



Northeast Ohio Regional Sewer District

2020 Rocky River West Branch & Tributaries Biological, Water Quality, and Habitat Study



**Water Quality and Industrial Surveillance
Environmental Assessment Group**

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Introduction

The Rocky River is located just west of Cleveland, flowing northward from its headwaters near Hinkley (East Branch) and Medina (West Branch) until its confluence with Lake Erie. In 2020, the Northeast Ohio Regional Sewer District (NEORS) conducted a full water quality assessment, consisting of water chemistry sampling, stream habitat assessment, and fish and macroinvertebrate assessments on the Rocky River for general watershed monitoring. The objective of this study was to evaluate the attainment of Ohio’s Water Quality Standards and determine any spatial and temporal trends in the watershed. This report will focus on the West Branch of the Rocky River, including the tributaries Baker Creek, Blodgett Creek, Plum Creek, and Minnie Creek.

Sampling was conducted by NEORS Level 3 Qualified Data Collectors certified by the Ohio EPA in Fish Community Biology, Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat Assessment as explained in the *2020 Rocky River Environmental Monitoring Study Plan* approved by Ohio EPA on June 15, 2020. All sampling and environmental assessments occurred between June 15, 2020 and September 30, 2020 (through October 15 for fish community assessments), as required in the Ohio EPA *Biological Criteria for the Protection of Aquatic Life Volume III* (1987b). The results gathered from these assessments were evaluated using the Ohio EPA’s Qualitative Habitat Evaluation Index (QHEI), Index of Biotic Integrity (IBI), Modified Index of Well-Being (MIwb), and the Invertebrate Community Index (ICI). Water chemistry data was validated per the methods outlined by the Ohio EPA (2019) and compared to the Ohio Water Quality Standards for their designated use to determine attainment (Ohio EPA 2018). An examination of the individual metrics that comprise the IBI, MIwb, and ICI was used in conjunction with the water chemistry data and QHEI results to assess the health of the stream.

Table 1 indicates the sampling locations with respect to river mile (RM), latitude and longitude, site description, and the types of surveys conducted. Figure 1 is a study area map, noting the location of each sampling location evaluated during the 2020 study. A digital photo catalog of the sampling locations is available upon request by contacting the NEORS WQIS Division.

Table 1. Rocky River West Branch and Tributaries Sampling Locations

Site Location	Lat	Long	River Mile	Description	River Code	Station ID	Sample Type
Rocky River W. Branch	41.4036	-81.8912	0.45	Upstream of confluence with East Branch	13-200-000	501850	F, M, C
Baker Creek	41.3526	-81.9002	0.15	Downstream of Sprague Road	13-202-000	T01S13	M, C
Blodgett Creek	41.3489	-81.8728	1.50	Upstream of Marks Road	13-200-003	T01A17	F, M, C
Plum Creek	41.3589	-81.9214	2.84	Adjacent to Usher Road	13-201-000	T01G03	F, M, C
Minnie Creek	41.3900	-81.8969	0.20	At Hope Community Church	13-200-001	T01A15	F, M, C

F = Fish community biology (includes habitat assessment)
 M = Macroinvertebrate community biology
 C = Water column chemistry

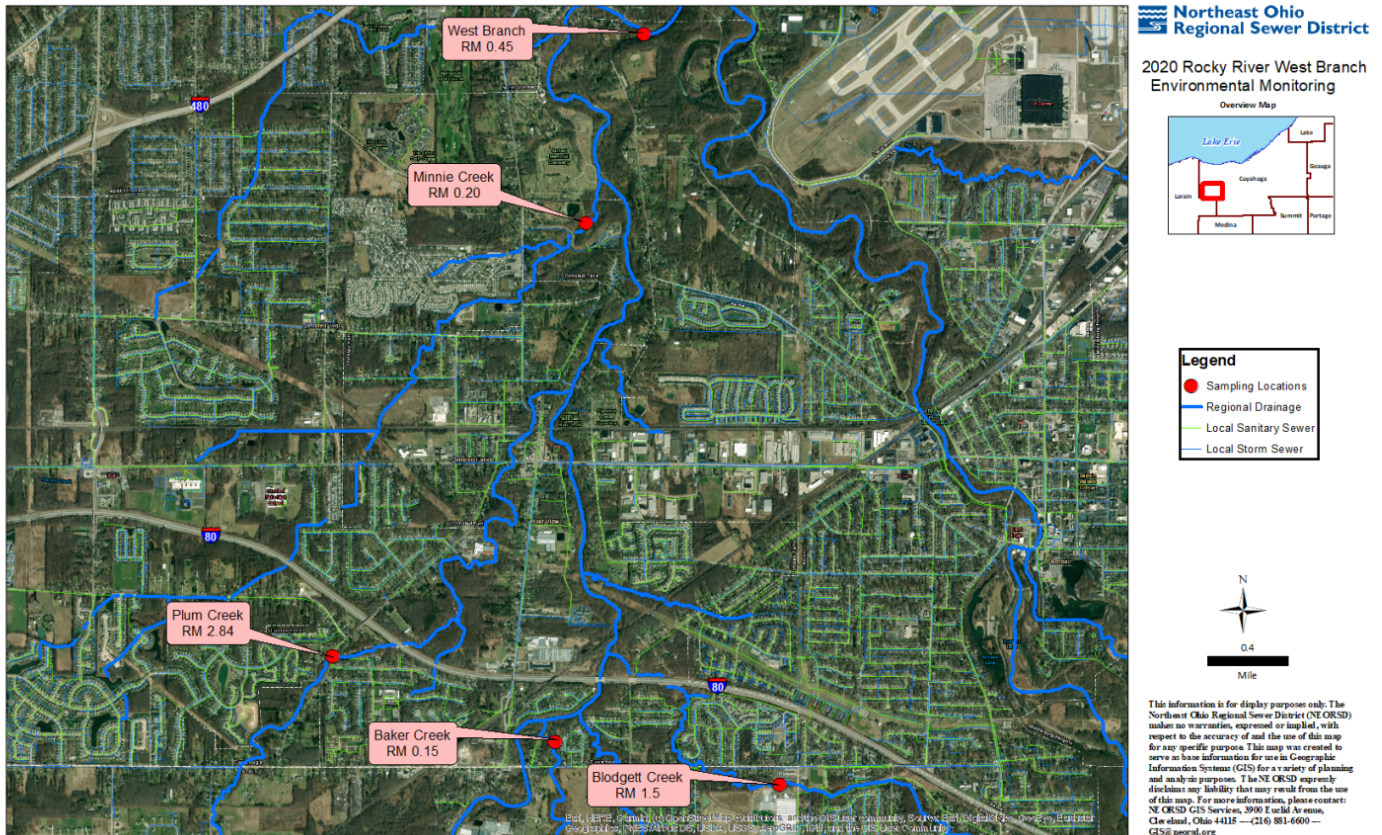


Figure 1. Rocky River West Branch and Tributaries Sampling Locations

The Ohio EPA assigns designated uses to establish minimum water quality requirements for surface waters in Ohio. These requirements represent measurable criteria for assessing the chemical, physical, and biological integrity of Ohio’s surface waters consistent with Clean Water Act requirements. The beneficial use designations for the Rocky River West Branch and its tributaries are listed below in Table 2 (Ohio EPA 2018). Minnie Creek has not been assigned a beneficial use designation by the Ohio EPA at the time of this study.

The Ohio EPA regulates wastewater pollutants discharged from point sources through the National Pollutant Discharge Elimination System (NPDES) and if necessary, establishes a Total Maximum Daily Load (TMDL) for the watershed. A draft TMDL report for the Rocky River was released in 2005 stating the Rocky River is impaired for recreational use due to elevated bacteria densities (Ohio EPA 2005). A TMDL for Plum Creek was also approved in 2001 to help alleviate organic enrichment and over-enriched nutrient concentrations. A list of NPDES permits within the Rocky River West Branch watershed are listed in Table 3 (Ohio EPA, n.d.).

