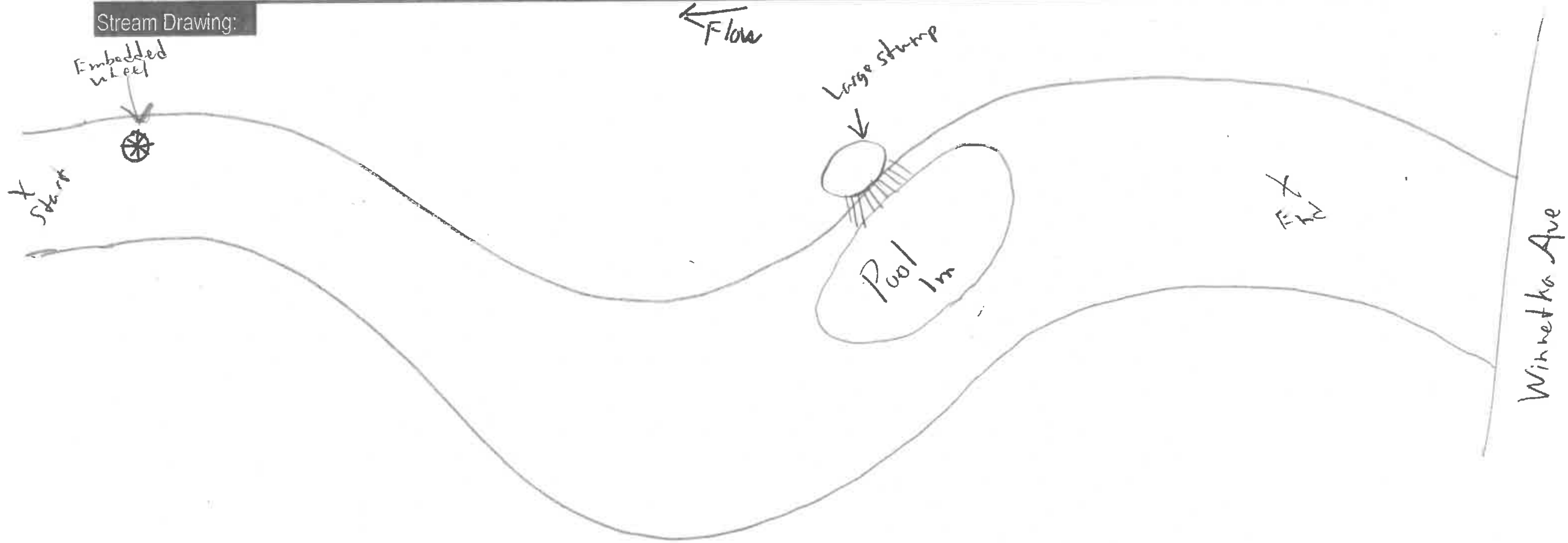
	Gear:	Distance:	Water Clarity:	Water Stage:	Canopy- % open:
First Sampling Pass	E	150	CTB	Normal	90

Yes	No	
☐	☐	Is Stream Ephemeral (no pools, totally dry of only damp spots)?
☐	☐	Is there water upstream? How far:
☐	☐	Is there water close downstream? How far:
☐	☐	Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):

- None ☐
- Industrial ☐
- WWTP ☐
- Agriculture ☐
- Livestock ☐
- Silviculture ☐
- Construction ☐
- Urban Runoff ☐
- CSOs ☐
- Suburban Impacts ☐
- Mining ☐
- Channelization ☐
- Riparian Removal ☐
- Landfills ☐
- Natural ☐
- Dams ☐
- Other Flow Alteration ☐
- Other: ____

Stream Drawing:



Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3, where: 0 = Cover type absent; 1 = cover type in very small amounts or if more common of marginal quality; 2 = cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 = cover type of highest quality in moderate of greater amounts. Examples of highest quality include, very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deep / fast water, or deep, well-defined, functional pools.

