NORTHEAST OHIO REGIONAL SEWER DISTRICT

2017 Chippewa Creek Environmental Monitoring

Prepared by
Water Quality and Industrial Surveillance Division

Introduction

In 2017, the Northeast Ohio Regional Sewer District (NEORSD) conducted water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys on Chippewa Creek. Sampling was conducted by NEORSD Level 3 Qualified Data Collectors certified by Ohio Environmental Protection Agency (EPA) in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORSD study plan *2017 Cuyahoga River Tributaries Environmental Monitoring* approved by Ohio EPA on May 12, 2017.

The lower Cuyahoga River has been designated as one of the 42 Great Lakes Areas of Concern (AOC) by the International Joint Commission. Past monitoring indicated impairment of aquatic biota in the river and was the basis of a Total Maximum Daily Load (TMDL) for the Lower Cuyahoga River (Ohio EPA, 2003). The causes of impairment to the river were classified as organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration. This study was completed to determine current conditions in the stream, as well as provide additional information to support the continued monitoring of the lower Cuyahoga AOC. Fish communities and benthic macroinvertebrate communities were surveyed at two sites in Chippewa Creek. One site was on the main branch of Chippewa Creek at River Mile (RM) 0.60 and the other on the Bramblewood Branch of Chippewa Creek at RM 0.10. The results from these surveys will help characterize the overall fish and macroinvertebrate community health in the stream.

Figure 1 is a map of the sampling locations evaluated, and Table 1 indicates the sampling locations with respect to river mile (RM), latitude/longitude, description and surveys conducted. A digital photo catalog of the sampling locations is available upon request by contacting the NEORSD's Water Quality and Industrial Surveillance (WQIS) Division.