Table 2. Use Designations for the Rocky River West Branch and Selected Tributaries													
	Beneficial Use Designation												
	Aquatic Life Habitat (ALU)							Water Supply			Recreation		
Stream	S R W	W W H	E W H	M W H	S S H	C W H	L R W	P W S	A W S	I W S	B W	P C R	S C R
Rocky River West Branch		+							+	+		+	
Plum Creek		+							+	+		+	
Blodgett Creek		+							+	+		+	
Baker Creek		+							+	+		+	
SRW = state resource water; WWH = warmwater habitat; EWH = exceptional warmwater habitat; MWH = modified warmwater habitat; SSH = seasonal salmonid habitat; CWH = coldwater habitat; LRW = limited resource water PWS = public water supply; AWS = agricultural water supply; IWS = industrial water supply; BW = bathing water; PCR = primary contact recreation; SCR = secondary contact recreation.													

Table 3. NPDES Permits tributary to the Rocky River West Branch							
Facility	NPDES	Type ^a	Class ^b	Receiving Stream	RM	County	Address
Town & Country Co-op Inc.	31G00087	I	Minor	West Br. Rocky River Tributary at RM 31.40	5.00-5.20	Medina	901 W. Smith Rd. Medina
RPM International Inc.	3PR00395, 3PK00255	P	Minor	West Br. Rocky River Tributary at RM 24.50	1.00	Medina	2628 Pearl Rd. Medina
Medina County Sewer District no. 500 Liverpool WWTP	3PK00004	P	Major	West Br. Rocky River Tributary at RM 14.80	0.20	Medina	89 Columbia Rd. Valley City
Columbia Hills Country Club	3PR00277	P	Minor	West Br. Rocky River	10.90	Lorain	State Rt. 252 Columbia Station
Sundaes in the Park WWTP	3PR00339	P	Minor	West Br. Rocky River	9.60	Lorain	25145 Royalton Rd. Columbia Station
Columbia School	3PT00087	P	Minor	West Br. Rocky River	9.60	Lorain	25796 Royalton Rd. Columbia Station
Cuyahoga Landmark Inc.	3IN00104	I	Minor	West Br. Rocky River	3.90	Cuyahoga	12966 Prospect Rd. Strongsville

Table 3. NPDES Permits tributary to the Rocky River West Branch							
Facility	NPDES	Type ^a	Class ^b	Receiving Stream	RM	County	Address
				Tributary at RM 4.90			
Columbia Park Water System MHP	3PV00013	P	Minor	West Br. Rocky River Tributary at RM 1.78	0.30	Cuyahoga	7100 Columbia Rd. Olmsted Falls
Plum Creek WWTP	3PG00052	P	Minor	Plum Creek, Rocky River West Branch	6.78	Lorain	Eddie Ln. Columbia
Centerra Co-op	3IG00087	I	Minor	West Br. Tributary at RM 31.47	--	Medina	901 West Smith Rd. Medina
Columba Gas Transmission Corp	3IN00301	I	Minor	Mallet Creek Tributary at RM 0.10	1.50	Medina	2834 Stiegler Rd. Medina
Highland High School	3PT00111	P	Minor	Granger Ditch	1.60	Medina	3880 Ridge Rd. Medina
Medina County Sewer District No. 11	3PG00043	P	Minor	Granger Ditch Tributary at RM 1.00	3.10	Medina	2404 Weymouth Rd. Hinkley Twp.
a – Publicly Owned Treatment Works (POTW) = P; Private industrial entity = I b – Class characterized by flow: <1MGD = Minor and ≥1MGD = Major WWTP = Wastewater Treatment Plant							

Water Chemistry and Bacteriological Sampling

Methods

Water chemistry and bacteriological sampling was conducted five times on the Rocky River West Branch and tributaries between July 22 and August 19, 2020, at the five sites listed in Table 1. Techniques used for sampling and analyses followed the Ohio EPA Surface Water Field Sampling Manual for water quality parameters and flows (2019). 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 one 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 and 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).

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

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, 2018a).

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

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), this type of mercury sampling was used as a screening tool to determine whether contamination was present above those levels typically found in the river.

Water chemistry analysis sheets for each site are available upon request from the NEORSWQIS Division. Dates of water chemistry sampling compared to Rocky River West Branch flow data (USGS 04201429) are shown below in Figure 2.

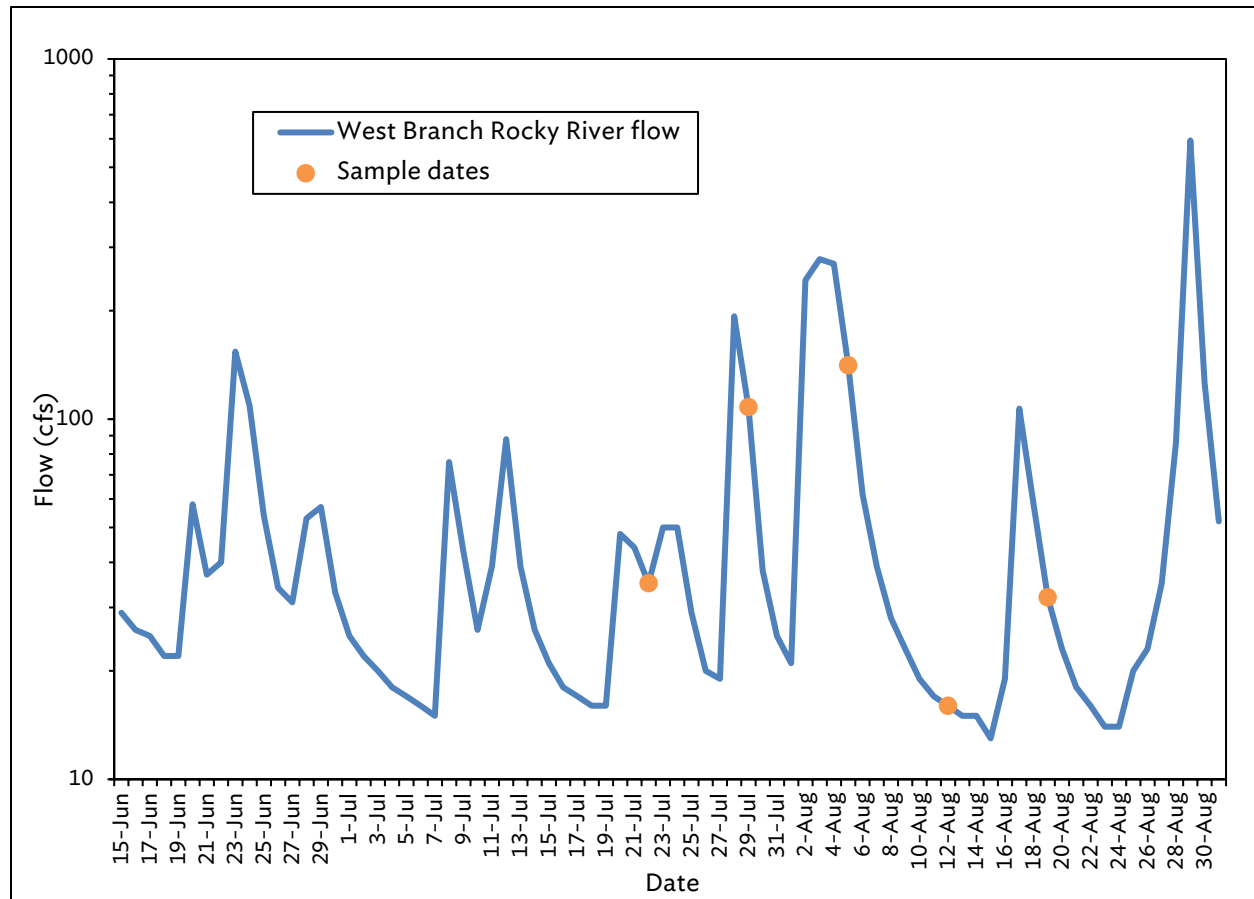


Figure 2. Rocky River West Branch Flow Data

Results and Discussion

The Rocky River West Branch and tributary sites sampled in 2020 are designated as warmwater habitat (WWH) and primary contact recreation to the Ohio EPA Water Quality standards (2020). Over the course of five sampling events in 2020, two field blanks and two duplicates were collected as part of this study. There were two parameters that showed possible contamination in the field blanks. These parameters were chromium and COD. It is unclear how the field blanks may become contaminated and may be due to inappropriate sample collection, handling, and/or contaminated blank water. Of the two duplicate samples collected, zero instances occurred in which the data was rejected because the acceptable RPD was exceeded. Lack of exceedances shows that precision and consistency in sample collection and analytical procedures and proper sample handling took place during the course of the study.