APPENDIX D: NORTH BRANCH CHICAGO RIVER 2020-2021 CAUSES

D-1: North Branch All Sites Causes by Narrative Category 2020-21
D-2: Skokie River Unweighted and Weighted Causes by Count and Percent 2020
D-3: Middle Fork N. Branch Unweighted and Weighted Causes by Count and Percent 2020-21
D-4: West Fork Unweighted and Weighted Causes by Count and Percent 2021

***Appendix Table D-1**. A compendium of causes listed in the Synthesis table (Table 23) by major North Branch river or fork and the number of very poor, poor, and fair threshold exceedances in each arranged by six major causal categories.*

	Very Poor					Poor					Fair						
Cause	**Skokie R.**	**M. Fk. N. Br.**	**W. Fk.**	**Total**	**Cause**	**Skokie R.**	**M. Fk. N. Br.**	**W. Fk.**	**Total**	**Cause**	**Skokie R.**	**M. Fk. N. Br.**	**W. Fk.**	**Total**	**Grand Total**	**Category Totals**	**Category %**
Urban Land Use																	
Dev. WS	7	1	4	12	Dev. WS	1	9	2	12	Dev. WS	0	1	0	1	25	**30**	8.2%
Imperv30C	0	0	0	0	Imperv30C	0	1	1	2	Imperv30C	1	0	2	3	5		
Habitat																	
QHEI	0	0	0	0	QHEI	5	8	4	17	QHEI	1	3	1	5	22	**100**	27.2%
Substr.	4	3	1	8	Substr.	3	7	0	10	Substr.	1	0	2	3	21		
QHEI Ratio	1	1	0	2	QHEI Ratio	2	4	3	9	QHEI Ratio	1	4	2	7	18		
Poor Attr.	0	1	0	1	Poor Attr.	2	4	4	10	Poor Attr.	0	0	0	0	11		
Chan.	0	0	0	0	Chan.	5	5	4	14	Chan.	3	2	2	7	21		
High Mod. Attr.	0	0	0	0	High Mod. Attr.	5	2	0	7	High Mod. Attr.	0	0	0	0	7		
Ionic Strength/Demand																	
Chloride	2	8	5	15	Chloride	1	0	1	2	Chloride	5	3	0	8	25	**56**	15.3%
Conduct.	2	7	4	13	Conduct.	2	3	6	11	Conduct.	4	1	0	5	29		
TSS	0	0	1	1	TSS	0	0	1	1	TSS	0	0	0	0	2		
Toxics																	
Sed. PAH	7	10	5	22	Sed. PAH	0	2	0	2	Sed. PAH	5	2	2	9	33	**64**	17.4%
Sed. Metals	0	0	0	0	Sed. Metals	2	5	4	11	Sed. Metals	4	6	1	11	22		
Toxicity	0	0	0	0	Toxicity	0	1	0	1	Toxicity	0	0	0	0	1		
Ammonia	0	0	4	4	Ammonia	0	1	0	1	Ammonia	0	2	1	3	8		
Organic Enrichment/Low D.O.																	
Low D.O.	1	5	4	10	Low D.O.	3	1	1	5	Low D.O.	4	9	5	18	33	**70**	19.1%
Org. Enrich.	0	1	4	5	Org. Enrich.	2	6	2	10	Org. Enrich.	0	2	0	2	17		
TKN	0	0	0	0	TKN	0	2	3	5	TKN	4	6	5	15	20		
Nutrient Enrichment/Effects																	
TP	0	0	1	1	TP	0	0	0	0	TP	1	3	4	8	9	**47**	12.8%
Nitrate	0	0	0	0	Nitrate	0	1	1	2	Nitrate	1	3	1	5	7		
Max. D.O.	0	0	0	0	Max. D.O.	0	0	0	0	Max. D.O.	7	7	1	15	15		
D.O. Swing	1	7	3	11	D.O. Swing	2	0	2	4	D.O. Swing	0	1	0	1	16		
Totals	**25**	**44**	**36**	**105**	**Totals**	**35**	**62**	**39**	**136**	**Totals**	**42**	**55**	**29**	**126**	**367**	**367**	**100.0%**

Appendix Table D-2*. Causes of aquatic life impairment in the Skokie River in 2020 arranged by very poor, poor, and fair threshold exceedances and weighted and unweighted proportion by cause and causal category.*