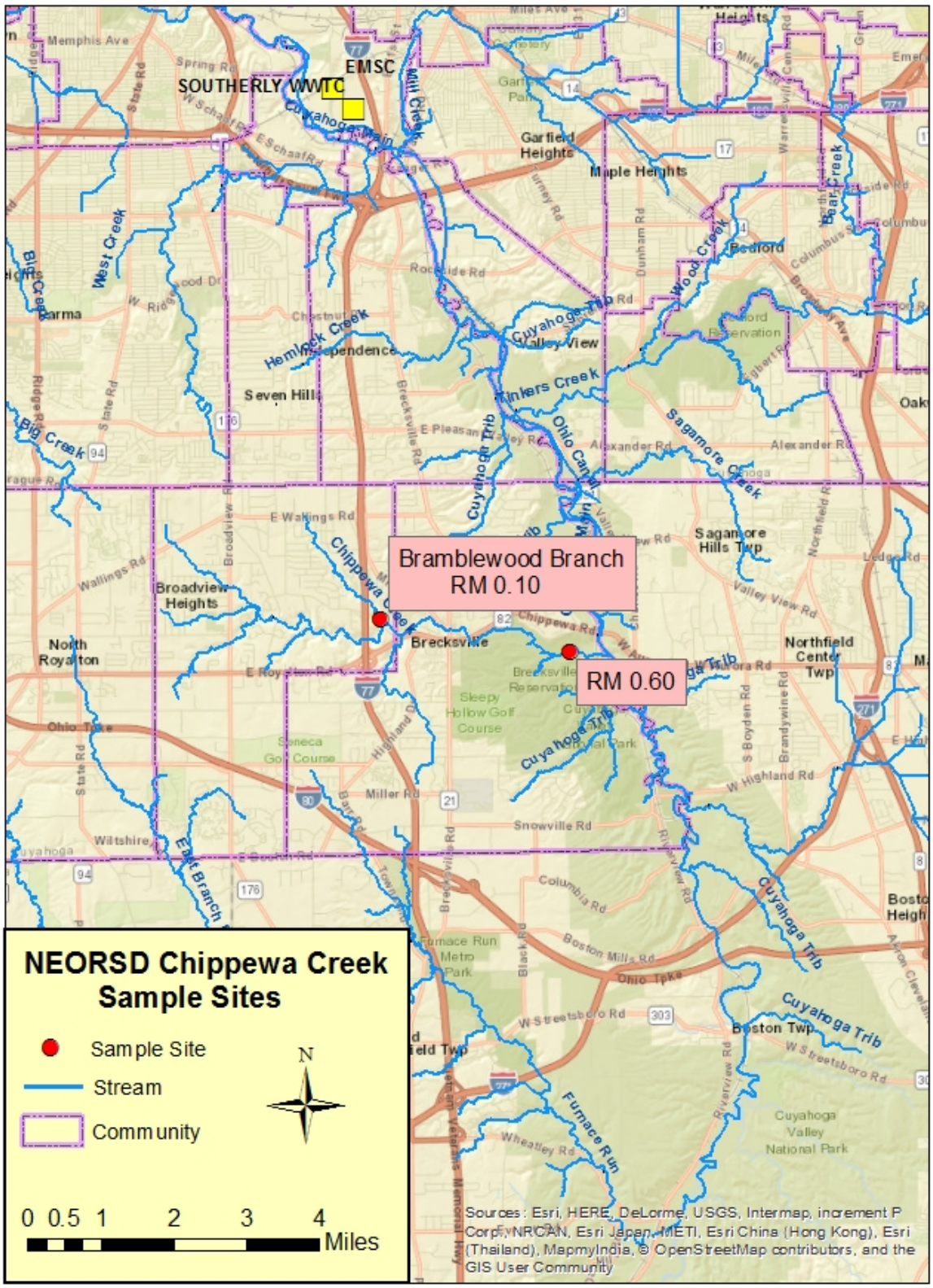

Figure 1. Sampling Locations

Table 1. Sample Locations					
Location	Latitude	Longitude	River Mile	Description	Purpose
Chippewa Creek	41.3173	-81.5952	0.60	Downstream of ford over creek on Chippewa Creek Drive. Metroparks Brecksville Reservation.	General watershed monitoring. Support Cuyahoga AOC.
Chippewa Creek, Bramblewood Branch	41.3244	-81.6448	0.10	Bramblewood Branch, upstream of confluence with the main branch. East of Harris Road and Eagle Valley Court.	General watershed monitoring.

Water Chemistry Sampling

Methods

Water chemistry and bacteriological sampling was conducted five times between July 11 and August 8, 2017, on Chippewa Creek, Main Branch, RM 0.60 and Chippewa Creek, Bramblewood Branch, RM 0.10. Techniques used for sampling and analyses followed the Ohio EPA *Surface Water Field Sampling Manual for water quality parameters and flows* (2015). Chemical water quality samples from each site were collected with a 4-liter disposable polyethylene cubitainer with a disposable polypropylene lid, three 473-mL plastic bottles and a 125-mL plastic bottle. The first 473-mL plastic bottle was field preserved with trace nitric acid, the second was field preserved with trace sulfuric acid and the third bottle received no preservative. The sample collected in the 125-mL plastic bottle (dissolved reactive phosphorus) was filtered using a 0.45-µm PVDF syringe filter. All water quality samples were collected as grab samples. Bacteriological samples were collected in sterilized plastic bottles preserved with sodium thiosulfate. At the time of sampling, measurements for dissolved oxygen, dissolved oxygen percent, pH, temperature, specific conductivity, and conductivity were collected using either a YSI 600XL or EXO1 sonde. Duplicate samples and field blanks were each collected at randomly selected sites, at a frequency not less than 5% of the total samples collected. Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

Formula 1: $$RPD = \left(\frac{|X-Y|}{((X+Y)/2)} \right) * 100$$

X= is the concentration of the parameter in the primary sample
Y= is the concentration of the parameter in the duplicate sample

The acceptable percent RPD is based on the ratio of the sample concentration and detection limit (Formula 2) (Ohio EPA, 2015).

Formula 2: Acceptable % RPD = $[(0.9465X^{-0.344})*100] + 5$

X = sample/detection limit ratio

Those RPDs that were higher than acceptable may indicate potential problems with sample collection and, as a result, the data was not used for comparison to the water quality standards.

Mercury analysis for all the sampling events was done using EPA Method 245.1. Because the detection limit for this method is above the criteria for the Human Health Nondrinking and Protection of Wildlife Outside Mixing Zone Averages (OMZA), it generally cannot be determined if the Chippewa Creek was in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine whether contamination was present above those levels typically found in the creek.

Water chemistry analysis sheets for each site are available upon request from the NEORSD WQIS Division.