Paired parameters were evaluated for QA/QC purposes on all samples where one parameter is a subset of another. No subset parameter exceeded the concentration of the corresponding parent parameter; therefore, all paired parameter results were accepted as valid.

Exceedances of the recreational bacteriological criteria occurred at all five sites during the 2020 sampling season. The recreational 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 streams designated as 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. These calculations are formulated when there are at least five samples collected within a rolling 90-day period. When duplicate samples were collected at a sample location, the results were reported as an average.

Both criteria were exceeded at all sample locations for the 90-day periods beginning on July 22, 2020 (Table 4). These exceedances are unlikely attributed to just wet-weather events which occurred on only one of the five sampling dates. The samples that were collected during wet-weather were collected on the tail end of the wet-weather event after flows had returned to normal. The wet-weather events were measured at the NEORSO Olmsted Falls rain gauge. Potential sources of bacteria inputs may include inadequate wastewater treatment systems and likely include failing household sewage treatment systems (HSTS), which are common in the Rocky River West Branch watershed.

Date	Rocky River W. Br. RM 0.45	Baker Creek RM 0.15	Blodgett Creek RM 1.50	Plum Creek RM 2.84	Minnie Creek RM 0.20
7/22/2020	733	2,940	8,960	4,020	14,830
7/29/2020	1012	1,630	2,083	1,510	816
8/5/2020	533	1,000	2,175	1,230	467
8/12/2020	155	219	1,122	1,510	584
8/19/2020*	202	344	1,723	425	1,046
90-day Geomean	415	815	2,393	1,368	1,281
	Exceeds statistical threshold value of 410 MPN/100mL				
	Exceeds geometric mean criterion for 90-day period of 126 MPN/100mL				
	*Wet-weather event: greater than 0.10 inches of rain, but less than 0.25 inches, samples collected that day and the following day are considered wet-weather samples; greater than 0.25 inches, the samples collected that day and the following two days are considered wet-weather samples.				

All mercury results in 2020 were below the method detection limit. Because the detection limit for EPA Method 245.1 is above the criteria for the Human Health Non-Drinking and Protection of Wildlife OMZAs, it cannot be determined if the sites were in attainment of those criteria. It is expected that the use of a low-level mercury analysis like EPA Method 1631E, instead of EPA Method 245.1, may have resulted in exceedances of the criteria throughout the sampling period. It is possible that mercury may be introduced into the Rocky River West Branch and Tributaries from urban runoff and atmospheric deposition 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. The SNAP assigns designations for quality of surface waters based on factors including dissolved oxygen (DO) swings, benthic chlorophyll α , total phosphorous (TP), and dissolved inorganic nitrogen (DIN) (Ohio EPA 2015). NEORSD did not collect data on benthic chlorophyll or DO swings in 2020; however, nutrient concentrations were collected and analyzed for general watershed monitoring purposes. When all necessary data is not available to perform a full SNAP, provisional targets of 0.40 mg/L total phosphorus and 3.6 mg/L DIN are used as water quality target concentrations (WQTC).

Table 5 shows nutrient concentration results for the five Rocky River West Branch sites. The results of DIN and TP were compared to Table 2 listed in the SNAP document (Figure 3). Minnie Creek displayed enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors; increased risk to ecological conditions with poor habitat. Rocky River West Branch, Blodgett Creek, and Baker Creek displayed levels typical of working landscapes; little to no risk to beneficial uses. Plum Creek displayed levels typical of enriched conditions, low risk to beneficial use if allied responses are within normal ranges, increased risk with poor habitat.

Table 5. 2020 Rocky River West Branch and Tributaries Nutrient Analysis				
Sample Location	*Geomean DIN (mg/L)	*Geomean TP (mg/L)	Geomean DRP (mg/L)	Geomean Nitrate-Nitrite (mg/L)
Rocky River W. Branch RM 0.45	1.590	0.111	0.062	<i>1.551</i>
Baker Creek RM 0.15	1.288	0.057	0.017	<i>1.246</i>
Blodgett Creek RM 1.50	0.982	0.053	0.027	0.941
Plum Creek RM 2.84	1.939	0.151	0.092	<i>1.884</i>
Minnie Creek RM 0.20	2.172	0.476	0.430	<i>2.127</i>
* Data used in Table 2 of SNAP (Ohio EPA 2015)				
Bold: Exceeds provisional WQTC				
<i>Italics</i> = Exceeds the 2001 Rocky River Nutrient TMDL Target Concentrations: 1.3 mg/L Nitrate-Nitrite & 0.19 mg/L TP				

Minnie Creek exhibited a TP geomean concentration of 0.476 mg/L, which exceeded the provisional WQTC of 0.40 mg/L. SNAP considers sampling for nutrients during *stable, baseflow conditions*. Three dry weather samples reported as a geomean are required to assign a narrative rating using the SNAP. This was achieved in 2020 while sampling during stable, baseflow conditions.

		← 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)

Figure 3. Table 2 of the Stream Nutrient Assessment Procedure (Ohio EPA, 2015b)

Columbia Mobile Home Park (MHP) East, LLC manages its own wastewater treatment system in Olmsted Township and discharges its treated wastewater (0.250 MGD design flow) to Minnie Creek at RM 0.41. Since October of 2016, Columbia MHP East, LLC has been in *significant/category 1 noncompliance* with the Ohio EPA, consistently violating its nitrogen-ammonia (N-NH₃), *E. coli*, and total suspended solids (TSS) NPDES permit limits (USEPA ECHO). Ohio EPA has yet to renew their NPDES permit, which expired on June 30, 2018. The Columbia MHP wastewater effluent is likely significantly contributing to the elevated nutrient concentrations observed downstream in Minnie Creek and in the Rocky River West Branch. The Ohio EPA should continue to work with the Columbia MHP WWTP to remediate their poor wastewater treatment system and work towards renewal and compliance of their NPDES permit.

Description	Limit Type	Number of Exceedances	Days with Exceedances
Total Suspended Solids	Monthly Average	2	61
Total Suspended Solids	Weekly Maximum	4	14
Ammonia	Monthly Average	15	245
Ammonia	Weekly Maximum	15	56
<i>E. coli</i>	Monthly Geomean	4	122
<i>E. coli</i>	Weekly Geomean	4	28

Plum Creek

Plum Creek at RM 2.84 scored 67.25 and had a narrative rating of *Good*. The sample reach displayed sparse to moderate instream cover. There was moderate embeddedness and silt covered cobble and gravel substrates. The limited instream cover consisted of shallows, root wads, and logs/woody debris. The reach at RM 2.84 had high quality features like good development, no channelization, high stability, and minimal to no erosion. Historical data from Ohio EPA shows scores consistently in the *Good* to *Excellent* narrative range throughout the lower three miles of Plum Creek.

Blodgett Creek

Blodgett Creek displayed habitat suitable for a warmwater fish community, receiving a 60.50 QHEI score and a narrative rating of *Good*. High quality WWH attributes included gravel substrates, low-normal embeddedness and max depths greater than 40 cm, but less than 70 cm. The river riparian width on river right has previously been developed into a park, with only a small buffer zone of un-mowed grass near the river, resulting in a slightly incised section of stream. Moderate riffle and pool quality were noted, as the zone had no deep pools, and sand and small gravel substrates displayed moderate stability in the riffle habitat. Riffle and margin habitat quality consists mostly of overhanging grasses and rootmats within the reach.

Minnie Creek

Minnie Creek also displayed *Good* stream habitat with a score of 60.25. The diverse substrate types dominated by gravel and sand were moderately silted and embedded. Instream cover consisted of three types, rootwads, woody debris, and undercut banks. The good channel morphology was characterized by high sinuosity, no channelization, and moderate channel stability. MWH attributes included no fast currents and moderate embeddedness and silt cover. Overall, Minnie Creek displays physical stream habitat characteristics of a WWH stream.