Causal Agents	Very Poor	VP%	VP Wtd.	VP Wtd.%	Poor	Poor%	Poor Wtd.	Poor Wtd.%	Fair	Fair%	Fair Wtd.%	Total	Total%	Total Wtd.	Wtd. %
Dev. WS	7	6.9%	35	12.9%	1	1.0%	3	1.1%	0	0.0%	0.0%	8	7.8%	38	14.0%
Imperv30C	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.0%	0.4%	1	1.0%	1	0.4%
Urban Land Use	**7**	**6.9%**	**35**	**12.9%**	**1**	**1.0%**	**3**	**1.1%**	**1**	**1.0%**	**0.4%**	**9**	**8.8%**	**39**	**14.3%**
QHEI	0	0.0%	0	0.0%	5	4.9%	15	5.5%	1	1.0%	0.4%	6	5.9%	16	5.9%
Substr.	4	3.9%	20	7.4%	3	2.9%	9	3.3%	1	1.0%	0.4%	8	7.8%	30	11.0%
QHEI Ratio	1	1.0%	5	1.8%	2	2.0%	6	2.2%	1	1.0%	0.4%	4	3.9%	12	4.4%
Poor Attr.	0	0.0%	0	0.0%	2	2.0%	6	2.2%	0	0.0%	0.0%	2	2.0%	6	2.2%
Chan.	0	0.0%	0	0.0%	5	4.9%	15	5.5%	3	2.9%	1.1%	8	7.8%	18	6.6%
High Mod. Attr.	0	0.0%	0	0.0%	5	4.9%	15	5.5%	0	0.0%	0.0%	5	4.9%	15	5.5%
Habitat Related	**5**	**4.9%**	**25**	**9.2%**	**22**	**21.6%**	**66**	**24.3%**	**6**	**5.9%**	**2.2%**	**33**	**32.4%**	**97**	**35.7%**
Chloride	2	2.0%	10	3.7%	1	1.0%	3	1.1%	5	4.9%	1.8%	8	7.8%	18	6.6%
Conduct.	2	2.0%	10	3.7%	2	2.0%	6	2.2%	4	3.9%	1.5%	8	7.8%	20	7.4%
TSS	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.0%	0	0.0%	0	0.0%
Ionic Strength/Demand	**4**	**3.9%**	**20**	**7.4%**	**3**	**2.9%**	**9**	**3.3%**	**9**	**8.8%**	**3.3%**	**16**	**15.7%**	**38**	**14.0%**
Sed. PAH	7	6.9%	35	12.9%	0	0.0%	0	0.0%	5	4.9%	1.8%	12	11.8%	40	14.7%
Sed. Metals	0	0.0%	0	0.0%	2	2.0%	6	2.2%	4	3.9%	1.5%	6	5.9%	10	3.7%
Toxicity	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.0%	0	0.0%	0	0.0%
Ammonia	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.0%	0	0.0%	0	0.0%
Toxics	**7**	**6.9%**	**35**	**12.9%**	**2**	**2.0%**	**6**	**2.2%**	**9**	**8.8%**	**3.3%**	**18**	**17.6%**	**50**	**18.4%**
Low D.O.	1	1.0%	5	1.8%	3	2.9%	9	3.3%	4	3.9%	1.5%	8	7.8%	18	6.6%
Org. Enrich.	0	0.0%	0	0.0%	2	2.0%	6	2.2%	0	0.0%	0.0%	2	2.0%	6	2.2%
TKN	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	3.9%	1.5%	4	3.9%	4	1.5%
Organic Enrichment/Low D.O.	**1**	**1.0%**	**5**	**1.8%**	**5**	**4.9%**	**15**	**5.5%**	**8**	**7.8%**	**2.9%**	**14**	**13.7%**	**28**	**10.3%**
TP	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.0%	0.4%	1	1.0%	1	0.4%
Nitrate	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.0%	0.4%	1	1.0%	1	0.4%
Max. D.O.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	6.9%	2.6%	7	6.9%	7	2.6%
D.O. Swing	1	1.0%	5	1.8%	2	2.0%	6	2.2%	0	0.0%	0.0%	3	2.9%	11	4.0%
Nutrient Enrichment/Effects	**1**	**1.0%**	**5**	**1.8%**	**2**	**2.0%**	**6**	**2.2%**	**9**	**8.8%**	**3.3%**	**12**	**11.8%**	**20**	**7.4%**
Total Observations	**24**	**23.5%**	**120**	**46.0%**	**30**	**34.3%**	**90**	**38.6%**	**34**	**41.2%**	**15.4%**	**102**	**100.0%**	**272**	**100.0%**

***Appendix Table D-3**. Causes of aquatic life impairment in the Middle Fork N. Branch in 2020-21 arranged by very poor, poor, and fair threshold exceedances and weighted and unweighted proportion by cause and causal category.*

