Northeast Ohio Regional Sewer District

2024 Cuyahoga River
Biological, Water Quality, and Habitat Study

Water Quality and Industrial Surveillance

Environmental Assessment Group

March 2025

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Introduction

The Cuyahoga River is located in Northeast Ohio, flowing through the cities of Akron and Cleveland before its final confluence with Lake Erie. The Northeast Ohio Regional Sewer District (NEORSD) service area spans the lower 25.3 miles of the Cuyahoga River. The NEORSD's responsibilities include managing sewage conveyance and treatment through its major interceptor sewers and three wastewater treatment plants. The NEORSD Southerly Wastewater Treatment Center (WWTC) is a significant discharger to the Cuyahoga River at RM 10.57, with a design flow of 175 million gallons per day (MGD) and a peak flow capacity of 400 MGD. The treatment process consists of preliminary screening, grit removal, primary settling, activated sludge process, secondary clarification, and chlorine disinfection from May-October.

The NEORSD also manages local stormwater runoff, flooding, and erosion issues through its Regional Stormwater Management Program. Communities bordering the Cuyahoga River that participate in both the wastewater and stormwater services include Brecksville, Sagamore Hills, Valley View, Independence, Brooklyn Heights, Cuyahoga Heights, and Cleveland. All cities listed here are issued an Ohio Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) or a stormwater general permit for all, or portions of their municipality. The NEORSD assists in numerous control measures listed in these MS4 permits, including the stormwater management and illicit discharge programs.

The lower 46.5 miles of the Cuyahoga River was designated as one of the 42 Great Lakes Areas of Concern (AOC) in 1985 by the International Joint Commission. This designation described the river as having severe anthropogenic environmental degradation, and not capable of supporting its beneficial use designations. The lower 5.60 miles of the Cuyahoga is designated as a ship channel and has limited capability to support healthy biological communities due to a combination of habitat and water quality issues. Past monitoring has indicated impairment of the aquatic biota and recreational standards, particularly in the northernmost sections of river. The Ohio EPA has listed numerous sites on the Cuyahoga River as impaired in 2024 according to the Integrated Water Quality Monitoring and Assessment Report (Ohio EPA, 2024). Major historical causes of impairment to the river include organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration (Ohio EPA, 2004). There are currently four parameters included in the approved TMDL for the Cuyahoga River within NEORSD's service area: dissolved oxygen (DO), total phosphorus (TP), nitrate-nitrite (NO3-NO2), and in-stream habitat. Recent environmental monitoring by the NEORSD has indicated that some sites have displayed full attainment of their respective biological criteria.

The NEORSD is investing in infrastructure to eliminate and capture combined sewer overflows (CSOs) in the NEORSD interceptor sewer collection system. The NEORSD entered into a consent decree with the United States EPA in 2011. It was estimated that NEORSD-operated CSOs discharged approximately 1,040 million gallons (MG) of mixed storm and sanitary sewage to the Lower Cuyahoga River in 2017 and 980 MG in 2021. Recently completed and ongoing CSO capture tunnel projects including the Southerly Storage Tunnel and the Westerly Storage Tunnel are predicted to capture the majority of these remaining CSO discharges.

In 2024, the NEORSD conducted water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community assessments on the lower Cuyahoga River. There were numerous objectives of this study. The first objective was to evaluate the potential water quality impacts of Southerly WWTC on the lower Cuyahoga River and identify any spatial and temporal water quality trends. A second objective was to re-evaluate the water quality and biological communities in the Cuyahoga River Ship Channel, which was last surveyed by NEORSD in 2016. A third objective was to assess the impact of the removal of the Station Road Dam which occurred in 2020. Finally, monitoring at river mile (RM) 1.20 was conducted to determine baseline conditions prior to a restoration project that will be completed there that will create riparian habitat and fish refuge areas.

During the 2024 sampling season, ten stream locations were evaluated from RM 20.75 to RM 0.20 (Table 1 and Figure 1). Additional water chemistry data was collected at two other sites (SUS and SDS, Table 1) in accordance with the Ohio EPA NPDES permit to discharge to the Cuyahoga River. Sampling was conducted by NEORSD Level 3 Qualified Data Collectors (QDCs) certified by the Ohio EPA in Fish Community Biology, Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat Assessments as explained in the NEORSD project study plan "*2024 Cuyahoga River Environmental Monitoring*" approved by Ohio EPA on April 29, 2024. All sampling and environmental assessments occurred between June 15 through September 30, 2024 (through October 15 for fish sampling 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 methods outlined by the Ohio EPA *Surface Water Field Sampling Manual for water quality parameters and flows* (2023a) and compared to the Ohio Water Quality Standards (WQS) for their designated use(s) to determine attainment (Ohio EPA, 2023b). An examination of the individual metrics that comprise the IBI, MIwb, and ICI was used in conjunction with water chemistry data and QHEI scores to assess the health of the stream.

Figure 1 shows a study area map of all sample locations evaluated during the 2024 study. Sampling locations with respect to RM, latitude/longitude, description, and the types of surveys conducted are listed in Table 1. Benthic macroinvertebrate and water chemistry collection sites are located near the midpoint of each electrofishing zone, indicated by the RM. GPS coordinates are recorded at the downstream end of each sampling zone. A digital photo catalog of sampling locations is available upon request by contacting the NEORSD's Water Quality and Industrial Surveillance (WQIS) Division.