Baker Creek

Since no fish community assessment or QHEI was performed on Baker Creek in 2020, all habitat data is derived from the macroinvertebrate crew field sheets. The riparian zone on river right has been eliminated as an urban housing development has encroached on the stream. Manicured grass lawns border the stream on river right. Substrate within the reach consisted of moderate to fine sized, unembedded substrates, promoting a well-suited macrohabitat. The sampling reach consisted of riffle and runs with no pool present. Margin quality was poor, with few root mats and tree roots present. Attention should be paid to the impact of development in the Baker Creek watershed, which poses the risk of causing excessive erosion and sedimentation and may jeopardize attainment of the stream's biota.

Fish Community Biology Assessment

Methods

Two quantitative electrofishing passes were conducted at all sites listed in Table 1 except for Baker Creek due to a lack of landowner permission for a contiguous 150 meters on the stream. A list of the dates when the surveys were completed, along with approved flow measurements from United States Geological Survey gage stations are shown in Table 8. Sampling was conducted using headwater and wading electrofishing techniques and consisted of shocking all habitat types within a sampling zone while moving from downstream to upstream. Sampling zones on the West Branch Rocky River were 0.2 kilometers. Sampling zones on Blodgett, Minnie, and Plum creeks were 0.15 kilometers. Sampling methods at all sites followed Ohio EPA methods detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Fish collected during the surveys were identified, weighed (wading sites only), and examined for the presence of DELT anomalies (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.

Table 8. Sampling Dates and River Flows		
Date	Sampling Location	Daily Mean Flow (CFS)
6/25/20	Blodgett Creek RM 1.50	0.68
6/25/20	Minnie Creek RM 0.20	0.23
6/26/20	Rocky River W. Branch RM 0.45	34.8
6/26/20	Plum Creek RM 2.84	0.80
7/27/20	Blodgett Creek RM 1.50	3.80
8/6/20	Minnie Creek RM 0.20	0.23
9/4/20	Plum Creek RM 2.84	0.59
9/17/20	Rocky River W. Branch RM 0.45	32.9
Rocky River West Branch measured at USGS 04201500 Blodgett Creek measured at USGS 04201409 Plum Creek measured at USGS 04201423 Minnie Creek measured at USGS 04201429		

The electrofishing results were compiled and utilized to evaluate fish community health through the application of two Ohio EPA indices, the Index of Biotic Integrity (IBI) and the Modified Index of Well-Being (MIwb) (at wading sites). The IBI incorporates twelve community metrics representing structural and functional attributes. The structural attributes are based upon fish community aspects such as fish abundance 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 12 metrics utilized for wading and headwater sites are listed in Table 9.

The second fish index utilized by Ohio EPA, is the Modified Index of Well-being (MIwb). The MIwb, Formula 1 below, incorporates four fish community measures: numbers of individuals, biomass, and the Shannon Diversity Index (H) (Formula 2 below) based on numbers and weight of fish. The MIwb is a result of a mathematical calculation based upon the formula.

Formula 1:
$$MIwb = 0.5 \ln N + 0.5 \ln B + \bar{H}(No.) + \bar{H}(Wt.)$$

N = Relative numbers of all species excluding species designated as highly tolerant, hybrids, or exotics

B = Relative weights of all species excluding species designated as highly tolerant, hybrids, or exotics

$\bar{H}(No.)$ = Shannon Diversity Index based on numbers

$\bar{H}(Wt.)$ = Shannon Diversity Index based on weight

Formula 2:
$$\bar{H} = - \sum \left[\left(\frac{n_i}{N} \right) \log_e \left(\frac{n_i}{N} \right) \right]$$

n_i = Relative numbers or weight of species

N = Total number or weight of the sample

The Rocky River is located completely within the EOLP ecoregion and follows the EOLP IBI metric scoring. The WWH IBI scoring criterion in the EOLP is 40 for headwater streams and 38 for wading streams. The WWH MIwb scoring criterion in the EOLP is 7.9 for wading sites. The MIwb is not applicable for headwater sites where drainage areas are less than 20 mi². A site is considered to be within nonsignificant departure (NSD) if the score falls within 4 IBI units or 0.5 MIwb units of the criterion (Table 10).

Table 9. IBI Metrics	
Wading sites	Headwater sites (<20 sq. miles)
Number of indigenous fish species	Number of indigenous fish species
Number of darter species	Number of darter species
Number of sunfish species	Number of headwater species
Number of sucker species	Number of minnow species
Number of intolerant species	Number of sensitive species
Percent tolerant species	Percent tolerant species
Percent omnivore species	Percent omnivore species
Percent insectivore species	Percent insectivore species
Percent of top carnivore species	Percent pioneering species
Number of individuals (minus tolerants)	Number of individuals (minus tolerants)
Percent of simple lithophilic spawners	Number of simple lithophilic species
Percent DELT anomalies	Percent DELT anomalies

Table 10. Fish Community Biology Scores for EOLP Ecoregion							
Ohio EPA Narrative	Very Poor	Poor	Fair	Marginally Good	Good	Very Good	Exceptional
IBI Score - Headwater	12-17	18-27	28-35	36-39	40-45	46-49	50-60
IBI Score - Wading	12-17	18-27	28-33	34-37	38-45	46-49	50-60
MIwb Score (Wading only)	0-4.4	4.5-5.8	5.9-7.3	7.4-7.8	7.9-8.8	8.9-9.3	≥9.4
Ohio EPA Narrative	Non-Attainment			NSD	Attainment		
NSD – Non-Significant Departure of WWH attainment							

Results and Discussion

Rocky River West Branch

The fish community in the Rocky River West Branch indicates *Very Good* water quality conditions. Rocky River West Branch RM 0.45 was calculated to be in full aquatic life attainment for the IBI and MIwb (Table 11), meeting the WWH criteria. Adequate habitat and water quality conditions supported a fish assemblage with moderate to high species richness and insectivorous species, and moderate to low numbers of tolerants and DELT anomalies. Although achieving WWH attainment, low to moderate abundance of pollution-intolerant fishes and simple lithophilic spawning species were observed.

Table 11. 2020 Rocky River West Branch and Tributaries IBI and MIwb Results							
Location	River Mile	1 st Pass		2 nd Pass		Average	
		IBI	MIwb	IBI	MIwb	IBI	MIwb
West Branch Rocky River	0.45	46	8.8	48	9.3	47	9.1
Blodgett Creek	1.50	26	--	32	--	29	--
Plum Creek	2.84	26	--	24	--	25	--
Minnie Creek	0.20	26	--	44	--	35	--
Bold = meets WWH criterion [IBI ≥40; MIwb ≥8.7]							
^{ns} non-significant departure from biocriterion (IBI ≥36; MIwb ≥8.2)							

The Rocky River has historically been monitored by the Ohio EPA since 1981. Improvements to the Rocky River fish community have been noted, as fish community scores failed to meet WWH attainment prior to 1997 (Figures 4 and 5) (Ohio EPA 1993, 1999b). Assessments in 2019 and 2020 at RM 0.45 now shows that the site is in full attainment. Even though the site is

meeting WWH attainment, *E. coli* densities still indicate that there is sewage contamination in the watershed upstream of this location. Biological index scores in the Rocky River West Branch improved in the late 1990s as toxic releases were remediated from the Montville Landfill (RM ~ 34.0) when the facility shut down. These remediation efforts have resulted in improved water quality and a more robust fish community in the Rocky River West Branch over the last twenty years.