Causal Agents	Very Poor	VP%	VP Wtd.	VP Wtd.%	Poor	Poor%	Poor Wtd.	Poor Wtd.%	Fair	Fair%	Fair Wtd.%	Total	Total%	Total Wtd.	Wtd. %
Dev. WS	1	0.6%	5	1.1%	9	5.6%	27	5.9%	1	0.6%	0.2%	11	6.8%	33	7.2%
Imperv30C	0	0.0%	0	0.0%	1	0.6%	3	0.7%	0	0.0%	0.0%	1	0.6%	3	0.7%
Urban Land Use	**1**	**0.6%**	**5**	**1.1%**	**10**	**6.2%**	**30**	**6.5%**	**1**	**0.6%**	**0.2%**	**12**	**7.5%**	**36**	**7.8%**
QHEI	0	0.0%	0	0.0%	8	5.0%	24	5.2%	3	1.9%	0.7%	11	6.8%	27	5.9%
Substr.	3	1.9%	15	3.3%	7	4.3%	21	4.6%	0	0.0%	0.0%	10	6.2%	36	7.8%
QHEI Ratio	1	0.6%	5	1.1%	4	2.5%	12	2.6%	4	2.5%	0.9%	9	5.6%	21	4.6%
Poor Attr.	1	0.6%	5	1.1%	4	2.5%	12	2.6%	0	0.0%	0.0%	5	3.1%	17	3.7%
Chan.	0	0.0%	0	0.0%	5	3.1%	15	3.3%	2	1.2%	0.4%	7	4.3%	17	3.7%
High Mod. Attr.	0	0.0%	0	0.0%	2	1.2%	6	1.3%	0	0.0%	0.0%	2	1.2%	6	1.3%
Habitat Related	**5**	**3.1%**	**25**	**5.4%**	**30**	**18.6%**	**90**	**19.5%**	**9**	**5.6%**	**2.0%**	**44**	**27.3%**	**124**	**26.9%**
Chloride	8	5.0%	40	8.7%	0	0.0%	0	0.0%	3	1.9%	0.7%	11	6.8%	43	9.3%
Conduct.	7	4.3%	35	7.6%	3	1.9%	9	2.0%	1	0.6%	0.2%	11	6.8%	45	9.8%
TSS	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.0%	0	0.0%	0	0.0%
Ionic Strength/Demand	**15**	**9.3%**	**75**	**16.3%**	**3**	**1.9%**	**9**	**2.0%**	**4**	**2.5%**	**0.9%**	**22**	**13.7%**	**88**	**19.1%**
Sed. PAH	10	6.2%	50	10.8%	2	1.2%	6	1.3%	2	1.2%	0.4%	14	8.7%	58	12.6%
Sed. Metals	0	0.0%	0	0.0%	5	3.1%	15	3.3%	6	3.7%	1.3%	11	6.8%	21	4.6%
Toxicity	0	0.0%	0	0.0%	1	0.6%	3	0.7%	0	0.0%	0.0%	1	0.6%	3	0.7%
Ammonia	0	0.0%	0	0.0%	1	0.6%	3	0.7%	2	1.2%	0.4%	3	1.9%	5	1.1%
Toxics	**10**	**6.2%**	**50**	**10.8%**	**9**	**5.6%**	**27**	**5.9%**	**10**	**6.2%**	**2.2%**	**29**	**18.0%**	**87**	**18.9%**
Low D.O.	5	3.1%	25	5.4%	1	0.6%	3	0.7%	9	5.6%	2.0%	15	9.3%	37	8.0%
Org. Enrich.	1	0.6%	5	1.1%	6	3.7%	18	3.9%	2	1.2%	0.4%	9	5.6%	25	5.4%
TKN	0	0.0%	0	0.0%	2	1.2%	6	1.3%	6	3.7%	1.3%	8	5.0%	12	2.6%
Organic Enrichment/Low D.O.	**6**	**3.7%**	**30**	**6.5%**	**9**	**5.6%**	**27**	**5.9%**	**17**	**10.6%**	**3.7%**	**32**	**19.9%**	**74**	**16.1%**
TP	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	1.9%	0.7%	3	1.9%	3	0.7%
Nitrate	0	0.0%	0	0.0%	1	0.6%	3	0.7%	3	1.9%	0.7%	4	2.5%	6	1.3%
Max. D.O.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	4.3%	1.5%	7	4.3%	7	1.5%
D.O. Swing	7	4.3%	35	7.6%	0	0.0%	0	0.0%	1	0.6%	0.2%	8	5.0%	36	7.8%
Nutrient Enrichment/Effects	**7**	**4.3%**	**35**	**7.6%**	**1**	**0.6%**	**3**	**0.7%**	**14**	**8.7%**	**3.0%**	**22**	**13.7%**	**52**	**11.3%**
Total Observations	**38**	**23.6%**	**190**	**47.7%**	**53**	**38.5%**	**159**	**40.3%**	**38**	**34.2%**	**11.9%**	**161**	**100.0%**	**461**	**100.0%**

Appendix Table D-4*. Causes of aquatic life impairment in the West Fork in 2021 arranged by very poor, poor, and fair threshold exceedances and weighted and unweighted proportion by cause and causal category.*