Results and Discussion

The sites sampled in 2017 are designated warmwater habitat (WWH), agricultural water supply, industrial water supply, and primary contact recreation. For the 2017 study, one duplicate sample and one field blank were collected for quality assurance and quality control (QA/QC) purposes. The duplicate sample was collected at RM 0.10 on July 25, 2017. There were no parameters rejected based on RPD values.

The field blank was collected at RM 0.60 on July 18, 2017. For the field blank, there were three parameters that showed possible contamination. It is unclear how the field blank became contaminated and may be due to inappropriate sample collection, handling, and/or contaminated blank water. Table 2 lists water quality parameters that were listed as

estimated, rejected, or downgraded to trend only based on Ohio EPA data validation protocol.

Table 2. Parameters affected by possible blank contamination
Cr
DRP
TP

The final QA/QC check for the samples that were collected was for paired parameters, or those parameters in which one is a subset of the other. In 2017, four instances occurred in which the data for the paired parameters needed to be qualified because the sub-parameter was greater than the parent one (Table 3). The comparisons revealed no rejected data for the sample sites. Four sets of parameters revealed estimated data. Since there were no exceedances associated with these parameters, qualification of these results did not significantly change the overall water chemistry assessment of Brandywine Creek.

Table 3. Unacceptable Paired Parameter RPDs					
River Mile	Date	Paired Parameters	Acceptable RPD (%)	Actual RPD (%)	Qualifier
0.60	7/18/2017	TS/TDS	15.4	0.7	J
0.10	7/18/2017	TP/DRP	56.1	34.5	J
0.10	8/8/2017	TP/DRP	63.8	22.2	J
0.10	8/8/2017	TS/TDS	13.3	1.5	J
J=Result is estimated.					

Exceedances of the recreational bacteriological criteria occurred at both sites during 2017. The criteria for *Escherichia coli (E. coli)* consist of two components: a 90-day geometric mean and a value not to be exceeded in more than 10% of the samples collected during a 90-day period (statistical threshold value). For those streams designated primary contact recreation, these criteria are 126 colony counts/100mL or most-probable number (MPN)/100mL and 410 colony counts/100mL or MPN/100mL, respectively. Both criteria were exceeded at both of the sites for the 90-day periods beginning on July 11, 2017 (Table 4). These exceedances were mostly due to a significant wet-weather event that occurred before the July 11, 2017 sampling. Potential sources of bacteria to the river could include stormwater runoff, wildlife fecal material, improper connections to the storm sewer system, or failing home septic systems.

Table 4. 2017 Chippewa Creek *E. coli* Densities (most-probable number/100mL)		
Date	RM 0.60	BB RM 0.10
7/11/2017	1419	489
7/18/2017	164	303
7/25/2017	150	377
8/1/2017	28	63
8/8/2017	68	304

Exceed Exceeds statistical threshold value and geometric mean criteria for 90-day period starting on that date

Exceeds geometric mean criterion for 90-day period starting on that date

Water chemistry sampling at RMs 0.60, and Bramblewood Branch RM 0.10 in 2017 revealed mercury concentrations that were below the method detection limit for EPA Method 245.1. It is expected, that the use of EPA Method 1631E, a low-level method, instead of EPA Method 245.1, would have resulted in exceedances of the criteria throughout the sampling period. Mercury may be introduced into Chippewa Creek from urban stormwater runoff within the watershed.

In 2015, the Ohio EPA Nutrients Technical Advisory Group released a proposed Stream Nutrient Assessment Procedure (SNAP) designed to determine the degree of impairment in a stream due to nutrient enrichment. SNAP assigns designations for quality of surface waters based on factors including dissolved oxygen (DO) swings, benthic chlorophyll *a*, total phosphorous, and dissolved inorganic nitrogen (Ohio EPA, 2015a).

While all the parameters necessary for SNAP were not assessed in 2017, nutrients were assessed for general watershed monitoring at the sites in 2017. Table 5 shows the results of the geometric mean concentration of all five sampling events in 2017 of dissolved inorganic nitrogen (mg/L) and total phosphorus (mg/L). Table 2 of SNAP (See Figure 2) assesses a general ecological risk of nutrient enrichment based upon the dissolved inorganic nitrogen and total phosphorus concentrations.

Table 5. 2017 Chippewa Creek Nutrient Concentrations		
River Mile	Total Phosphorus Geometric Mean (mg/L)	Dissolved Inorganic Nitrogen Geometric Mean (mg/L)
0.60	0.010	0.087
BB 0.10	0.015	0.326

TABLE 2 – Concentrations of total phosphorus (TP) and dissolved inorganic nitrogen (DIN) arrayed by narrative levels of ecological risk.