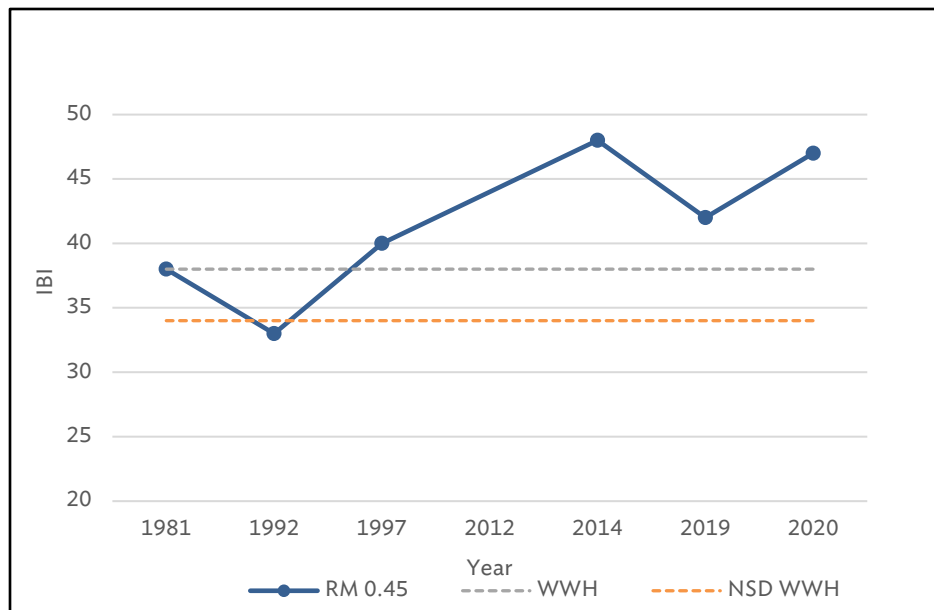


Figure 4. Rocky River West Branch Historical IBI Scores

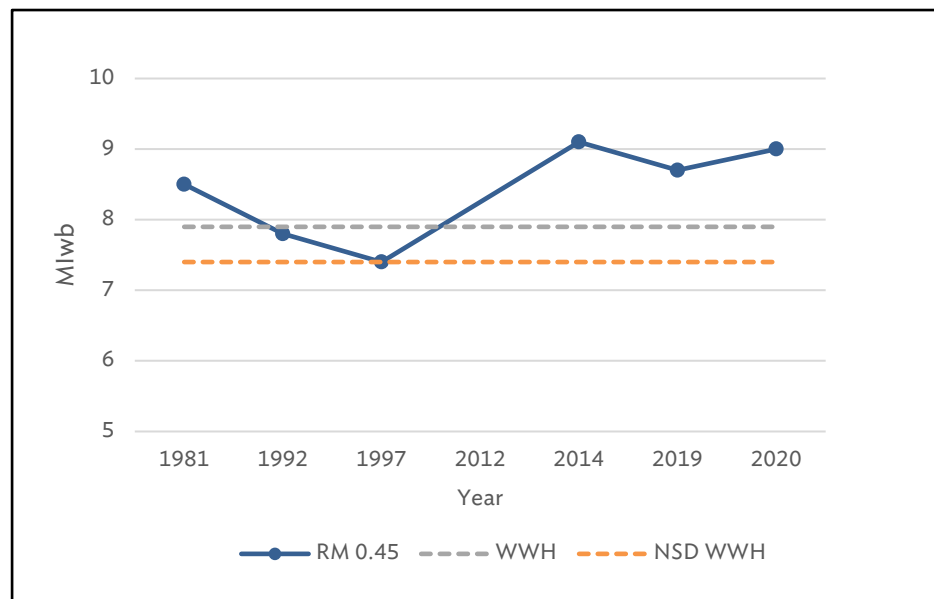


Figure 5. Rocky River West Branch Historical MIwb Scores

Baker Creek

Landowner permission was not granted for a continuous 150 meters of Baker Creek; therefore, no fish community or habitat assessments were performed. Baker Creek was assessed by the Ohio EPA in 2014 and received an IBI score of 40, indicating good water quality and attainment of the WWH designated use. Land use within the watershed has experienced moderate development since the 2014 assessment, with more development planned to take place over the next several years. No point sources of pollution are identified within the Baker Creek watershed.

Blodgett Creek

Despite *Good* habitat being present throughout the reach (QHEI=60.50), Blodgett Creek received an IBI score of 29 resulting in a *Fair* narrative rating. Six total fish species were collected from Blodgett Creek in 2020, with pollution-tolerant fish accounting for the majority of the first (99.7%) and second (76.9%) electrofishing passes. A healthy population of tolerant species, free from any DELTs (Deformities, Erosions, Lesions and Tumors), dominates RM 1.50 of Blodgett Creek.

In both 2019 and 2020, Blodgett Creek field seasons, the fish community consisted of zero darter species and zero sensitive species during all four electrofishing passes. Of the seven species collected in 2019 and 2020, five species have feed guilds classified as either generalists, herbivores, or omnivores (Ohio EPA, 2006b), suggesting a potential disruption of the food base. This potential disruption may be due to a fish barrier at approximately RM 0.30, that likely prevents the migration of fish species upstream during normal flow conditions (See Figure 6). No insectivorous specialized feeding fish were collected in Blodgett Creek in 2019 and a single green sunfish (insectivore) was collected on the second electrofishing pass in 2020. This single fish had no impact on the IBI score. Blodgett Creek electrofishing data from 2019 and 2020 coincides with Ohio EPA historical data upstream of RM 0.90 that has never achieved WWH attainment (Figure 8). Only one sample location on Blodgett Creek (RM 0.10) was in attainment and met the applicable use designation for that section of stream (Ohio EPA, 1999b). It is likely due to being downstream of the fish barrier at RM 0.30 and the local recolonization of fish from the confluence with the Rocky River West Branch.



Figure 6. Fish barrier at Blodgett Creek RM 0.30.

Plum Creek

Plum Creek fish community scores were considered *Fair* with an average IBI score of 25. At RM 2.84, an average IBI score of 28 (*Fair*) was calculated in 2019 by NEORS. Figure 8 shows that the 2019 and 2020 fish sampling events showed a slight increase in score when compared to historical Ohio EPA IBI scores (18, 1997 and 24, 2014). Habitat limitations at the confluence of Plum Creek and the Rocky River West Branch are having a negative impact on upstream Plum Creek IBI scores. A series of natural waterfall acts as a physical barrier to fish migration into Plum Creek from the Rocky River West Branch (Figure 7).



Figure 7. Plum Creek Waterfalls

Sampling efforts in 2020 at RM 2.84 saw a reduction in the number of species collected (ten, 2020 and thirteen, 2019), and therefore a reduction to the IBI score. Proportion of tolerant fishes has decreased from greater than 85% in 1997 (Ohio EPA, 1999b) to less than 60% in 2020. There were no headwater species, one sensitive species, and one darter species collected in 2020, resulting in minimal positive impact to the overall IBI score. One wetland species, the central mudminnow, was collected during 2019 and 2020 sampling events. The brook stickleback was collected during the 2019 sampling events. With both fish species present in the stream, it suggests that there is wetland connectivity to Plum Creek. However, even with wetland connectivity, the natural fish barrier virtually eliminates fish from re-colonizing the upper reaches of Plum Creek from the Rocky River West Branch, hindering its WWH attainment.

In 2020, Ohio EPA recommended an experimental seeding of upper Plum Creek with a representative collection of headwater fish species from adjacent waters within the basin. A reintroduction of this nature could potentially ascertain the restoration potential of Plum Creek. In April 2021, NEORSD staff began collecting these headwater species from within the Rocky River basin and introduced them at two locations in Plum Creek (RMs 2.84 and 1.70). Collected fish were identified, counted, and tagged using a visual implant elastomer prior to seeding. NEORSD staff plans to sample the two reintroduction areas in fall 2021 to monitor progress of the project. Future seedings are also planned.