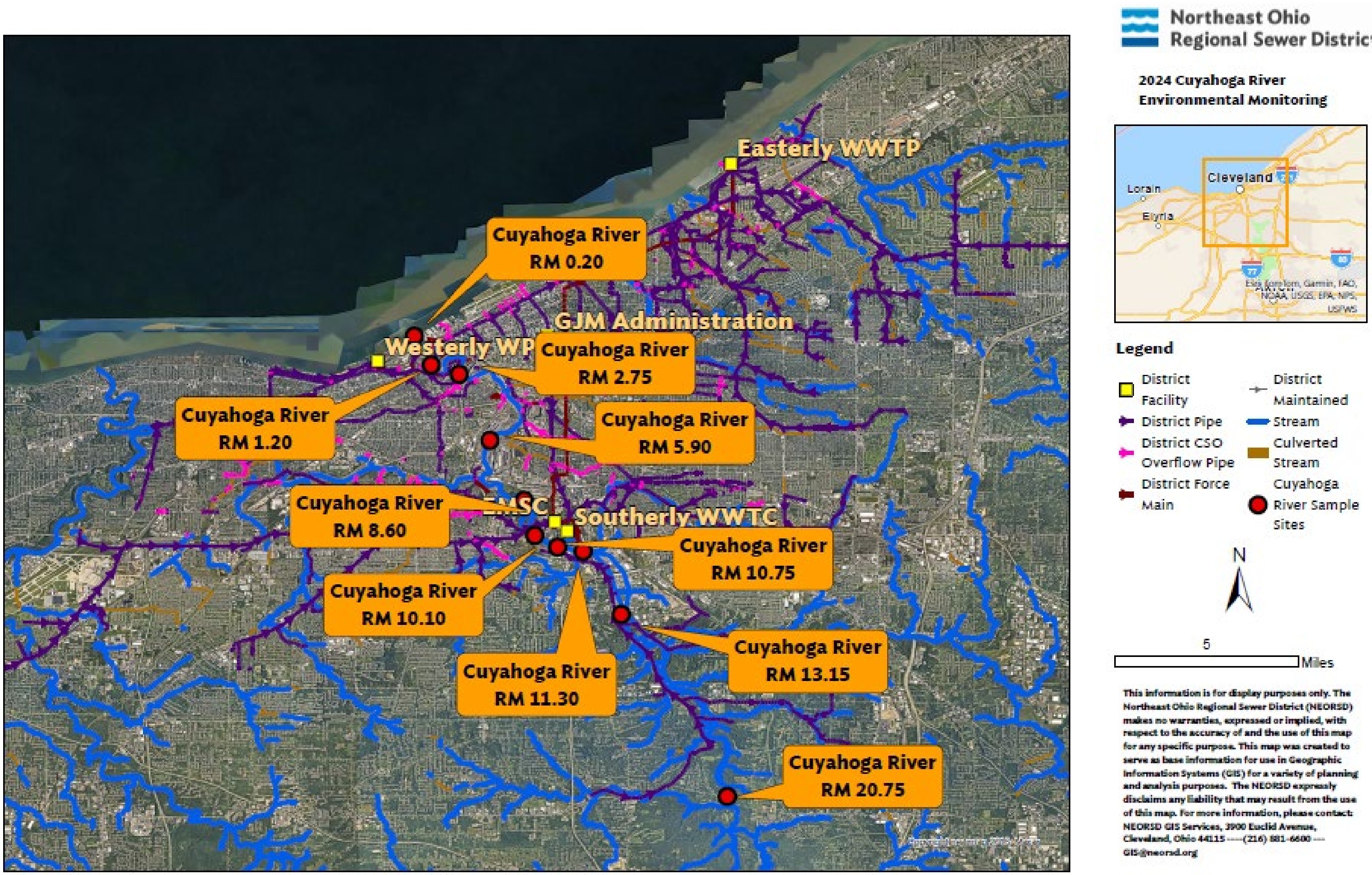

Figure 1. Cuyahoga River Sampling Locations

Table 1. 2024 Cuyahoga River Sampling Locations

Location	River Mile	Station ID	Latitude	Longitude	Drainage Area (mi^2)	Sampling Conducted
Upstream of Former Canal Diversion Dam	20.75	502170	41.3207	-81.5875	583	M, C
U.S. of Rockside Road and Confluence with Mill Creek	13.15	502020	41.3929	-81.6295	703	F, M, C
D.S. of Confluence with Mill Creek	11.30	F01S10	41.4179	-81.6446	730	F, M, C
*U.S. Southerly WWTC @ Chlorine Access Bridge	10.95 (SUS)	F01A25	41.4180	-81.6480	743	C
U.S. Southerly WWTC Effluent Discharge	10.75	F01A25	41.4196	-81.6547	743	F, M, C
D.S. Southerly WWTC Effluent Discharge	10.10	F99Q02	41.4242	-81.6638	744	F, M, C
*D.S. Southerly WWTC @ Southerly Interceptor Bridge	9.78 (SDS)	F01S09	41.4272	-81.6662	744	C
D.S. Southerly WWTC Effluent Discharge	8.60	200025	41.4381	-81.6680	745	F, M, C
Head of Navigation Channel	5.90	F01W43	41.4651	-81.6738	787	F, M, C
Mid-Navigation Channel/GLRI Habitat	2.75	200005	41.4918	-81.6933	806	F, M, C
Upstream Detroit-Superior Bridge	1.20	200002	41.4918	-81.7046	807	F, M, C
Near Mouth of River in Navigation Channel	0.20	F01A64	41.5032	-81.7116	813	F, M, C

F = Fish community biology (includes habitat assessment)
M = Macroinvertebrate community biology
C = Water chemistry
*Water chemistry is collected 2x/month as part of Southerly WWTC NPDES permit

The Ohio EPA assigns designated uses to establish minimum water quality requirements for surface waters. These requirements represent measurable criteria for assessing the chemical, physical, and biological integrity of Ohio's surface waters consistent with Clean Water Act requirements. From 2017-2019, Ohio EPA conducted the most recent extensive watershed survey, in addition to other sampling events that have been conducted by Level 3 participants in Ohio

EPA's Credible Data Program including NEORSD. Ohio EPA compiles this data to either verify existing uses, or to recommend updated aquatic life use (ALU) to be codified in Ohio's WQS. Proposed beneficial use designations and recommendations included maintaining the WWH use for most of the Cuyahoga mainstem but upgrading the section from Tinkers Creek upstream to Brandywine Creek from warmwater habitat (WWH) to exceptional warmwater habitat (EWH). The Cuyahoga Mainstem from RM 5.6 to the mouth was recommended to be designated modified warmwater habitat – channelized (MWH-C) (Ohio EPA, 2023c). Based on records of steelhead trout collected by Ohio EPA and NEORSD in the lower Cuyahoga mainstem, the reach from the mouth extending upstream to the Gorge Dam at RM 44.6 was recommended to be designated as Seasonal Salmonid Habitat (SSH) (Ohio EPA, 2021). The current beneficial use designations for the Cuyahoga River codified in OAC 3745-1-26 are listed below in Table 2 (Ohio EPA, 2023b).

Table 2. Beneficial Use Designations for the Cuyahoga River

Water Body Segment	Beneficial Use Designation												
	Aquatic Life Habitat (ALU)							Water Supply			Recreation		
	SRW	WWH	EWH	MWH	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Cuyahoga River – Entirety of ship channel (RM 5.60) to the mouth (including the old river channel) *							+			+		+	
- Brandywine Creek to Tinkers Creek (RM 24.17 to 16.36)**			+		+				+	+		+	
- All other segments		+							+	+		+	

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.

*During the months of June-January when a biological survey would be performed, the current ALU designation is LRW.

** Proposed Beneficial Use Designation changes based on data collected between 2016-2018 (Ohio EPA, 2021b).

Water Chemistry and Bacteriological Sampling

Methods

Water chemistry and bacteriological sampling was conducted five times between June 26 and July 24, 2024, at the locations listed in Table 1 except for RMs 10.95 (SUS) and 9.78 (SDS), where samples were collected twice monthly year-round. Techniques used for sampling and analyses followed the Ohio EPA *Surface Water Field Sampling Manual for water quality parameters and flows* (2023a). 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, percent dissolved oxygen, pH, temperature, conductivity, and specific conductance were collected using a YSI EXO1 sonde. Duplicate/replicate samples and field blanks were each collected at randomly selected sites, at a frequency of 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/replicate sample (Formula 1).

Formula 1: $$\mathrm{RPD} = \left| \frac{x-y}{\left[\frac{(x-y)}{2}\right]} \right| \times 100$$

x = is the concentration of the parameter in the primary sample

y = is the concentration of the parameter in the duplicate/replicate sample

The acceptable percent RPD is based on the ratio of the sample concentration and detection limit (Formula 2) (Ohio EPA, 2023).

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

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. Water chemistry analysis sheets for each site are available upon request from the NEORSD WQIS Division. Dates of water chemistry sampling compared to Cuyahoga River flow data (USGS 04208000) are shown below in Figure 2. It was noted that all five samples were collected during periods of near baseline flows, though several samples were collected during wet weather (within 48 hours following a rain event with a total precipitation of 0.1 inches or 72 hours following a rain event with a total precipitation of 0.25 inches).

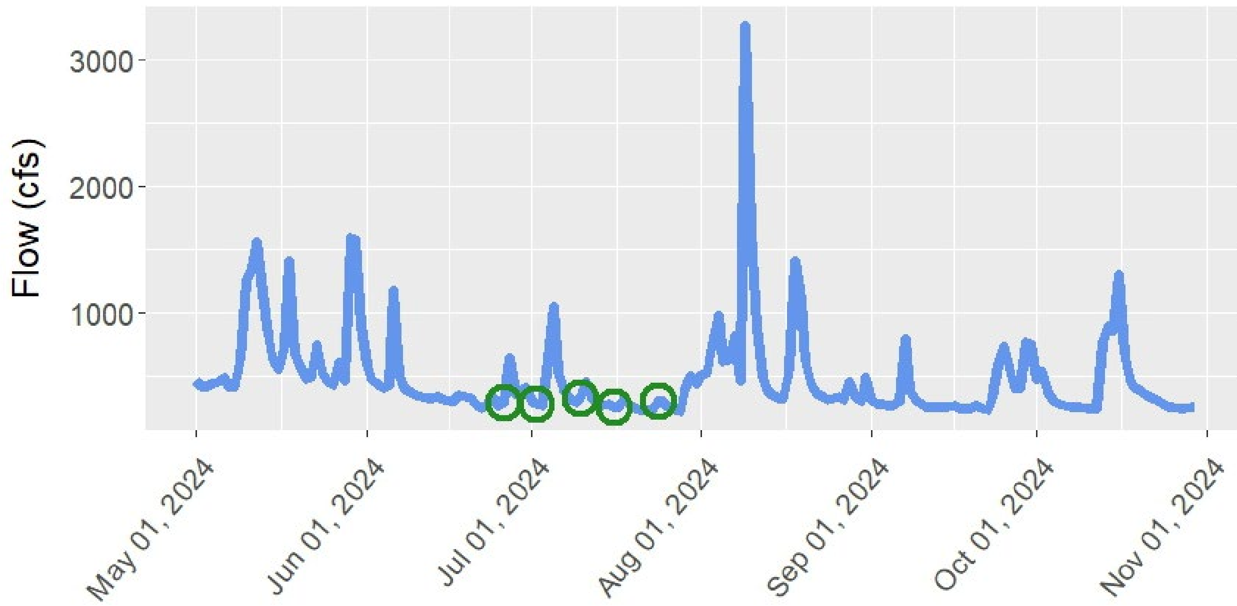

Figure 2. 2024 Cuyahoga River Flow Data at USGS Station 04208000. Daily mean discharge values are shown in blue. Sample collection dates are shown in green circles.