Causal Agents	Very Poor	VP%	VP Wtd.	VP Wtd.%	Poor	Poor%	Poor Wtd.	Poor Wtd.%	Fair	Fair%	Fair Wtd.%	Total	Total%	Total Wtd.	Wtd. %
Dev. WS	4	3.8%	20	6.1%	2	1.9%	6	1.8%	0	0.0%	0.0%	6	5.8%	26	8.0%
Imperv30C	0	0.0%	0	0.0%	1	1.0%	3	0.9%	2	1.9%	0.6%	3	2.9%	5	1.5%
Urban Land Use	**4**	**3.8%**	**20**	**6.1%**	**3**	**2.9%**	**9**	**2.8%**	**2**	**1.9%**	**0.6%**	**9**	**8.7%**	**31**	**9.5%**
QHEI	0	0.0%	0	0.0%	4	3.8%	12	3.7%	1	1.0%	0.3%	5	4.8%	13	4.0%
Substr.	1	1.0%	5	1.5%	0	0.0%	0	0.0%	2	1.9%	0.6%	3	2.9%	7	2.1%
QHEI Ratio	0	0.0%	0	0.0%	3	2.9%	9	2.8%	2	1.9%	0.6%	5	4.8%	11	3.4%
Poor Attr.	0	0.0%	0	0.0%	4	3.8%	12	3.7%	0	0.0%	0.0%	4	3.8%	12	3.7%
Chan.	0	0.0%	0	0.0%	4	3.8%	12	3.7%	2	1.9%	0.6%	6	5.8%	14	4.3%
High Mod. Attr.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.0%	0	0.0%	0	0.0%
Habitat Related	**1**	**1.0%**	**5**	**1.5%**	**15**	**14.4%**	**45**	**13.8%**	**7**	**6.7%**	**2.1%**	**23**	**22.1%**	**57**	**17.5%**
Chloride	5	4.8%	25	7.7%	1	1.0%	3	0.9%	0	0.0%	0.0%	6	5.8%	28	8.6%
Conduct.	4	3.8%	20	6.1%	6	5.8%	18	5.5%	0	0.0%	0.0%	10	9.6%	38	11.7%
TSS	1	1.0%	5	1.5%	1	1.0%	3	0.9%	0	0.0%	0.0%	2	1.9%	8	2.5%
Ionic Strength/Demand	**10**	**9.6%**	**50**	**15.3%**	**8**	**7.7%**	**24**	**7.4%**	**0**	**0.0%**	**0.0%**	**18**	**17.3%**	**74**	**22.7%**
Sed. PAH	5	4.8%	25	7.7%	0	0.0%	0	0.0%	2	1.9%	0.6%	7	6.7%	27	8.3%
Sed. Metals	0	0.0%	0	0.0%	4	3.8%	12	3.7%	1	1.0%	0.3%	5	4.8%	13	4.0%
Toxicity	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.0%	0	0.0%	0	0.0%
Ammonia	4	3.8%	20	6.1%	0	0.0%	0	0.0%	1	1.0%	0.3%	5	4.8%	21	6.4%
Toxics	**9**	**8.7%**	**45**	**13.8%**	**4**	**3.8%**	**12**	**3.7%**	**4**	**3.8%**	**1.2%**	**17**	**16.3%**	**61**	**18.7%**
Low D.O.	4	3.8%	20	6.1%	1	1.0%	3	0.9%	5	4.8%	1.5%	10	9.6%	28	8.6%
Org. Enrich.	4	3.8%	20	6.1%	2	1.9%	6	1.8%	0	0.0%	0.0%	6	5.8%	26	8.0%
TKN	0	0.0%	0	0.0%	3	2.9%	9	2.8%	5	4.8%	1.5%	8	7.7%	14	4.3%
Organic Enrichment/Low D.O.	**8**	**7.7%**	**40**	**12.3%**	**6**	**5.8%**	**18**	**5.5%**	**10**	**9.6%**	**3.1%**	**24**	**23.1%**	**68**	**20.9%**
TP	1	1.0%	5	1.5%	0	0.0%	0	0.0%	4	3.8%	1.2%	5	4.8%	9	2.8%
Nitrate	0	0.0%	0	0.0%	1	1.0%	3	0.9%	1	1.0%	0.3%	2	1.9%	4	1.2%
Max. D.O.	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.0%	0.3%	1	1.0%	1	0.3%
D.O. Swing	3	2.9%	15	4.6%	2	1.9%	6	1.8%	0	0.0%	0.0%	5	4.8%	21	6.4%
Nutrient Enrichment/Effects	**4**	**3.8%**	**20**	**6.1%**	**3**	**2.9%**	**9**	**2.8%**	**6**	**5.8%**	**1.8%**	**13**	**12.5%**	**35**	**10.7%**
Total Observations	**28**	**26.9%**	**140**	**55.2%**	**33**	**37.5%**	**99**	**35.9%**	**19**	**27.9%**	**8.9%**	**104**	**100.0%**	**326**	**100.0%**