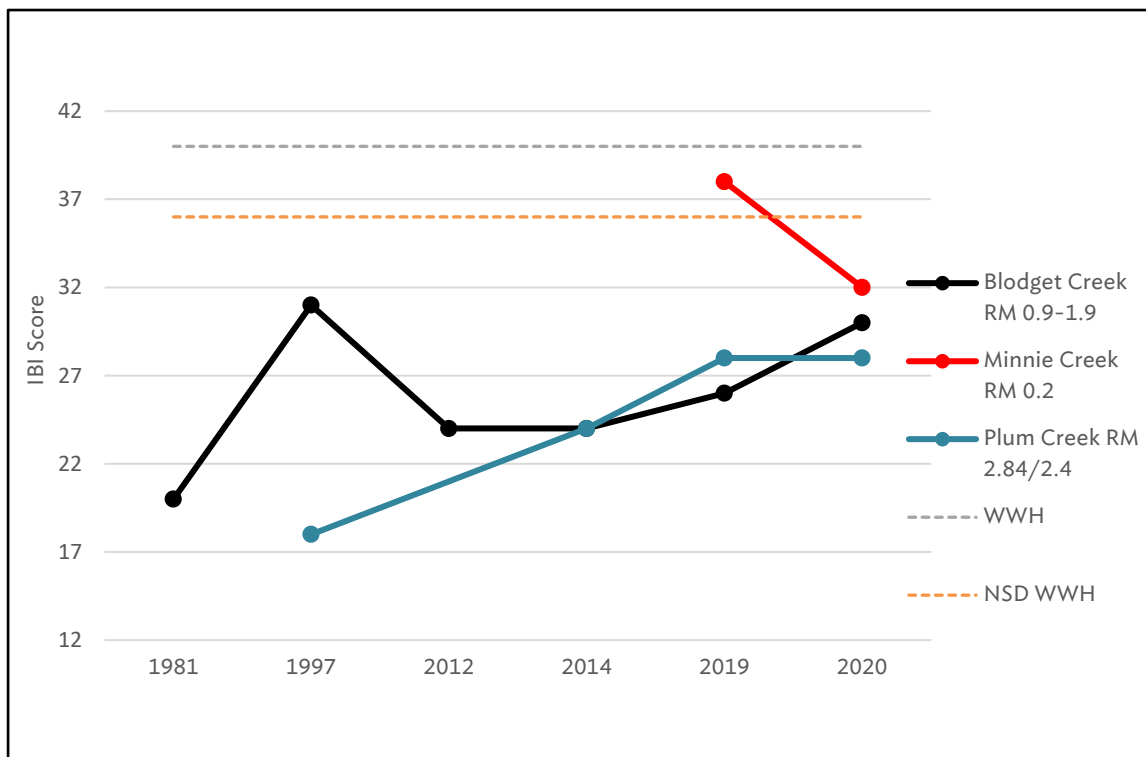


Figure 8. Rocky River West Branch Tributaries Historical IBI Scores

Minnie Creek

Minnie Creek’s water quality was sampled in 2019 and 2020 by NEORSD staff; however, it had not previously been assessed by the Ohio EPA. Therefore, Minnie Creek has not been

designated a specific water quality standard ALU designation. The average IBI score (35, *Fair*) from 2020 was not in attainment of the WWH criterion. The combined IBI scores from 2019 and 2020 fish sampling, however, resulted in an average score of 36, meeting non-significant departure for WWH criterion. A diverse fish community reflects that of a warmwater habitat stream, typically indicating fair to good water quality. There were no DELT anomalies observed during the fish sampling events in 2019 or 2020, further backing the claim of fair to good water quality within Minnie Creek. It was noted that the fish community varied slightly between the first and second sampling events in both 2019 and 2020. It seems that the first sampling event each year resulted in a lower diversity and number of fish species being collected. With the Minnie Creek sample site being close to the confluence of the Rocky River West Branch, this shift in community structure could reflect seasonal recolonization of fish from the river to the creek. There could potentially be water quality issues at hand as well related to the upstream Columbia Park Water System MHP. Overall, habitat and fish community scores reflect that of a WWH stream.

Macroinvertebrate Community Biology Assessment

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 all locations listed in Table 1. The recommended period for HDs to be installed is six weeks.

The macroinvertebrate samples were sent to Third Rock Consultants, Inc. 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 NEORSD WQIS Division.

The macroinvertebrate sampling methods followed Ohio EPA protocols as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI). The ICI consists of ten community metrics (Table 12), each with four scoring categories. Metrics 1-9 are based on the quantitative sample, while Metric 10 is based on the qualitative EPT taxa collected. The sum of the individual metric scores result in the overall ICI score. This scoring evaluates the macroinvertebrate community against Ohio EPA's reference sites for each specific eco-region. The WWH ICI criterion in the EOLP ecoregion is 34 (Table 13) and a site is considered within non-significant departure if the score falls within 4 ICI units of the criterion.

Table 12. ICI Metrics
Total Number of Taxa
Number of Mayfly taxa
Number of Caddisfly taxa

Table 12. ICI Metrics
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

Table 13. ICI Range for EOLP Ecoregion							
Ohio EPA Narrative	Very Poor	Poor	Fair	Marginally Good	Good	Very Good	Exceptional
ICI Score	0-6	8-12	14-28	30-32	34-40	42-44	46-60
Ohio EPA Status	Non-Attainment			NSD	Attainment		
NSD – Non-Significant Departure of WWH attainment							

Results and Discussion

Rocky River West Branch

The initial HD set at Rocky River West Branch RM 0.45 was found to be missing at the time of sample collection. A second HD was installed on August 19, 2020. Following a series of heavy rain events that occurred over the 6-week installation period, the second HD was unable to be retrieved and only a qualitative sample was taken. Therefore, a narrative rating was assigned to this site based on results of the qualitative sample. The site was assigned a narrative rating of *Good* in 2020. Macroinvertebrate data provided by the Ohio EPA from the Erie/Ontario Lake Plain ecoregion (EOLP) from 2005 to 2014 was used for comparative purposes in the assignment of the narrative rating. The historical average numbers of qualitative taxa, qualitative EPT taxa, and qualitative sensitive taxa for wadable sites in the EOLP with ICI scores falling under each narrative rating category are provided in Figures 9-11.

The total number of qualitative taxa present at the site was 48. This falls between the average number of qualitative taxa for wadable sites with historical narrative ratings of *Good* and *Very Good* (Figure 9). Thirteen qualitative EPT taxa were collected. This is equal to the average number of qualitative EPT taxa for headwater sites with historical narrative ratings of *Good* (Figure 10). Seven sensitive taxa (moderately intolerant) were present in the qualitative sample at this site. This falls between the average number of qualitative sensitive taxa for sites with historical narrative ratings of *Marginally Good* and *Good*. The RM 0.45 sample location has eroded down to bedrock throughout nearly the entire reach. Poor margin quality, riffle habitat, lack of pool habitat, and the predominately bedrock substrate composition pose limitations to macroinvertebrate community performance at this site.

Rocky River West Branch RM 0.45 was given an estimated field narrative rating of *Very Good* at the time of sample collection, due to the observed density and diversity of macroinvertebrates, and relatively high abundance of EPT taxa observed at the site. The number of qualitative taxa, qualitative EPT taxa, and qualitative sensitive taxa were all near average values observed at historical sites with narrative ratings between *Marginally Good* and *Very Good*. Therefore, the site was assigned a narrative rating of *Good* in 2020 (Table 14).

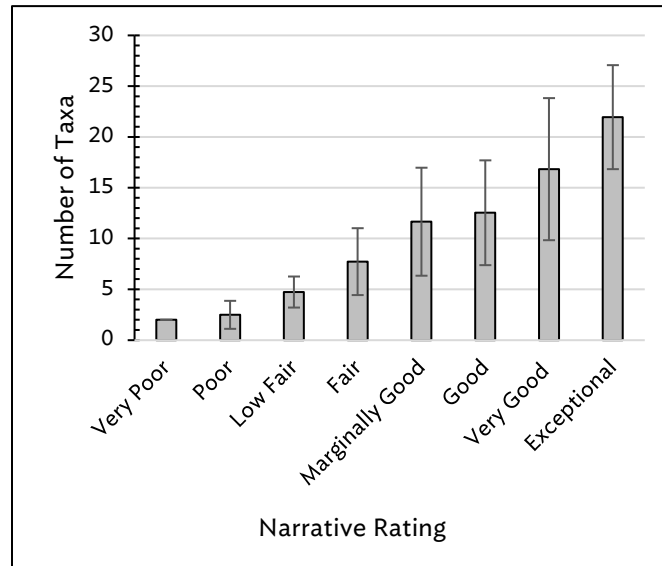


Figure 9. Averages with standard deviation of the number of qualitative taxa collected at EOLP wadable sites by narrative rating. * Number of qualitative taxa present at site.