Results and Discussion

Data Validation QA/QC Checks

Over the course of five sampling events completed in 2024, three field blanks, two duplicate samples, and one replicate sample were collected as part of this study. There were no instances where data needed to be qualified based on field blank contamination. A single parameter was qualified for the field replicate sample collected July 2, 2024, as well as the field duplicate collected on July 16, 2024. On July 2, 2024, the chemical oxygen demand (COD) replicate results were outside of the acceptable RPD resulting in the data being qualified as rejected. On July 16, 2024, the TP duplicate results were outside of the acceptable RPD resulting in the data being qualified as rejected (Table 3).

Table 3. Duplicate/Replicate Samples with RPDs Greater than Acceptable

River Mile	Date	Parameter	Result (Duplicate Result)*	Acceptable RPD	Actual RPD
20.75	7/2/2024	COD	15.9 (6.07)	64.9	89.5
11.30	7/16/2024	TP	0.121 (0.264)	51.8	74.3
* Results in mg/L					

Paired parameters, wherein one parameter is a subset of another, were also evaluated in accordance with QA/QC protocols for all samples collected at each sampling site. There was one instance in which the data for the paired parameters needed to be qualified because the sub-parameter value was greater than the parent value. This occurred with the sample collected at RM 10.10 on July 16, 2024. The result from this sample for dissolved reactive phosphorus (DRP) was elevated compared to TP with an RPD greater than the acceptable RPD (Table 3). This resulted in this data being qualified as rejected.

Table 4. Paired Parameter Qualifiers

River Mile	Date	Parent Parameter (Result*)	Sub Parameter (Result*)	Acceptable RPD	Actual RPD	Qualifier
10.10	7/16/24	TP (0.122)	DRP (0.231)	45.4	61.8	Rejected
* Results in mg/L						

Combined Sewer Overflows on the Lower Cuyahoga River

The NEORSD is responsible for a total of 21 CSO outfalls on the Cuyahoga River not including overflows from the Southerly WWTC. The NEORSD has been tasked through a federal consent decree to reduce CSO discharges to the environment by 90% of the estimated 2011 discharge volume of 4.5 billion gallons annually. In response, the NEORSD has invested in grey and green infrastructure projects to eliminate and capture CSO discharges. Table 5 provides a summary of the CSO outfalls on the Cuyahoga River ordered by river mile location. The average number of annual overflows and discharge volumes provided in Table 5 are estimated from a combination of metered direct monitoring data, and modeled discharge predictions for the time period from 2019 and 2023. These data are taken from the NEORSD CSO annual reports. Data for 2024 was not yet available at the time this publication was finalized.

Of the 21 NEORSD-operated CSOs on the Cuyahoga River, three CSOs in particular were responsible for 91% of the average annual discharge volume for the period from 2019 to 2023. CSO 036 discharges accounted for the largest portion at 40% of the total volume or 369.5 MG. CSO 080 contributed 36% (336.4 MG), and CSO 040 contributed 15% (135.6 MG) of the total CSO volume to the Cuyahoga River. These three CSOs are located within the Cuyahoga River ship channel between RMs 2.90 and 5.10. Interestingly, these sites are located downstream of RM 5.90, which was the site that had the highest number of *E. coli* criteria exceedances in 2024. This may indicate that other issues including, but not limited to, urban runoff, local sanitary sewer overflows, and common trench sewer inflow and infiltration (I&I) play a larger role in bacteriological contamination than do CSOs, as further discussed in the below recreational use results and discussion section.

As of 2019, eleven of the 21 CSOs on the Cuyahoga River have been controlled by multiple projects. While some small number of discharges still occur from these outfalls, these discharges made up less than 1% of the annual NEORSD CSO discharge volume to the Cuyahoga River with a total volume of 7.6 MG compared to the average discharge volume of 925.7 MG from all outfalls.

Construction of the Westerly Storage tunnel was completed in the summer of 2024. This tunnel captures flow from CSOs 074, 080 and 087. Capture of flows from these outfalls will reduce the total CSO discharge volume to the Cuyahoga River by approximately 355.3 MG or 38.5% of the total volume. The remaining NEORSD-operated CSOs will be controlled by the Southerly Storage Tunnel which is anticipated to be operational by 2029. This 2024 study will provide information on the conditions prior to the completion of the last of the Project Clean Lake infrastructure efforts to capture CSO discharges along the Cuyahoga River.

Table 5. Annual Statistics and Location by River Mile of NEORSD-Operated CSOs on the Cuyahoga River for 2019-2023

CSO	River Mile	Year Controlled or Estimated to be Controlled	Controlling Project	Average Annual Overflows (#)	Average Annual Discharge Volume (MG)
CSO 074	0.20	2024	Westerly Storage Tunnel	17	8.6
CSO 075	0.20	2021	Westerly Low Level Relief Sewer	6	1.9
CSO 092	0.50	2013	Flats East Bank	1	0.0
CSO 091	0.65	2013	Flats East Bank	0	0.0
CSO 090	0.80	2018	Stones-Superior-Canal	2	0.4
CSO 076	1.00	2024	Elm Avenue Relief Sewer	6	4.2
CSO 078	1.45	2021	Westerly Low Level Relief Sewer	2	0.2
CSO 080	2.90	2024	Westerly Storage Tunnel	80	336.4
CSO 081	3.15	2011	Early Action	3	0.7
CSO 040	4.15	2029	Southerly Storage Tunnel/Kingsbury Run	61	135.6
CSO 086	4.20	2017	Mary Street Pump Station Upgrade	3	2.1
CSO 087	4.35	2024	Westerly Storage Tunnel	33	10.3
CSO 038	4.50	2011	Early Action	1	0.0
CSO 039	4.55	2029	Southerly Tunnel	31	10.2

Table 5. Annual Statistics and Location by River Mile of NEORSD-Operated CSOs on the Cuyahoga River for 2019-2023					
CSO	River Mile	Year Controlled or Estimated to be Controlled	Controlling Project	Average Annual Overflows (#)	Average Annual Discharge Volume (MG)
CSO 037	4.80	2011	Early Action	1	2.2
CSO 036	5.10	2029	Southerly Tunnel	51	369.5
CSO 035	5.40	2029	Southerly Tunnel	37	20.9
CSO 088	6.40	2024	Pearl Jennings Pump Station	58	17.4
CSO 033	7.65	2029	Southerly Tunnel	11	5.0
CSO 060	9.70	2011	Early Action	0	0.0
CSO 250	11.25	2011	Early Action	0	0.0
			Total:	404	925.7
These CSOs contributed 91% of the total NEORSD CSO discharge volume between 2019 and 2023.					
These CSOs have been controlled by NEORSD Project Clean Lake prior to 2024.					

Recreation Use Results and Discussion

Attainment of the recreation designated use is determined using *Escherichia coli* (*E. coli*), a fecal-indicator bacteria commonly found in the intestinal tract and feces of warm-blooded animals (USEPA, 2012). The Cuyahoga River sites sampled in 2024 are designated as primary contact recreation according to the Ohio EPA Water Quality Standards (2023b). The primary contact recreation (PCR) criteria consist of two components based on *E. coli* densities. The first is an *E. coli* criterion not to exceed a statistical threshold value (STV) of 410 colony counts or most probable number per 100 milliliters (410 MPN/100ml) in more than ten percent of the samples collected during any 90-day period. The second component is a 90-day geometric mean criterion of 126 MPN/100mL (Ohio EPA, 2023b). In accordance with the Ohio EPA procedure and practice to qualify *E. coli* exceedances for the Primary Recreation criteria, the geometric mean and STV are only calculated and compared when a minimum of five bacteriological samples have been collected within a rolling 90-day period.

The ten locations that were used for the general watershed study were sampled five times each for *E. coli* (Table 6). In addition to these sites, the Southerly WWTC's NPDES permit requires sampling of the Cuyahoga River upstream (SUS; RM 10.95) and downstream (SDS; RM 9.78) of the effluent channel (Table 1 and Figure 1). *E. coli* was collected at these NPDES permit sites twice monthly throughout the recreational season from May through October. The data from this sampling was also used to assess the recreational criteria attainment and is listed in Table 7. When duplicate samples were collected at a sample location, the *E. coli* results are reported as an average.