Table 2 presents narrative descriptions of various levels of ecological condition and potential risk, arrayed with ranges of nutrient concentrations commonly observed at the respective ecological condition levels. This information may be useful reference for nutrient assessment using Charts A or C. **Chart A**: Attenuation from a defined source may be inferred by nutrient concentrations measured at successive stations within an evaluated segment decreasing from a higher risk level to a lower risk level. **Chart C**: Table 2 may be used as a general reference in assessing impairment risk. Actual risks and the potential benefits of abatement are site-specific determinations.

		← *DECREASING RISK*				
	TP Conc. (mg/l)	**DIN Concentration** (mg/l)				
		<0.44	0.44 < 1.10	1.10 < 3.60	3.60 < 6.70	≥6.70
DECREASING RISK ↑	<0.040	background levels typical of least disturbed conditions	levels typical of developed lands; little or no risk to beneficial uses	levels typical of modestly enriched condition in phosphorus limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition in phosphorus limited systems; moderate risk to beneficial use if allied responses are elevated	characteristic of tile-drained lands; otherwise atypical condition with moderate risk to beneficial use if allied responses are elevated (1.1% of observations)
	0.040-<0.080	levels typical of developed lands; little or no risk to beneficial uses	levels typical of developed lands; little or no risk to beneficial uses	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition in phosphorus limited systems; moderate risk to beneficial use if allied responses are elevated	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated (1.1% of observations)
	0.080-<0.131	levels typical of modestly enriched condition in nitrogen limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated; increased risk with poor habitat	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated (1.0% of observations)
	0.131-<0.400	levels typical of modestly enriched condition in nitrogen limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition; low risk to beneficial use if allied responses are within normal ranges; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors
	≥0.400	atypical condition (1.3% of observations)	atypical condition (1% of observations);	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors ; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors

"allied responses" = allied response indicators (24-hour DO swing, benthic chlorophyll)

SNAP Appendix – November 2015 **Table 2**

TABLE 2 (continued)

Ohio EPA's monitoring data for the years 1981 through 2011 (n = 16,870), from index period samples (June-October) and all stream sizes, was used to derive the information presented in Table 2. Following is the frequency of occurrence in the database for each nutrient concentration range, expressed as percent of total data values.

Frequency of Occurrence in Database, as Percent of Total (n=16,870)

Total Phosphorus (TP) [mg/l]	**Dissolved Inorganic Nitrogen (DIN)** [mg/l]				
	<0.44	0.44 < 1.10	1.10 < 3.60	3.60 < 6.70	≥6.70
<0.040	18.14%	5.00%	4.26%	1.13%	0.66%
0.040 < 0.080	6.50%	5.66%	4.87%	1.11%	0.29%
0.080 < 0.131	3.30%	3.77%	5.20%	1.01%	0.31%
0.131 < 0.400	3.62%	4.31%	11.39%	3.01%	1.45%
≥0.400	1.33%	0.99%	4.84%	4.07%	3.78%

Figure 2. Table 2 of SNAP

The results of using Table 2 of SNAP reveal a narrative of "background levels typical of least disturbed conditions" for Chippewa Creek RM 0.60 and Bramblewood Branch RM 0.10. This indicates that neither phosphorus or nitrogen are of a significant concern as a primary source of impairment at this site.

Habitat Assessment

Methods

Instream habitat assessments were conducted once at each site at RM 0.60 and Bramblewood Branch RM 0.10 in 2017 using the Qualitative Habitat Evaluation Index (QHEI). The QHEI was developed by the Ohio EPA to assess aquatic habitat conditions that may influence the presence or absence of fish species by evaluating the physical attributes of a stream. The index is based on six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank condition, pool and riffle quality, and stream gradient. The QHEI has a maximum score of 100, and a score of 55 (headwater streams) or more suggests that sufficient habitat exists to support a fish community that attains the warmwater habitat criterion (Ohio EPA, 2003). A more detailed description of the QHEI can be found in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006). QHEI field sheets for each site are available upon request from the NEORSD WQIS Division.