APPENDIX E: FIT FACTORS AND ILLINOIS NUTRIENT RANKING INDEX

E-1: FIT Factors for Deriving Primary, Secondary, and Tertiary Causes of Impairment
E-2: Northeast Illinois IPS Nutrient Ranking Index

Appendix E-1: Development of FIT Factors for Deriving Primary, Secondary, and Tertiary Causes of Impairment

The NE IL IPS thresholds were developed for the primary nutrient and nutrient-related parameters based on grab sample data. The thresholds were based on relationships between that data and stressor-specific sensitive fish species and macroinvertebrate taxa. The relationship between the sensitive species/taxa with the fIBI and mIBI supported benchmarking these thresholds to the General Use criteria and an "Excellent" level of biological performance.

The FIT weighting score influences the categories of narrative condition (i.e., very poor, poor, or fair) each cause of impairment is placed. Each stressor is ranked from 0.1 (excellent) to 10 (very poor) based on the respective relationships with the number of stressor-sensitive fish species or macroinvertebrate taxa as the response variable with a particular stressor (Table E-1). Where the association is very strong (i.e., FIT value < 0.1) it means there were few outliers and a stronger power of prediction. The weighting factor is 1 and stressors that scored as very poor are still considered to be predictive of very poor biological assemblages. As the FIT value increases (i.e., >0.1 to 0.3) it signals increased variability (more outliers are observed). The weighting factor declines to 0.8 and a stressor value of 9 (very poor) would be down weighted to a score of 7.2 (poor) because the stress:response relationship had more outliers. While the ability to distinguish poor vs. very poor assemblages is reduced, it still reflects a severe impairment. A FIT value of >0.3-1 indicates a weaker causative relationship and has lower weighting factor (X 0.6). This would change a stressor score of 9 (very poor) to a score of 5.4 (fair). Parameters with FIT vales of >3 were not used to identify causes of impairment. A summary of FIT values for 69 variables is in Appendix Table E-2.

Appendix Table E-1. *FIT weighting scores based on FIT coefficients.*

FIT (< 0.10) X 1;
FIT (> 0.10 – <0.3) X 0.8
FIT (> 0.30 – < 1.0) X 0.6
FIT (> 1.00 – < 3.0) X 0.5
FIT (> 3.00 – < 10.0) X 0.2
FIT (> 10 0) X 0.1

Stressor relationships can become stronger as more data is added to the IPS databases hence the need for continued monitoring. Some parameters that have weak FIT scores are because of a lack of data along a complete stressor gradient. For example, there are fewer data points at excellent biological sites for parameters such as sediment PAHs and sediment metals. This weakens the FIT values for the excellent narrative range thus in these situations only a good narrative threshold is derived. There are other important variables (e.g., benthic chlorophyll a) where the current datasets are insufficient to develop a ranking thus highlighting the need to build up the dataset.

The severity of effect of some stressors (e.g., FIT Scores <0.1) could possibly mask the effects of other stressors. As more data is collected and as some of the more prevalent stressors are abated, the influence of masked stressors may become more evident. As such, the FIT values and scores could change in future iterations of the IPS. More data will also improve the accuracy of assigning species and taxa as sensitive or tolerant to a particular stressor.

Appendix Table E-2. *FIT values based on the deviation between ambient stressor rank vs. predicted stressor rank based on fish species or macroinvertebrate taxa for streams in the NE IL IPS study area. The algorithm for FIT calculation is summarized in the text. The cell shading is related to FIT weighting coefficients: 1.0; 0.8; 0.6; 0.5; 0.2.*