Exceedances of the 90-day geometric mean bacteriological criteria for primary contact recreation occurred at all sampling locations for the general watershed study with the exception of RMs 0.20 and 1.20 (Table 6). *E. coli* densities at these sites were likely lower due to a combination of dilution from Lake Erie or settling of bacteria-laden sediments, as these zones are located in the lower section of the lacustuary region. Both the STV and geomean criteria were exceeded for the remaining sites. All of the exceedances of the STV criterion occurred during wet-weather events as defined in Table 6. During wet-weather storm events, stormwater runoff from urban areas collects pollutants, and excessive stormwater flows may overwhelm local and interceptor sewers causing I&I, CSOs, and sanitary sewer overflows. It was noted that four out of the five sampling events for the general watershed study occurred during wet-weather events. The wet-weather event resulting in the largest number of exceedances of the STV threshold occurred within 24 hours prior to the July 24, 2024, sampling event with a total precipitation of 1.00 inches.

Figure 3 provides a boxplot of the 2024 *E. coli* results. Median *E. coli* densities increased from upstream to downstream up to RM 5.90. Median *E. coli* densities begin to decrease downstream of RM 5.90, likely due to lacustuary influence. The Wilcoxon Ranked Sum test was used to determine if there was a significant difference in *E. coli* densities between sampling locations. RM 20.75 was used as the upstream control site for comparison. RMs 10.75, 10.10, 5.90, and 2.75 all had significantly elevated *E. coli* densities compared to RM 20.75 when paired by date. RM 5.90 was also compared to the other sites as it had the highest median *E. coli* density in 2024. The results at RM 5.90 were significantly elevated ($p<0.05$, one tailed) compared to all sites except RMs 8.60, 10.10, and 11.30. The elevated *E. coli* densities at this site were likely due to a mixture of anthropogenic sources including common trench I&I, CSOs, sanitary sewer overflows, and urban runoff.

Table 6. *E. coli* Densities (MPN/100mL)							
River Mile	Sample Collection Date					Criterion	
	6/26/24*	7/2/24	7/10/24*	7/16/24*	7/24/24*	90-Day STV Exceedance (%)	90-Day Geomean (MPN/ 100 mL)
20.75	80	88	161	105	687	20	152
13.15	83	142	142	96	1,986	20	200
11.30	186	114	184	142	1,046	20	225
10.75	132	199	2,420	91	1,990	40	409
10.10	114	228	1,120	130	1,710	40	365
8.60	165	199	1,300	104	1,553	40	370
5.90	1,733	361	387	1300	6,700	60	1,161
2.75	276	96	206	328	2,920	20	350
1.20	166	71	38	28	91	0	65
0.20	112	17	178	137	14	0	58
72-hour Rain (in)	0.40	0.14	0.10	0.14	1.00		
48-hour Rain (in)	0.05	0.00	0.10	0.14	1.00		
24-hour Rain (in)	0.05	0.00	0.10	0.01	1.00		

Exceeds statistical threshold value of 410 MPN/100mL.
Exceeds 90-day STV criterion of 10%.
Exceeds 90-day geometric mean criterion of 126 MPN/100mL.

*Wet-weather Event: Samples collected within 72 hours of a rain event with a total precipitation of 0.25 inches or within 48 hours of a rain event with a total precipitation of 0.1 inches.

As discussed above, over 91 % of the historical NEORSD CSO discharge volume originates from outfalls located between RMs 5.10 and 2.90. The impact of these overflows is likely masked by the lacustuary influence of Lake Erie in this reach. It is also possible that *E. coli*-laden particles settle to the substrate under the low-flow conditions within the shipping channel, resulting in the observed decrease in *E. coli* densities observed from RM 2.75 to the confluence. CSO-080 was controlled in 2024 prior to the start of this study. This CSO is located at RM 2.90 and historically contributed an average of 36.3% of the total NEORSD CSO volume to the Cuyahoga River. Notably, two sites downstream of this outfall, RM 1.20 and RM 0.20, met the recreational criteria in 2024. No sites in this region had previously met the recreation criteria in all NEORSD studies that were conducted between 2011 and 2016. The control of CSO-080 may have contributed to this improvement. Continued improvement throughout the lower Cuyahoga River is expected to occur following completion of the Southerly Storage Tunnel, which will control the remaining NEORSD-operated CSOs on the Cuyahoga River.

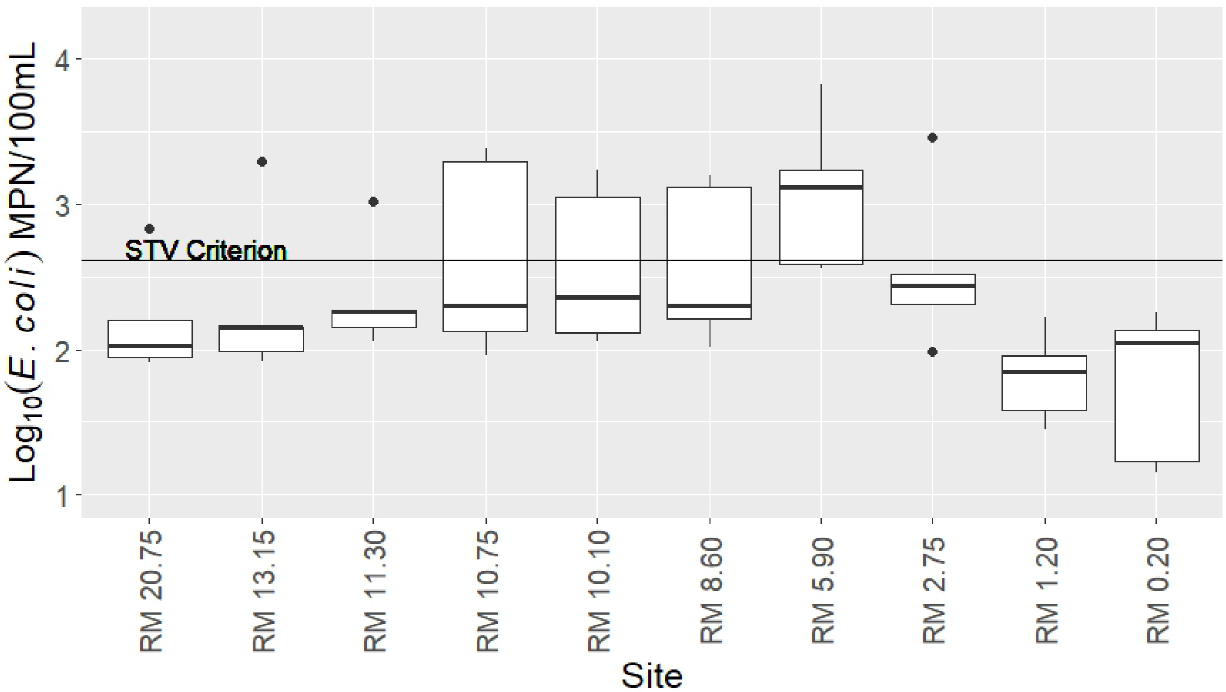

Figure 3. Boxplot of 2024 *E. coli* results by site.

Figure 4 and Table 7 compare *E. coli* results at the upstream (SUS, RM 10.95) and downstream (SDS, RM 9.78) monitoring points on the Cuyahoga River to the recreational criteria. Both sites were in exceedance of the geomean recreational criteria for all applicable 90-day periods. The SDS site met the STV criteria for all 90-day periods, while the SUS site was in exceedance of the STV criteria for all 90-day periods except for the period beginning on May 1, 2024. The Wilcoxon ranked sum test was used to compare the two sites, pairing by date. The upstream site was found to have consistently elevated *E. coli* densities compared to the downstream site ($p<0.05$). This indicates that the Southerly WWTC does not negatively contribute to the elevated *E. coli* densities in the Cuyahoga River. In fact, the effluent appears to have a positive dilutionary influence. This appears to result in lowered *E. coli* densities in the river downstream of the effluent channel, particularly during wet-weather events when there is no active WWTC overflow.