Results and Discussion

Both sites had QHEI scores that met Ohio EPA's headwater target of 55.0 and, therefore, should be capable of supporting WWH fish communities. River mile 0.60 on the main branch of Chippewa Creek scored a 76.0, a score in the *Excellent* narrative range. River mile 0.10 on the Bramblewood Branch of Chippewa Creek scored a 65.5, a score in the *Good* narrative range.

The stream habitat was assessed on July 27, 2017, at RM 0.60. This site was characterized by a gravel and sand substrate. Moderate amounts of instream cover were found throughout the stream reach. Shallows in slow water, rootmats, and pools greater than 70 centimeters were the most common cover types present. The reach had little to no erosion on both sides of the stream, no channelization, and a moderately wide, higher quality flood plain. These all benefitted the overall QHEI score in a positive way. Due to moderately low stability, shifts in the stream location and pool/riffle/run sequence are possible. Future monitoring will make note of this.

The stream habitat was assessed on July 26, 2017, on the Bramblewood Branch at RM 0.10. This site was dominated by a bedrock and sand substrate throughout the stream reach. Sparse to moderate amounts of instream cover were present in the area. Boulders, logs/woody debris, and shallows in slow water were the only cover types present. Good development, no channelization, and a sinuous stream all contributed to the *Good* narrative score given to the reach. Although the maximum depth in the reach is less than 40 cm, the physical conditions of this stream segment should be able to support a healthy fish community.

Individual components of the QHEI can also be used to evaluate whether a site is capable of meeting the WWH designated use. This is done by categorizing specific attributes as indicative of either a WWH or modified warmwater habitat (MWH) (Rankin, 1995). Attributes that are considered characteristic of MWH are further classified as being of moderate or high influence on fish communities. The presence of one high or four moderate influence characteristics has been found to result in lower IBI scores, with a greater prevalence of these characteristics usually preventing a site from meeting WWH attainment (Ohio EPA, 1999).

Both sites had WWH characteristics of no channelization or recovered, extensive/moderate cover, and low-normal overall embeddedness (Table 6). Bramblewood Branch RM 0.10 had a maximum depth of less than 40 centimeters, which is considered a “High Influence” MWH attribute. Both sites exhibited low sinuosity, while RM 0.60 had no fast current. Both attributes are considered “Moderate Influence” MWH attributes.

Table 6. Chippewa Creek Qualitative Habitat Evaluation Index Score and Physical Attributes

			WWH Attributes										**MWH Attributes**																
													High Influence						Moderate Influence											
River Mile	QHEI Score	Habitat Rating	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinousity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max. Depth >40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or no Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max. Depth <40 cm (WD, HW sites)	**Total High Influence Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total Moderate Influence Attribute**
0.60	76.0	Excellent	x	x				x		x	x	x	6						0						x			x				2
0.10	65.5	Good	x		x	x	x	x	x	x		x	8					x	1						x							1

Fish Community Assessment

Methods

Two quantitative electrofishing passes were conducted at each site in 2017. Sampling was conducted using longline and rollerpram electrofishing techniques and consisted of shocking all habitat types within a sampling zone while moving from downstream to upstream. The sampling zone was 0.15 kilometers for each site. The methods that were used followed Ohio EPA protocol methods as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Fish collected during the surveys were identified, weighed, and examined for the presence of anomalies, including DELTs (deformities, eroded fins, lesions, and tumors). All fish were then released to the waters from which they were collected, except for vouchers and those that could not be easily identified in the field.

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of the Ohio EPA Index of Biotic Integrity (IBI). The IBI incorporates twelve community metrics representing structural and functional attributes. The structural attributes are based upon fish community aspects such as fish numbers and diversity. Functional attributes are based upon fish community aspects such as feeding strategies, environmental tolerances, and disease symptoms. These metrics are individually scored by comparing the data collected at the survey site with values expected at reference sites located in a similar geographical region. The maximum possible IBI score is 60 and the minimum possible score is 12. The summation of the 12 individual metrics scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional, Good, Marginally Good, Fair, Poor* or *Very Poor*. The twelve metrics utilized for longline headwater sites are listed in Table 7.

Table 7. Index of Biotic Integrity Metrics
Longline Headwater
Number of native species
Number of darter species
Number of headwater species
Number of minnow species
Number of sensitive species
Percent tolerant
Percent omnivores
Percent insectivores
Percent pioneering species
Number of individuals

Table 7. Index of Biotic Integrity Metrics
Longline Headwater
Percent simple lithophils
Percent DELTs

Lists of the species, numbers, weights, pollution tolerances and incidence of DELT anomalies for fish collected during the electrofishing passes at each site are available upon request from the NEORSD WQIS Division.