Stressor	FIT Value	Stressor	FIT Value
Impervious Land Use (500m)	0.01	Copper (Wat.)	1.75
QHEI Embeddedness Score	0.03	Lead (Wat.)	2.11
Urban Land Uses (WS)	0.03	Zinc (Sed.)	2.22
QHEI Overall Score	0.04	Benzo(g,h,i)perylene	2.32
QHEI Substrate Score	0.04	Indeno(1,2,3-cd)pyrene (Sed.)	2.41
QHEI Good Attributes	0.04	Copper (Sed.)	2.42
Total Phosphorus	0.04	Benzo(b)fluoranthene (Sed.)	2.51
Impervious Land Use (30m)	0.04	Turbidity	2.61
Impervious Land Use (30m Clipped)	0.04	Nickel (Sed.)	2.67
Conductivity	0.05	Manganese (Wat.)	2.74
QHEI Channel Score	0.07	Benzo(a)pyrene (Sed.)	2.85
QHEI Silt Cover Score	0.07	Pyrene (Sed.)	2.85
Developed Land Use (WS)	0.07	Voluble Suspended Solids	2.81
Minimum Dissolved Oxygen	0.10	Lead (Sed.)	3.01
Total Dissolved Solids	0.10	Nickel (Wat.)	3.26
Impervious Land Use (WS)	0.10	Benzo(a)anthracene (Sed.)	3.48
Hydro-QHEI Depth Score	0.11	Chrysene (Sed.)	3.51
QHEI Poor Habitat Attributes	0.12	Fluoranthene (Sed.)	3.91
Hydro-QHEI Overall Score	0.13	Strontium (Sed.)	4.44
Zinc (Wat.)	0.13	Dibenz(a,h)anthracene (Sed.)	4.57
Hydro-QHEI Current Score	0.14	Agricultural Land Use (WS)	4.82
TKN	0.14	Anthracene (Sed.)	5.10
QHEI Pool Score	0.15	Phenanthrene (Sed.)	5.10
Heavy Urban Land Use (WS)	0.17	Arsenic (Sed.)	6.21
Chloride	0.17	Chromium (Sed.)	6.29
QHEI Cover Score	0.17	Sulfate	6.49
BOD (5-Day)	0.21	Manganese (Sed.)	7.08
QHEI Riffle Score	0.27	Silver (Sed.)	7.11
Total Ammonia	0.28	Aluminum (Sed.)	8.26
Nitrate	0.29	Barium (Sed.)	8.88
Sodium	0.29	Arsenic (Wat.)	9.19
QHEI Gradient Score	0.31	Potassium (Wat.)	10.13
Total Suspended Solids	0.32	Cadmium (Sed.)	11.0
Maximum Dissolved Oxygen	0.94		
Cadmium (Wat.)	0.93		
Arsenic (Sed.)	1.26		

Appendix E-2: Northeast Illinois IPS Nutrient Ranking Index

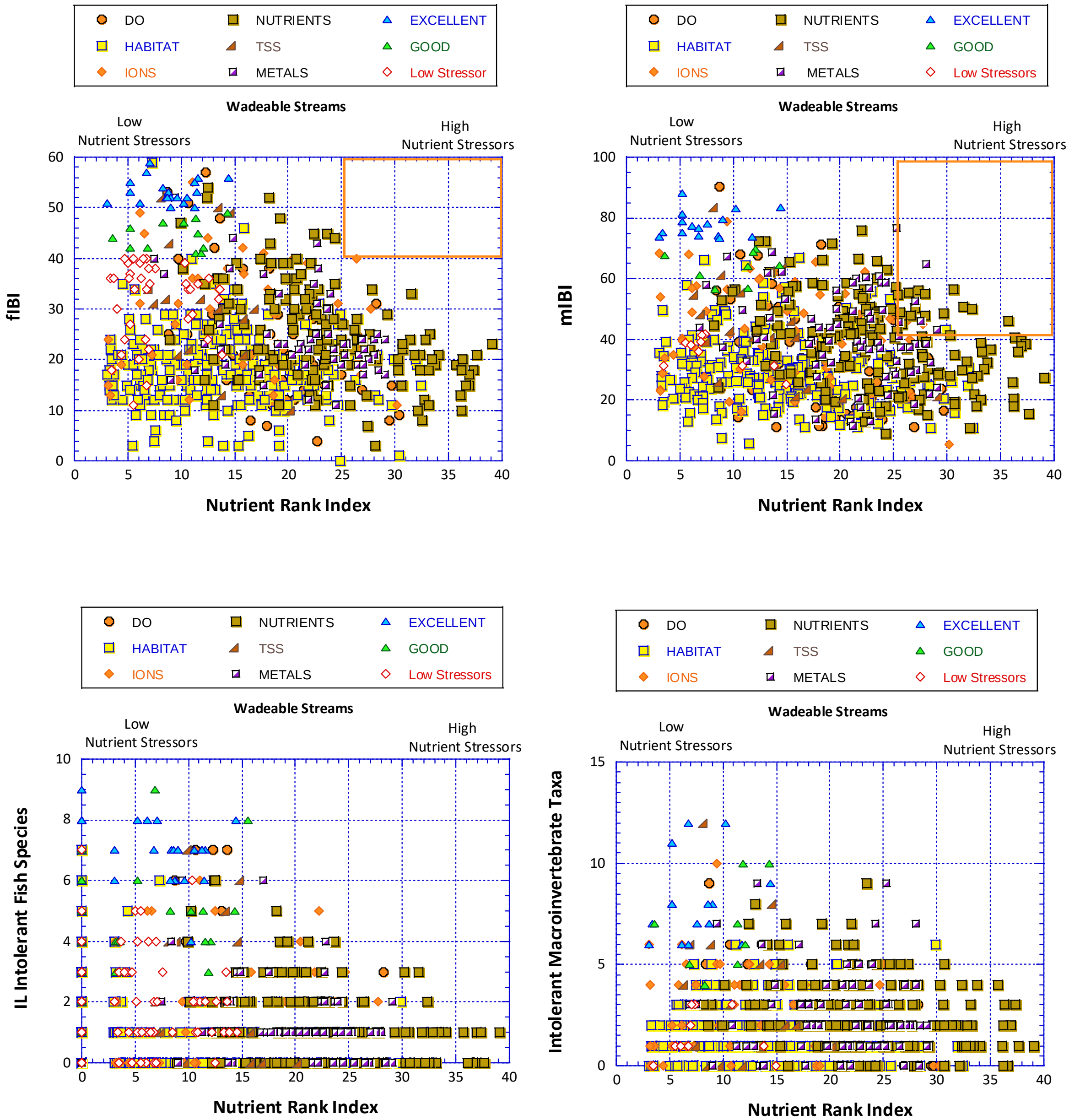
With the emphasis on nutrients in NE Illinois a Nutrient Ranking Index (NRI) was developed by summing the ranking of each of the individual primary nutrient or nutrient-related parameters with each weighted based on the FIT coefficient (Appendix Table E-2). The equation is as follows:

Nutrient Rank Index = (TPR*1) + (Min. DOR*1) + (TKNR*0.8) + (BOD_5R*0.8) + (NITRR*0.8) + (Max. DOR*0.6)

Where; TPR = Total Phosphorus Rank
Min. DOR = Minimum Dissolved Oxygen Rank
TKNR = Total Kjeldahl Nitrogen Rank
BODR = Biochemical Oxygen Demand (5-day) Rank
NITRR = Nitrate Rank
Max. DOR = Maximum Dissolved Oxygen Rank

Appendix Figure E-1 illustrates the correlation between the Nutrient Rank Index (NRI) and the fIBI (top, left), mIBI (top, right), the number of Illinois intolerant fish species (bottom, left) and the number of Illinois intolerant macroinvertebrate taxa (bottom, right). In these graphs points were coded to the strongest stressor rank for all categories of stressors (excluding land use parameters) and where the most limiting stressor rank was greater than a score of four (i.e., General Use benchmark). Boxes in the upper right corner reflect Nutrient Rank Index ranges where biological performance is clearly limited. In these plots fish appear a bit more limited than macroinvertebrates. We expect the relationship between the NRI and biological response variables to improve other indicators such as continuous dissolved oxygen-based maximum daily D.O. swings and algal indicators (benthic chlorophyll). Even so there is a strong enough relationship to make this indicator a useful marker for stressor identification efforts eutrophication in a study area. NRI values of >25 are always associated with degraded fish assemblages and often associated with degraded macroinvertebrate indices (Appendix Figure E-1).

Where a biological assemblage is of excellent quality NRI values are nearly always less than 15. The Power BI dashboard for nutrients will provide this data for all sites where it is available and will also provide individual parameter (e.g., TP, TKN, min D.O.) rankings for nutrients and other parameter categories as well. Such data can be matched to recent local data on continuous D.O., and benthic and sestonic chlorophyll where it exists. Sites with high NRI values and high D.O. swings from continuous data can be examined along with biological data responses to see if patterns of response are similar. The Power BI will also have NRI values, among other data, summarized at both the reach and Huc12 scale to determine whether nutrient signatures are rare or prevalent nearby and across the watershed. The goal for developing the NRI is to have a screening value that can then be matched to more site specific data to conduct a stressor identification analysis.



***Appendix Figure E-1**. Correlation between the Nutrient Rank Index and the fIBI (top, left), MIBI (top, right), the number of Illinois intolerant fish species (bottom, left) and the number of Illinois intolerant macroinvertebrate taxa (bottom, right). In these graphs points are coded by the strongest stressor rank for all categories of stressors (excluding land use) and where the most limiting stressor rank was greater than a score of four (i.e., General Use benchmark).*