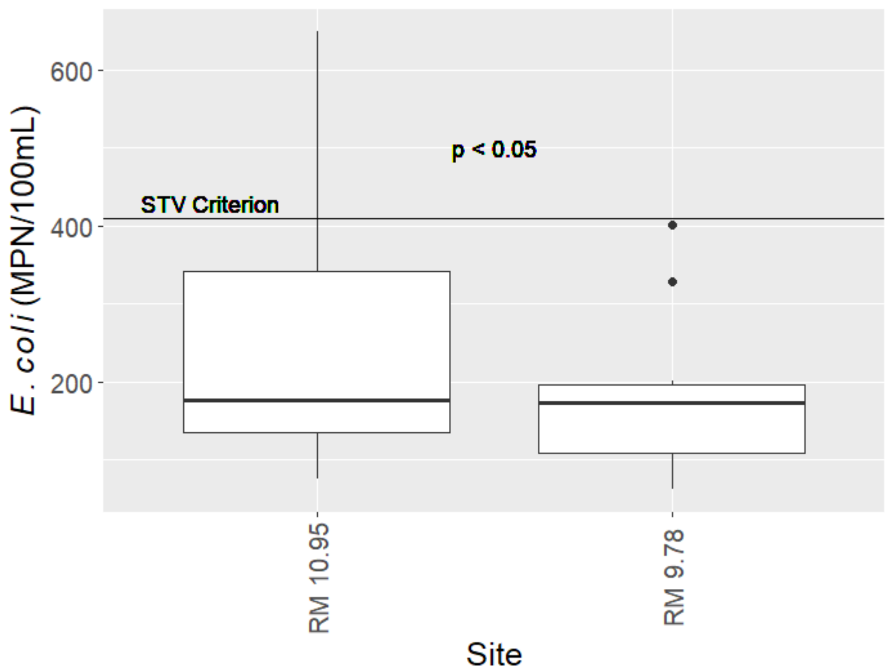

Figure 4. Boxplot of the *E. coli* results at the Cuyahoga River supplemental sampling sites.

Table 7. *E. coli* Densities (MPN/100mL) from NPDES permit sampling						
Date	SUS (RM 10.95)			SDS (RM 9.78)		
	Sample Result	90-Day STV Exceedance %	90-Day Geomean	Sample Result	90-Day STV Exceedance %	90-Day Geomean
5/1/2024	75	0	160	104	0	139
5/15/2024	144	17	227	178	0	168
6/3/2024*	201	33	292	167	0	192
6/17/2024	104	33	280	62	0	183
7/1/2024	192	33	275	194	0	201
7/15/2024*	387	33	300	192	0	202
8/1/2024*	613	33	259	328	0	184
8/15/2024	649	20	218	401	0	163
9/3/2024	156	-	-	124	-	-
9/16/2024	93	-	-	108	-	-
10/1/2024	326	-	-	201	-	-
10/21/2024	161	-	-	108	-	-
Seasonal geomean	204			160		

Exceeds statistical threshold value of 410 MPN/100mL.
Exceeds STV criterion for 90-day period of 10%.
Exceeds geometric mean criterion for 90-day period of 126 MPN/100mL.
*Wet-weather Event

Water Column Chemistry Results and Discussion

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 Non-drinking and Protection of Wildlife Outside Mixing Zone Averages (OMZA), it generally cannot be determined if the sites were 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 river. Mercury was detected in two samples during the wet-weather event on July 24, 2024, at RMs 10.10 and 11.30 (Table 8). Both sample results fell between the MDL and PQL and were therefore qualified as estimated. As the remaining results were all below the MDL, it is not possible to determine if the criteria for mercury were exceeded at these sites.

Table 8. Mercury Results Above the MDL

Date	River Mile	Result (ug/L)	MDL (ug/L)	PQL (ug/L)
7/24/24	10.10	0.016	0.015	0.05
	11.30	0.024	0.015	0.05

Mercury pollution is not uncommon in the Great Lakes region. Coal-fired power plants have historically lined the southern shores of Lake Erie. It was not until 2011 that the US Department of Energy established national standards to control mercury emissions. Three major coal fired power plants in the greater Cleveland area ceased operations in 2015 (Cleveland.com, 2015), as the parent company switched energy sources from coal over to natural gas. A 2018 NEORSD fish tissue study found mercury contamination in fish across the Cleveland Lake Erie shoreline and from fish in the Cuyahoga River (NEORSD, 2020). However, contamination was lower than the US EPA Human Health water quality criterion for methylmercury and an apparent decline in median mercury concentrations was evident. Other sources of mercury to surface waters are from atmospheric deposition, impervious surface runoff (Fulkerson et al., 2007), and other NPDES permitted point sources within the watershed.

On July 16, 2024, the hardness concentrations at RMs 0.20 and 1.20 were unusually low at 36 mg/L at both sites. This was likely due to a combination of dilution from rainfall and strong north winds. The north winds that day may have caused the currents to reverse, leading to dilution from Lake Erie water at these two sites, both located in the lacustuary zone. This drop in hardness caused the Aquatic Life Tier I Outside Mixing Zone Maximum (OMZM) criterion to be below the detection limit for silver. Because of this, it could not be determined if these sites were in attainment of the criterion on that day. However, based on data collected during the other sampling events and past studies, it is not expected that silver contamination is a significant issue at any of the sites.

Nutrients and Comparisons to Proposed Eutrophication Standards

In 2018, the Ohio EPA released an Early Stakeholder Outreach regarding Nutrient Water Quality Standards for Ohio's Large Rivers (≥500 mi^2 drainage area). The proposed eutrophication standards, shown in Table 9, will establish standards based on sestonic chlorophyll *a*, 5-day biochemical oxygen demand (BOD), 24-hour dissolved oxygen (DO) range, total Kjeldahl nitrogen (TKN), and use total suspended solids (TSS) for sites where chlorophyll *a* data is lacking (Ohio EPA, 2018).

The Ohio EPA is also proposing a seasonal average, summer base-flow target level of total TP at 0.130 mg/L as a management target for presently over-enriched waters (Miltner, 2018). This target has been proposed to reduce chlorophyll *a* concentrations to less than 100 µg/L in large rivers. Chlorophyll *a* concentrations greater than 100 µg/L contribute to elevated BOD, large daily DO swings, and a greater concentration of suspended solids; all of which display gross levels of enrichment and suggest a high likelihood of biological enrichment (Miltner, 2018). In addition to these proposed nutrient WQS, nutrient target concentrations remain from the lower Cuyahoga River TMDL (Ohio EPA, 2004). This TMDL lists target criteria for TP at 0.12 mg/L and nitrate-nitrite at 1.42 mg/L. These concentrations were developed from statewide reference, or least impacted sites, as either the 75^{th} percentile (nitrate-nitrite) or concentrations typical of fish IBI scores achieving attainment (TP) (Ohio EPA, 1999). The proposed WQS seasonal phosphorus average will be used in lieu of the TMDL target criterion since it represents the most recent criteria.

Table 9. Ohio EPA Proposed Eutrophication Standards for Ohio's Large Rivers

	Acceptable	Enriched or Over Enriched	Over Enriched
Indicator		Chronic Condition	Acute Condition
Sestonic Chlorophyll	< 30 µg/L as seasonal average	Magnitude 30 < 100µg/L seasonal average with biological impairment Frequency ≥ 30 µg/L < 100µg/L as seasonal average in two of three years	Magnitude ≥ 100µg/L anytime with biological impairment Frequency ≥ 100µg/L multiple observations at base flow
BOD5	< 2.5 mg/L as seasonal average	Magnitude ≥ 2.5mg/L < 6mg/L seasonal average with biological impairment Frequency ≥ 2.5mg/L < 6mg/L seasonal average in two of three years	Magnitude ≥ 6mg/L anytime with biological impairment and seasonal average chlorophyll ≥ 30µg/L Frequency ≥ 6mg/L two or more times during the base flow period
24-hour D.O. Range	< 6.5 mg/L	≥ 7mg/L - 9mg/L (default to chlorophyll, BOD5 and biological indicators)	Magnitude and Frequency ≥ 9.0mg/L anytime with biological impairment
TKN	N/A	N/A	≥ 0.75mg/L may substitute for BOD5

Table 9. Ohio EPA Proposed Eutrophication Standards for Ohio's Large Rivers			
	Acceptable	Enriched or Over Enriched	Over Enriched
Indicator		Chronic Condition	Acute Condition
TSS		~ 20mg/L; general screening level of inspection of data sets lacking chlorophyll observations.	

Applicable parameter results from 2024 were applied to the above proposed eutrophication standards for comparative purposes only. All data for the five watershed sampling events occurred during baseline flows as recommended in the proposed eutrophication standards method. The twelve sampling events conducted for NPDES permit monitoring at SUS and SDS during the recreational season were collected under a variety of flow conditions with six samples collected near baseline flows.