Results and Discussion

Chippewa Creek, main branch, RM 0.60 had IBI scores that met the WWH criterion (Table 8). Chippewa Creek, Bramblewood Branch, RM 0.10 had IBI scores that did not meet or come within non-significant departure from the WWH criterion. 2017 surveys were the first that WQIS staff have conducted on Chippewa Creek. The data will be used for comparison with future surveys that are conducted on the stream. Surveys will be conducted again in 2018.

Table 8. 2017 Chippewa Creek IBI Results

		1st Pass	2nd Pass	Average
Location	River Mile	IBI	IBI	IBI
Downstream of ford over creek on Chippewa Creek Dr.	0.60	**48**	**46**	**47**
Bramblewood Branch, ust of confluence with main branch	0.10	26	28	27

Bold = meets WWH criterion [IBI ≥40]

Italics = non-significant departure from WWH criterion [IBI ≥36]

For the 2017 electrofishing events, the fish community within Chippewa Creek RM 0.60 sampling reach averaged an IBI score of 47, narratively *Very Good*, therefore attaining the IBI WWH criterion. When comparing the metric scores of each electrofishing pass, they were similar on each survey. IBI metrics "Proportion of Omnivores" and "Proportion of Insectivores" both decreased in score when comparing the first pass to the second. Conversely, IBI metric, "Number of Individuals" increased in score when comparing the first to the second pass. This resulted in only a difference of two IBI points between passes. Of all the fish collected during both passes on both surveys, there were no DELT anomalies reported. In addition, species composition was almost identical between passes. Eighteen native species, including the northern hogsucker, sand shiner, and the pollution intolerant redside dace as well as the non-native, goldfish, were collected on each electrofishing pass.

At Chippewa Creek, Bramblewood Branch, RM 0.10, the sampling reach averaged an IBI score of 27, narratively *Poor*, therefore not attaining the IBI WWH criterion. Again, when comparing scores from each pass, they were very similar on each survey. The only difference in IBI metrics between both electrofishing passes was an increase in the "Number of Simple Lithophilic Species". Four rainbow darters, which are simple lithophiles, were collected on the second pass on August 29, 2017. This resulted in a metric score that increased the total IBI score on the second pass. As for a reason why this sampling reach scored a *Poor* narrative IBI rating, a bedrock dominated substrate, combined with a lack of suitable habitat and instream cover hinders the fish population from expanding in this reach.

An examination of the individual IBI metrics also showed that generally, the number of sensitive species scored poorly (metric score of 1) at each sampling event on Chippewa Creek. This can most likely be attributed to water quality issues, such as failing home septic systems or improper connections to the storm system upstream of the sample site. The stress to fish associated with upstream water quality issues could therefore be a hindrance to the establishment of those sensitive species. Future monitoring will help confirm any water quality issues that may be present.

Macroinvertebrate Sampling

Methods

Macroinvertebrates were sampled quantitatively using modified Hester-Dendy (HD) samplers in conjunction with a qualitative assessment of Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly), also referred to as EPT taxa, inhabiting available habitats at the time of HD retrieval. Sampling was conducted at both locations listed in Table 1. Methods for sampling followed the Ohio EPA's Biological Criteria for the Protection of Aquatic Life, Volume III (1987b). The recommended period for HDs to be installed is six weeks.

The macroinvertebrate samples were sent to Third Rock Consulting of Lexington, Kentucky, for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as defined by the Ohio EPA (1987b). Lists of the species collected during the quantitative and qualitative sampling at each site are available upon request from WQIS.

The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI) (Ohio EPA 1987a, Ohio EPA

undated). The ICI consists of ten community metrics (Table 9), each with four scoring categories. Metrics 1-9 are based on the quantitative sample, while Metric 10 is based on the qualitative EPT taxa. The total of the individual metric scores result in the overall score. This scoring evaluates the community against Ohio EPA's reference sites for each specific eco-region.