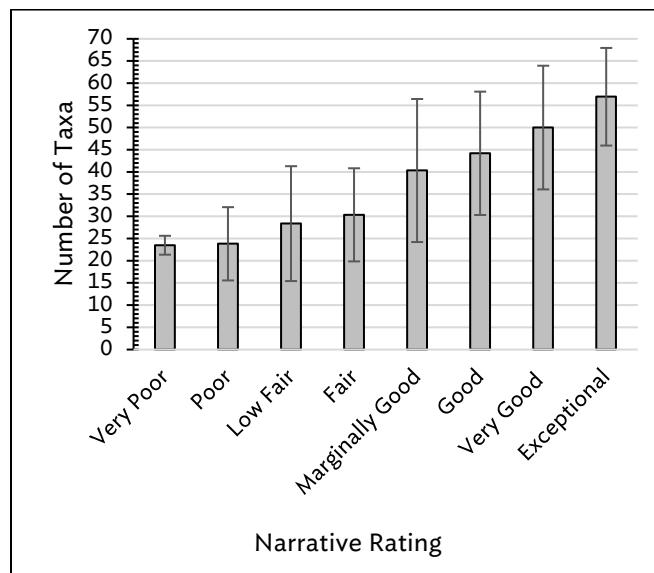


Figure 10. Averages with standard deviation of the number of qualitative EPT taxa collected at EOLP wadable sites by narrative rating. * Number of qualitative EPT taxa present at site.

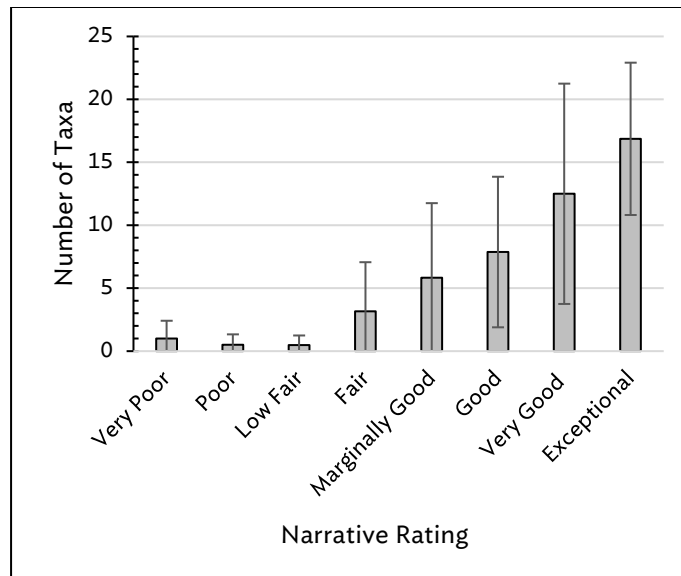


Figure 11. Averages with standard deviation of the number of sensitive EPT taxa collected at EOLP wadable sites by narrative rating. * Number of qualitative sensitive taxa present at site.

Baker Creek

The macroinvertebrate community in Baker Creek RM 0.15 resulted in a narrative rating of *Very Good* with a calculated ICI score of 44, which met the WWH designated use (Table 14). Sampling in 2019 also resulted in an ICI score of 44, indicating stability within the macroinvertebrate community at RM 0.15 (Figure 12). EPT taxa made up 8 of the 23 total qualitative taxa. Total number of taxa was well represented with 42 species. Only about 5% of all organisms collected in the HD were classified as tolerant species, resulting in a strong contribution to the ICI score. Another strong contributor to the ICI score were the four caddisfly species that represented 7.18% of the quantitative sample. Improvements to water quality in 2019 and 2020 are noted, as Ohio EPA monitoring in 1993 indicated a *Fair* macroinvertebrate community.

Blodgett Creek

The ICI score at Blodgett Creek RM 1.50 was calculated at 42, resulting in a narrative rating of *Very Good* (Table 14) and meeting the designated use of WWH. This was an improvement from the 2019 ICI score of 36 at RM 1.50. Caddisflies and tribe tanytarsini midges were both present in healthy percentages (7.1% and 52.65% respectively) of the overall population of macroinvertebrates collected (Figure 12). A low percentage of tolerant organisms helped RM 1.50 reach attainment. Although this reach of Blodgett Creek consisted of a high percentage of small benthic substrates that typically support a diverse macroinvertebrate population, scores indicate that the habitat is not having a negative impact on the population. This could be an indication that water quality is improving within the stream.

Vast improvements to water quality in Blodgett Creek have been observed over the last 30 years. The Ohio EPA noted in 1993; “during low flow conditions, Blodgett Creek appeared to be

comprised entirely of WWTP effluent.” Results from the 1993 sampling on lower Blodgett Creek displayed a community predominated by pollution-tolerant midges and a low taxa diversity. Since the removal of the two WWTPs in 1995, moderate taxa diversity and improved biological scores are now observed.

Minnie Creek

The ICI score at Minnie Creek RM 0.20 was calculated at 20 resulting in a narrative rating of *Fair*. This was a significant decrease from the 2019 ICI score of 42. Twenty-one taxa were collected in the qualitative sample, only one of which is classified as EPT taxa. A total of 35 species were collected between quantitative and qualitative sampling efforts. Other diptera and non-insects dominated the sampling effort representing 98.78% of the macroinvertebrate community (Figure 12). Gravel, sand, and other embedded substrates were prevalent throughout the sampling reach, providing minimal interstitial space for macroinvertebrates to occupy. Only one mayfly species was collected, representing 0.07% of the collected community, indicating potential water quality impairments. Dipteran and caddisfly taxa were both poorly represented as well, further confirming that water quality issues may be present. Waste loads to Minnie Creek from the Columbia Park Water System MHP, as well as failing home septic systems may be having a negative impact on the macroinvertebrate community in Minnie Creek. However, it is unclear what caused the decrease in score from 2019 to 2020.

Plum Creek

Plum Creek at RM 2.84 received a narrative rating of *Good* and the ICI score was calculated at 34 which the WWH designated use. This was a significant improvement over 2019’s ICI score of 26. Historical data retrieved from Ohio EPA shows similar macroinvertebrate scores, ranging from *Fair* to *Marginally Good* in Plum Creek. A total of 52 species were collected between the quantitative and qualitative samples. A good representation of EPT taxa (8) was collected during the qualitative sampling. A well-represented tribe tanytarsini midges group comprised 34.85% of the macroinvertebrate community (Figure 12). Low diversity and overall percentage of mayflies and caddisflies could indicate that water quality issues may be having an impact on the macroinvertebrate community. The ICI score in 2019 also confirms that water quality issues may be impacting Plum Creek.

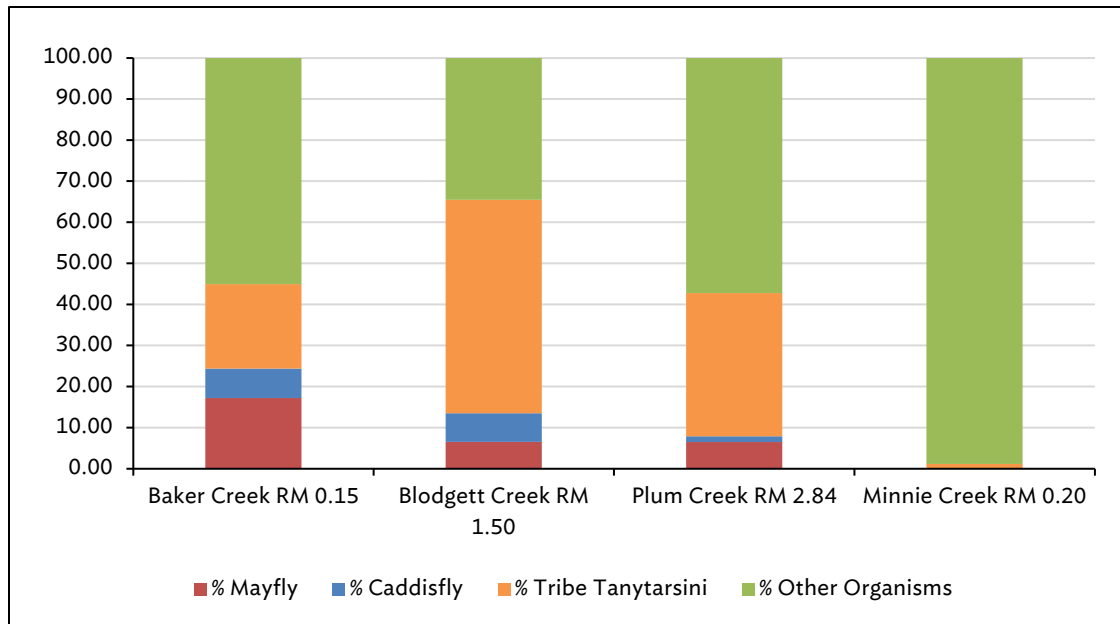


Figure 12. 2020 Rocky River West Branch Tributaries Macroinvertebrate Community Composition