TKN seasonal geomean levels at all twelve sample locations exceeded the "enriched or over enriched acute condition" criterion for the proposed eutrophication standards (Table 10). Nine of the sample locations also exceeded the proposed TP target of 0.130 mg/L. All sampling locations exceeded the nitrate-nitrite TMDL target concentration. Two sites within the ship channel had geomean TSS results above the target. Two additional sites had elevated BOD, with geomeans of 2.56 and 2.50 mg/L. None of the individual BOD results were above 6.0 mg/L, indicating the elevated BOD would be characterized as a chronic condition rather than acute over enrichment.

Table 10. Nutrient Analysis (Geometric Means*)

River Mile	N	TKN (mg/L)	NO_3-NO_2 (mg/L)	DRP (mg/L)	TP (mg/L)	TSS (mg/L)	BOD (mg/L)
20.75	5	0.832	5.10	0.125	0.197	7.6	2.39
13.15	5	0.850	5.02	0.102	0.140	11.4	2.17
11.30	5	0.873	4.99	0.094	0.146	10.3	2.21
10.95 (SUS)	12	0.869	4.03	0.045	0.089	11.8	2.28
10.75	5	0.848	4.90	0.090	0.128	12.0	2.36
10.10	5	0.859	6.64	0.177	0.194	13.4	2.37
9.78 (SDS)	12	0.851	5.32	0.131	0.153	9.3	2.10
8.60	5	0.879	6.46	0.166	0.231	9.9	2.50
5.90	5	1.001	6.27	0.150	0.198	18.2	2.56
2.75	5	1.051	5.28	0.108	0.170	22.6	2.46
1.20	5	1.022	4.72	0.105	0.153	16.3	2.44
0.20	5	0.967	3.66	0.074	0.125	22.9	2.14

Enriched/Over Enriched
Exceeds Nitrate-nitrite TMDL target criterion (1.42 mg/L).
*n = 5

The TSS results greater than 20 mg/L are likely indicative of suspended sediments from elevated stream flows and not necessarily sestonic chlorophyll *a*. The NEORSD Lake Erie Nutrient Study monitors trends of nutrients and chlorophyll *a* concentrations in Lake Erie near Cleveland and in three of its major tributaries. Historical sestonic chlorophyll data from the five-year period between 2018 to 2023 support this hypothesis as concentrations in the Cuyahoga River have averaged 9.2 ug/L at RM 10.95 (upstream of SWWTC effluent) and 7.80 ug/L at RM 0.20, well below the 30 mg/L WQS seasonal average.

Table 11 provides a statistical summary of the nutrient concentrations of the Southerly WWTC effluent throughout the 2024 recreational season. Of these parameters, TP is often considered a limiting nutrient for nuisance algae growth. Ohio Administrative Code Chapter 3745-1-37 sets the phosphorus effluent limits for Ohio POTWs at 1.00 mg/L (Ohio EPA, 2017). This limit was met by the Southerly WWTC throughout the entirety of the 2024 recreational season. The average TP concentration of the Southerly WWTC effluent was 0.54 mg/L with a range of 0.19 to 1.00 mg/L. Figure 5 provides a boxplot of the TP results from the 2024 general watershed study. A Wilcoxon signed rank test was used to compare TP concentrations downstream of the Southerly WWTC to concentrations in the Cuyahoga Valley National Park. There was no significant difference between either RM 20.75 or 13.15 and any other downstream site in terms of TP concentrations. This demonstrates that the distributions of phosphorus concentrations were similar downstream of the Southerly WWTC (RMs 10.10 and lower) compared to upstream sites.

Table 11. Southerly WWTC Effluent Nutrient Concentration Statistics

Parameter	n	Mean	Minimum	Maximum
TP	183	0.54	0.19	1.00
TKN	26	0.85	0.50	1.52
NO3-NO2	131	12.33	6.23	16.60

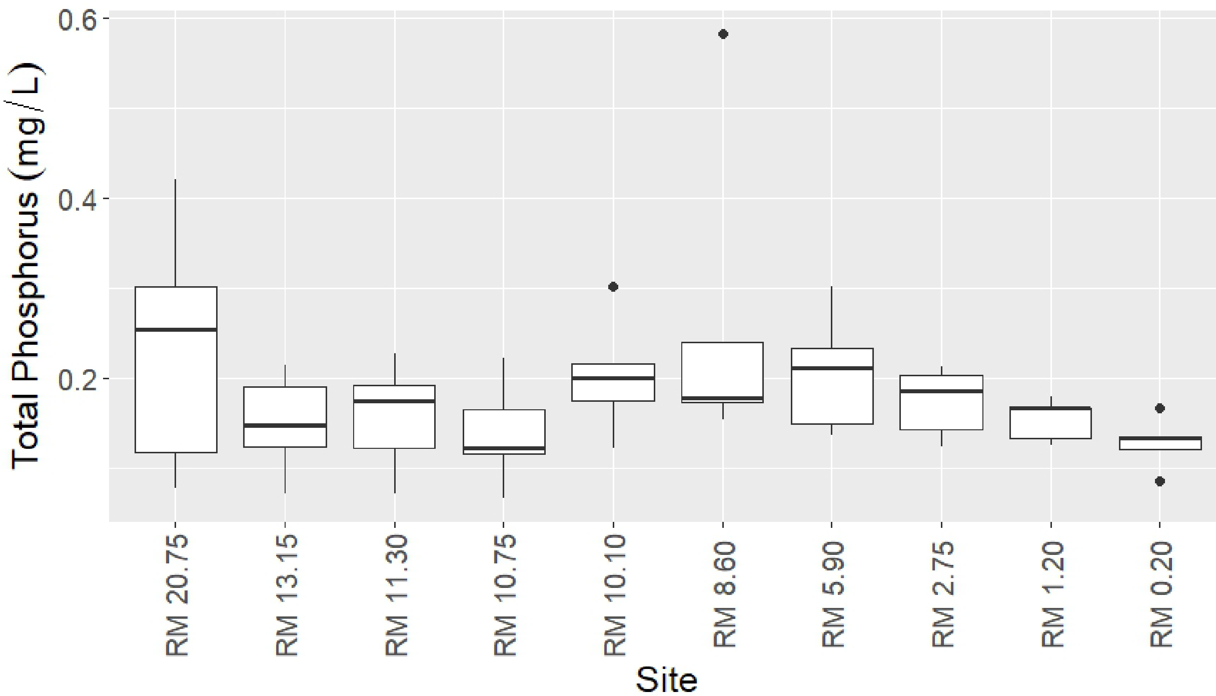

Figure 5. Boxplot of TP concentrations in 2024.

Additional statistical analysis for TP between the two NPDES permit sampling points was conducted to determine the TP contribution of the Southerly WWTC. A Wilcoxon signed rank test was used to compare TP concentrations between the SUS and SDS sites (Figure 6). Between these two sites, TP concentrations were significantly elevated downstream of the Southerly WWTC ($p < 0.001$). This demonstrates that there is a local shift to elevated TP concentrations downstream of the Southerly WWTC in the short stretch of river surrounding the WWTC. However, as discussed above, TP concentrations downstream of the Southerly WWTC were similar to upstream conditions in the Cuyahoga Valley National Park. Numerous other major and minor wastewater treatment plant discharges are also located within the Cuyahoga River watershed (ex: Akron, Bedford, Twinsburg, Aurora). All WWTCs within the Cuyahoga River watershed contribute to the overall wasteload allocation, and inevitably, the overall nutrient enrichment of the watershed. However, there is no evidence suggesting that the nutrient concentrations in the Cuyahoga River are resulting in a state of nuisance algae growth or eutrophication.