Table 9. Metrics
ICI
Total Number of Taxa
Number of Mayfly taxa
Number of Caddisfly taxa
Number of Dipteran taxa
Percent Mayflies
Percent Caddisflies
Percent Tanytarsini Midges
Percent Other Diptera and Non-Insects
Percent Tolerant Organisms (as defined)
Number of Qualitative EPT Taxa

Results and Discussion

The HD samplers were successfully recovered from both sampling sites on Furnace Run during the 2017 season. Combined with qualitative macroinvertebrate sampling on the day of HD retrieval, this allowed for a calculated ICI score to assess each of the sampling sites.

Based on the macroinvertebrate community at Chippewa Creek, RM 0.60 received an ICI score of 32 with a narrative rating of *Marginally Good* for 2017 (Table 10). This score is within non-significant departure from WWH criterion. Of the 43 total taxa collected in both the qualitative and quantitative sampling events, eight representatives from the EPT (Ephemeroptera, Plecoptera, and Trichoptera) were present, including: *Baetis flavistriga*, *Baetis intercalaris*, *Stenonema femoratum, Chimarra aterrima, Chimarra obscura, Cheumatopsyche sp., Ceratopsyche morosa, and Hydropsyche depravata group.* A significant portion of the ICI score can be attributed to the Tanytarsini midges that dominated the sample with a 49.51% presence. Additionally, only 2.7% of the sample consisted of tolerant organisms, which also helped bring up the ICI score at this site. These were the two highest scoring metrics at RM 0.60

Table 10. 2017 Chippewa Creek Macroinvertebrate Results						
Location	River Mile	ICI Score	Total Number of Taxa	Number of Qualitative EPT Taxa	% Tolerant (as defined)	Narrative Rating
Downstream of ford over creek on Chippewa Creek Dr.	0.60	*32*	43	8	12.12	*Marginally Good*
Bramblewood Branch, ust of confluence with main branch	0.10	*32*	38	7	2.69	*Marginally Good*
Bold indicates attainment of WWH criterion						
Italics indicates non-significant departure (≤4 ICI units) from criterion						

The macroinvertebrate community at Chippewa Creek, Bramblewood Branch, RM 0.10 received an ICI score of 32 with a narrative rating of *Marginally Good* for 2017. Again, this score is within non-significant departure from WWH criterion. Of the 38 total taxa collected in both the qualitative and quantitative sampling events, seven representative species from the EPT (Ephemeroptera, Plecoptera, and Trichoptera) were present, including: *Baetis tricaudatis, Baetis flavistriga, Chimarra aterrima, Cheumatopsyche sp., Ceratopsyche morose, Ceratopsyche sparna, and Hydropsyche depravata* group. The higher scoring metrics (6 points each) included "Number of Caddisfly Taxa," "Number of Dipteran Taxa," and the "Percent Caddisflies". These three metrics collectively accounted for over 56% of the total ICI score.

Conclusions

In 2017, the biological monitoring and sampling that was conducted on Chippewa Creek indicated that RM 0.6 was in full attainment of the biological criteria (Table 11). Bramblewood Branch, RM 0.10, was in partial attainment of the biological criteria. While the ICI score was within non-significant departure for RM 0.10, the IBI criterion was not met.

Environmental assessments in 2017 showed that for both sites, some water quality impairments may be preventing establishment of healthier biological communities. Exceedances of the water quality standards occurred for *E. coli*, indicating the presence of some sanitary sewage in the river. Potential sources of pollution include illicit discharges, failing septic systems, stormwater runoff, and flow from upstream tributaries. Addressing these potential sources could potentially improve the overall quality of the in-

stream biological community. Future monitoring will allow for the collection and comparison of more data regarding Chippewa Creek.

Table 11. 2017 Chippewa Creek Survey Results					
River Mile	Aquatic Life Use Attainment Status	Average IBI Score (*Narrative Rating*)	ICI Score (*Narrative Rating*)	QHEI Score (*Narrative Rating*)	Water Quality Exceedances
Chippewa Creek RM 0.60	FULL	47 *(Very Good)*	32 *(Marginally Good)*	76.00 *(Excellent)*	*E. coli*
Chippewa Creek, Bramblewood branch, RM 0.10	PARTIAL	27 *(Poor)*	32 *(Marginally Good)*	65.50 *(Good)*	*E. coli*
WWH biocriterion attainment: IBI score of 40; MIwb score of 8.2; ICI score of 34					
Non-significant departure: ≤4 IBI units; ≤0.5 MIwb units; ≤4 ICI units					

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