Table 14. 2020 Rocky River West Branch and Tributaries Macroinvertebrate Results						
Location	River Mile	ICI Score	Total Number of Taxa	Number of Qualitative EPT Taxa	% Tolerant (as defined)	Narrative Rating
Rocky River West Branch	0.45	--	--	--	--	Good*
Baker Creek	0.15	44	42	8	4.70%	Very Good
Blodgett Creek	1.50	42	44	8	3.55%	Very Good
Minnie Creek	0.20	20	35	1	2.51%	<i>Fair</i>
Plum Creek	2.84	34	52	8	13.37%	Good
Bold indicates attainment of WWH criterion of 34						
*Narrative rating is based on data and interpretation by QDC from qualitative sampling only						

Conclusions

For the 2020 sampling season, two of the five Rocky River West Branch and Tributary sites were in full attainment of the aquatic life criteria (Table 15). A full bioassessment (fish, macroinvertebrate, and water chemistry) was conducted on three of the five Rocky River West Branch and Tributary sites in 2020.

A quantitative/qualitative macroinvertebrate sample and water chemistry sampling were conducted at Baker Creek RM 0.15 in 2020. The ICI score for Baker Creek (44) resulted in full attainment for the macroinvertebrate community. Baker Creek RM 0.15 was not assessed for fish in 2020 due to landowner permission not being granted for a continuous 150 meters of the stream. A previous assessment from Ohio EPA in 2014 received an ICI score of 40 (*Good*). This suggests that if RM 0.15 were assessed for fish community biology in 2020, it would likely achieve full WWH attainment.

As mentioned in the 2019 report, two former golf courses in which Baker Creek intersects (Riverside Golf Course \approx 86 acres and Emerald Woods Golf Course \approx 300 acres) have been bought by developers and are planned to be developed into single family homes with sanitary sewer connections. Along with the parceling and sales of farming properties, increased development will vastly change the impervious surface landscape in the Baker Creek watershed. Development within the Baker Creek, Plum Creek, and the Rocky River West Branch watersheds is ongoing and attention to the impacts that land use changes will have on both flow regime and water quality is needed to prevent deterioration of its biota.

Table 15. 2020 Rocky River West Branch and Tributaries Survey Results

Site	Aquatic Life Use Attainment Status	IBI Score (Narrative Rating)	MIwb Score (Narrative Rating)	ICI Score (Narrative Rating)	QHEI Score (Narrative Rating)	Water Quality Exceedances
Rocky River West Branch RM 0.45	FULL**	47 (Very Good)	9.1 (Very Good)	-- (Good)	77.50 (<i>Excellent</i>)	<i>E. coli</i> , Mercury
Baker Creek RM 0.15	(FULL)*	--	---	44 (Very Good)	--	<i>E. coli</i> , Mercury
Blodgett Creek RM 1.50	PARTIAL	29 (<i>Fair</i>)	---	42 (Very Good)	60.50 (<i>Good</i>)	<i>E. coli</i> , Mercury
Plum Creek RM 2.84	NON	25 (<i>Poor</i>)	---	34 (Good)	67.25 (<i>Good</i>)	<i>E. coli</i> , Mercury
Minnie Creek RM 0.20	NON (WWH RECOMMENDED)	35 (<i>Fair</i>)	---	20 (<i>Fair</i>)	80.25 (<i>Good</i>)	<i>E. coli</i> , Mercury

WWH biocriteria 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

*Attainment status based on one organism group

**Based on macroinvertebrate qualitative narrative

-- No assessment completed

--- not applicable to Headwater sites

As in 2019, assessments in 2020 showed water quality impairments at all sites in the Rocky River West Branch drainage area. These impairments may be preventing the establishment of a healthier biological community within the watershed. With only one set of samples being collected at the tail end of a wet-weather event, significant rainfall events did not have an impact on 2020 water quality sampling. Significant Water Quality Standards exceedances for *E. coli* densities still occurred at all five sampling sites. These exceedances for *E. coli* densities may be attributable to failing home sewage treatment systems, poorly treated wastewater, and the Columbia Park Water Systems MHP. All mercury results in 2020 were below the method detection limit. Because the detection limit for EPA Method 245.1 is above the criteria for the Human Health Non-Drinking and Protection of Wildlife OMZAs, it cannot be determined if the sites were in attainment of those criteria.

Fish sampling, a qualitative macroinvertebrate sample, and water chemistry sampling were conducted at Rocky River West Branch RM 0.45. Rocky River West Branch RM 0.45 was not given a quantitative macroinvertebrate community score due to a missing HD. The 2020 qualitative sampling suggested an improvement from the 2019 ICI score, however more quantitative sampling is needed to better assess the macroinvertebrate community at RM 0.45.

The Rocky River West Branch RM 0.45 averaged a QHEI score of 75.5 while the three tributaries evaluated averaged a score of 69.3, both exceeding Ohio EPA's QHEI target scores and suggest sufficient reach-based habitat exists to support a warmwater fish community. All sites displayed good riffle/run/pool development and quality as well as adequate pool depth. Except for Minnie Creek RM 0.20, all locations displayed four or more best substrate types. Available habitat does not appear to be having a negative effect on the watershed. QHEI scores > 60 display that the urban landscape is not significantly impacting available fish habitat.

Of the tributaries, Minnie and Plum Creeks did not achieve scores in attainment of WWH criterion. Ohio EPA is yet to give Minnie Creek an ALU designation. Although there is a potential impact that Columbia Park Water System MHP may be having on Minnie Creek, the stream appears to be a candidate for WWH ALU designation. After analyzing the IBI, QHEI, and ICI scores in Minnie Creek in 2019 and 2020, Minnie Creek is recommended for WWH ALU designation by NEORS.

Plum Creek has historically been degraded, as the 1997 Ohio EPA report outlined organic and nutrient enrichment as the main cause of non-attainment, resulting in the development of a TMDL in 2001. Nutrient sampling during the 2020 season displayed results above the TMDL target concentrations with an exceedance of the geomean nitrate-nitrite minimum during the five sampling events. Although improved measurable chemical water quality has been observed, the fish are not achieving attainment. The experimental seeding project by NEORS will be monitored and surveyed by staff over the next three years. Even with the seeding project, the waterfall near the confluence of the Rocky River West Branch will continue to prevent fish from re-colonizing the stream, but the macroinvertebrate community should improve with water quality.

The NEORS has recently completed pre-monitoring for septic tank to sanitary sewer conversions in Olmsted Falls (Rocky River West Branch and Minnie Creek watersheds) and Strongsville (Baker Creek watershed). In addition to these projects, NEORS has recently

completed sampling for the Southwest Interceptor Local Sanitary Sewer Evaluation Study. This study will evaluate and prioritize potential water quality problems including excessive peak wet weather flows to district facilities, sanitary sewer overflows, urban stormwater runoff, illicit discharges to storm sewers, and failing septic systems. As NEORSD and local municipalities work together to reduce sewage and control urban stormwater runoff to the environment, a reduction in pollutants entering the streams and an improved overall water quality will likely follow.

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