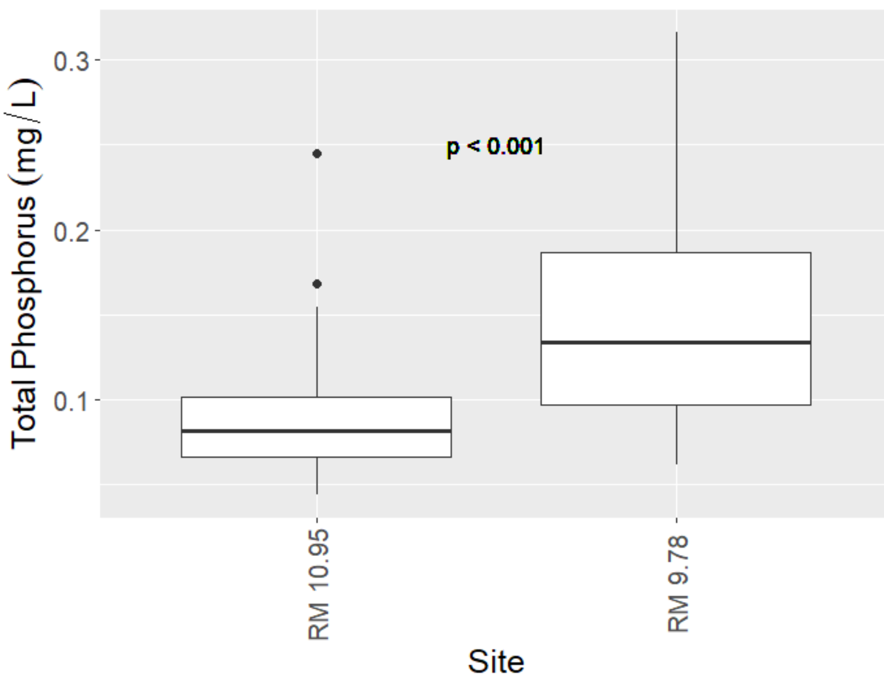

Figure 6. Boxplot of the TP results at the Cuyahoga River supplemental sampling sites.

Daily ranges in DO swings are known to increase with increasing chlorophyll *a* concentrations through photosynthesis and respiration. Daily DO swings of greater than 6.5 mg/L are therefore considered indicative of eutrophication (Miltner, 2018). Instantaneous DO measurements were collected on the Cuyahoga River every 30 minutes by a YSI EXO2 data sonde at USGS gage #04208000 in Independence, OH (RM 13.08). Figure 7 provides DO and stream flow measurements over time during the 2024 recreational season of May 1 through October 31. Compiled with NEORSD data sonde field observations, no WQS exceedances were observed for daily OMZ minimum DO concentrations. The minimum, mean, and maximum DO concentrations in the 2024 recreational season were 5.7, 8.4, and 13.2 mg/L, respectively.

DO swings are typically highest during periods of low flow and low turbidity which increases light penetration and algal growth. This is apparent in Figure 7 which shows decreased DO swings on the Cuyahoga River during periods of elevated flow. No DO swings in the 2024 recreational season exceeded the 6.5 mg/L target, indicating no eutrophication despite nutrient concentrations being above eutrophication targets. The minimum, mean, and maximum daily DO swings in the 2024 recreational season were 0.3, 2.1, and 4.9 mg/L, respectively. As TP concentrations were found to be similarly distributed throughout the NEORSD service area on the Cuyahoga River, this indicates that there is not a risk of eutrophication due to nutrient concentrations.

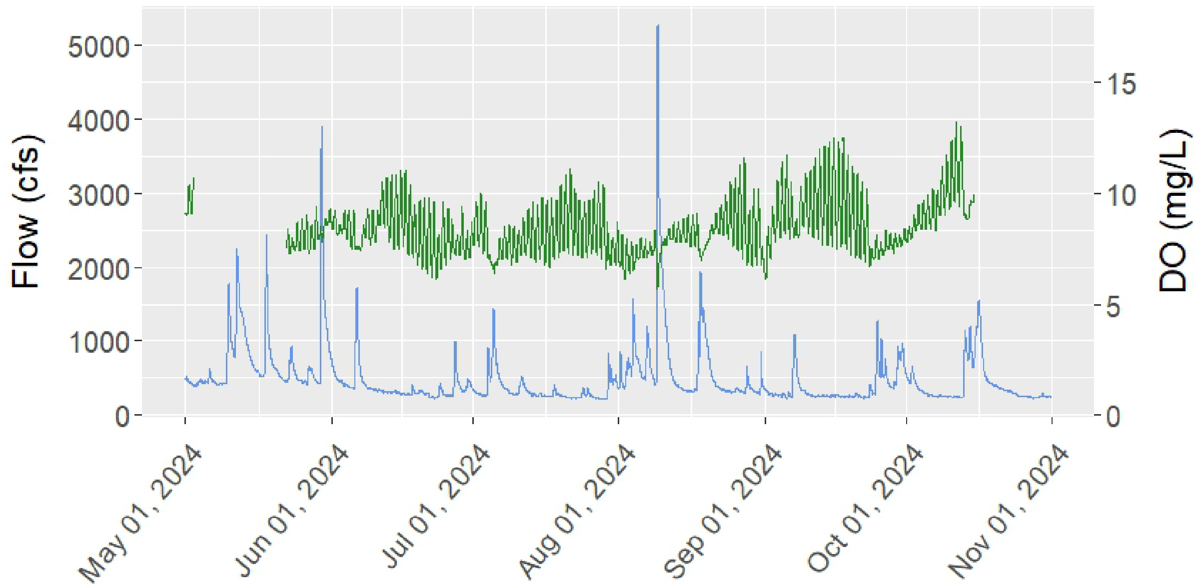

Figure 7. Effects of river flow on DO concentrations.

Habitat Assessment

Methods

Instream habitat assessments were conducted once at each site from RM 13.15 to RM 0.20 in 2024 (Table 1) using the Qualitative Habitat Evaluation Index (QHEI). No QHEI assessment was performed at RM 20.75 as the site could not be accessed for a fish survey due to lack of boat access. The Cuyahoga River Ship Channel begins at RM 5.60. The downstream end of RM 5.90 ends at RM 5.40 placing this site within the section designated as ship channel. The WWH target does not apply to the Cuyahoga River ship channel sites at RMs 5.90, 2.70, 1.20, and 0.20 as these sites are designated as Limited Resource Waters. QHEI scores at these sites were compared to WWH expectations for comparative purposes only.

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. Some of the habitat metrics used to determine a QHEI score include type(s) and quality of substrates, amount and quality of in-stream cover, channel morphology, extent and quality of riparian vegetation, pool and riffle development and quality, and stream gradient (Ohio EPA, 1989). The QHEI can be used to assess and evaluate a stream's aquatic habitat and determine which of the six habitat components need to be improved to reach the QHEI target score.

The QHEI has a maximum score of 100, and a score greater than 60 on streams with >20 mi^2 drainage area suggests that sufficient habitat exists to support a fish community that attains the warmwater habitat criterion (Ohio EPA, 2006). Scores greater than 75 frequently demonstrate habitat conditions that can support exceptional warmwater fish communities. 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.

Various attributes of stream habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional fish communities. Individual components of the QHEI can be used to evaluate whether a site can meet its warmwater habitat (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 a 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).

Results and Discussion

The Cuyahoga River lies entirely within the Erie/Ontario Drift and Lake plains ecoregion, within the glaciated portion of Northeast Ohio. The lower 13 river miles fall within the Erie Lake Plains sub-ecoregion. This sub-ecoregion is a nearly level coastal strip of lacustrine deposits punctuated by beach ridges and swales (USEPA, 2012). The predominately sand and gravel substrates and moderate gradient typically encountered throughout the lower 13 river miles of the Cuyahoga up to the ship channel reflect the general characteristics of this sub-ecoregion. Upstream of RM 13.00 is the lower section of the Erie Gorge sub-ecoregion, which is uniquely steep with rock exposures and high fluvial erosion rates. The RM 13.15 location is also located at the northernmost, downstream end of the Cuyahoga Valley National Park (CVNP). The section from river mile 5.60 to the mouth of the Cuyahoga River is designated as ship channel. This section consists primarily of a deep pool-like channel with sparse instream cover and primarily silt/muck substrates.

Figure 8 displays the QHEI scores from the most recent five-year period with respect to RM and the overall habitat targets. Table 11 provides a summary of QHEI scores and physical attributes. All sites between and including RMs 8.60 and 13.15 exceeded the Ohio EPA's target score of 60 for WWH in 2024. This suggests that sufficient instream habitat exists to support a warmwater fish assemblage at these sites. These sites possessed physical attributes supporting WWH targets including absence of current or historical channelization, stable substrates, adequate pool depths, good riffle/run/pool complex development, and fast currents. The moderate to sparse instream cover consisted of deep pools, woody debris, boulders, root wads, and shallows. Additionally, all sites displayed predominately sand and gravel substrates, glacial till substrate origin, and moderate to normal siltation. QHEI scores at these sites ranged from 65 (*Good*) to 81 (*Excellent*), with a mean score of 73.9. Three sites, RM 13.15, RM 10.75, and RM 8.60, all had QHEI scores >75, which resulted in narrative ratings of *Excellent*. These results were similar to results from the previous four years.

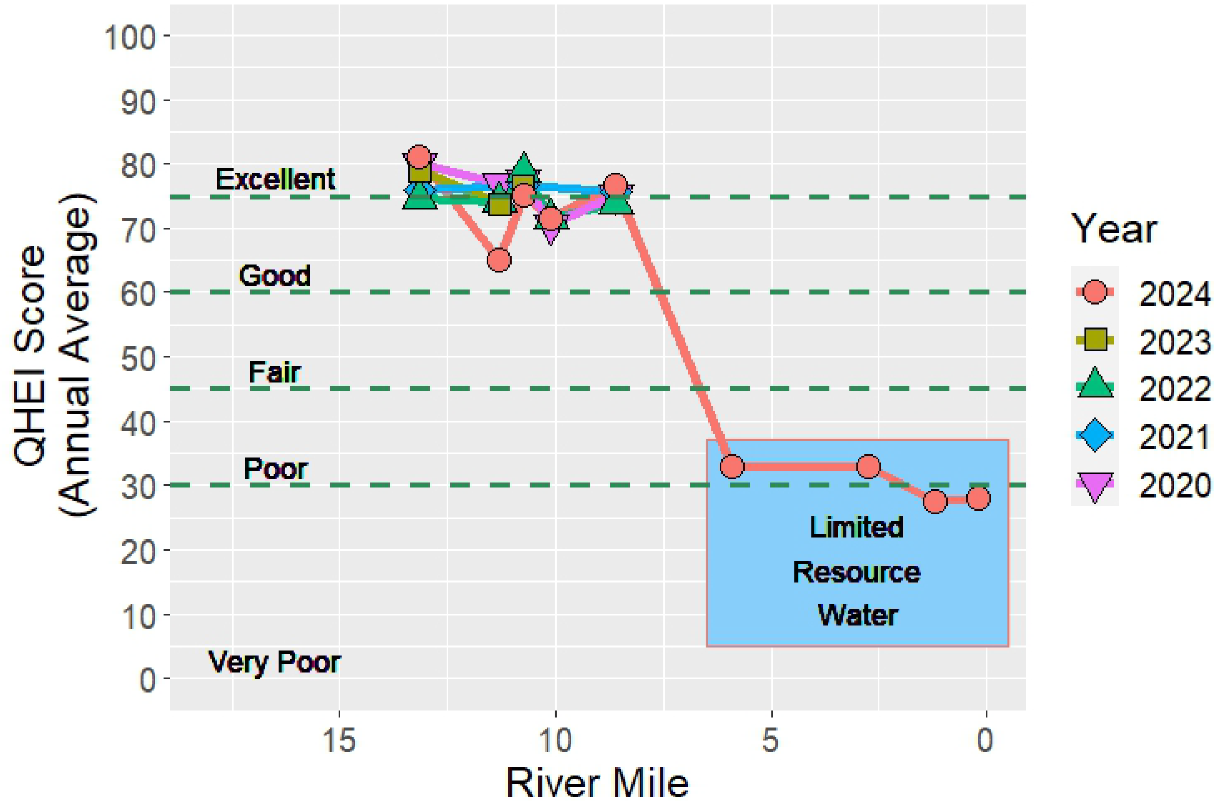

Figure 8. Longitudinal fish habitat QHEI scores Cuyahoga River mainstem 2024.

The sites between and including RMs 5.90 and 0.20 fall within the area designated as the Cuyahoga River ship channel. The WWH target does not apply to these sites and the QHEI score was applied for comparative purposes only. These sites lacked physical attributes supporting WWH targets. Substrate types consisted of silt and muck. Sparse instream cover in these sections primarily consisted of pools, boulders, and logs or woody debris. These sites are within the lacustuary region of the Cuyahoga River and completely lack riffles and fast-moving currents. The QHEI scores at RMs 5.90 through 0.20 ranged from 27.5 (*Very Poor*) to 33 (*Poor*) in 2024. This indicates insufficient habitat to support a warmwater fish assemblage at these sites.

Based on this information, all sites evaluated in 2024 are impacted by silt sedimentation, and its correlating negative effects on in-stream substrate seem to be the most significant limiting factor to the fish communities living within the lower Cuyahoga River. These problems may have many root causes. The removal of the Station Road Dam at RM 20.70, although important in restoring the stream biologically, seems to have had a temporary negative effect on sedimentation issues throughout the river downstream of the dam. This problem will likely remediate itself, but the river will take time to assimilate the excess sediment load. Urban and industrial land use borders the Cuyahoga River throughout most of the lower 13 miles once the river exits the CVNP. This results in a loss of riparian habitat and floodplain access. Influences from other highly urbanized major tributaries throughout the lower Cuyahoga River (Tinkers Creek, Mill Creek, and West Creek) may also be a factor resulting in excess sedimentation through higher peak flows and increased erosion rates.

The NEORSD has been conducting QHEI surveys on the Cuyahoga River as part of the Credible Data Program since 2006. Figure 9 shows all historical QHEI results conducted by the NEORSD on the Cuyahoga River over the last nineteen years. This graph provides QHEI scores over time with RM represented as a color gradient. QHEI scores have remained fairly consistent with respect to river mile over the course of the last two decades. QHEI scores upstream of the ship channel consistently scored in the *Good* to *Excellent* range with few exceptions. QHEI scores within the ship channel have remained in the *Poor* to *Very Poor* range as expected.

Figure 9. Historical NEORSD QHEI Scores for the Cuyahoga River.

Table 12. QHEI Scores and Physical Attributes.

			WWH Attributes											MWH Attributes																				
														High Influence						Moderate Influence														
River Mile	QHEI Score	Narrative Rating	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	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 Substrate (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 Attributes**	**(MWH-H.I.+1) / (WWH+1) Ratio**	**(MWH M.I.+1) / (WWH+1) Ratio**
13.15	81.00	*Excellent*	X	X		X	X	X	X	X	X	X	**10**						**0**		X											**1**	**0.1**	**0.2**
11.30	65.00	*Good*	X	X		X			X		X		**5**				X		**1**		X				X				X	X		**4**	**0.3**	**0.8**
10.75	75.25	*Excellent*	X	X		X	X	X	X		X	X	**8**						**0**		X								X	X		**3**	**0.1**	**0.4**
10.10	71.50	*Good*	X	X					X	X	X	X	**7**				X		**1**					X	X							**2**	**0.3**	**0.4**
8.60	76.75	*Excellent*	X	X		X	X	X	X		X		**7**						**0**		X								X	X		**3**	**0.1**	**0.5**
5.90	33.00	*Poor*									X		**1**	X	X		X		**3**		X			X	X			X	X		X	**6**	**2.0**	**3.5**
2.75	33.00	*Poor*									X		**1**	X	X		X		**3**		X			X	X			X	X		X	**6**	**2.0**	**3.5**
1.20	27.50	*Very Poor*									X		**1**	X	X		X		**3**		X			X	X			X	X		X	**6**	**2.0**	**3.5**
0.20	28.00	*Very Poor*									X		**1**	X	X	X	X		**4**		X			X				X	X		X	**5**	**2.5**	**3.0**

Fish Community Biology Assessment

Methods

Two quantitative electrofishing assessments were conducted at each site in 2024 except for RMs 0.20 and 1.20 where only a single pass was conducted. A list of dates when the surveys were completed, along with approved flow measurements from the USGS gage station in Independence, are shown in Table 13. Sampling was conducted using boat electrofishing techniques and consisted of shocking all habitat types within a sampling zone while moving from upstream to downstream by slowly and steadily maneuvering the boat as close to shoreline and submerged habitat as possible. The sampling zone was 0.50 kilometers for each site and followed the Ohio EPA 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.

Table 13. Fish Survey Dates and River Flows

Date	Sites sampled (River Mile)	Daily Mean Flow (CFS)
7/3/2024	11.30, 13.15	268
7/8/2024	1.20, 2.75	324
7/9/2024	5.90, 8.60	284
7/23/2024	0.20	236
8/15/2024	5.90	327
8/23/2024	10.10, 10.75	335
8/30/2024	11.30, 13.15	299
10/8/2024	10.10, 10.75	255
10/9/2024	2.75, 8.60	249

The electrofishing results were compiled and utilized to evaluate fish community health through the application of two Ohio EPA indices. The first index, the Index of Biotic Integrity (IBI), incorporates twelve community metrics representing structural and functional attributes (Table 14). The structural attributes are based upon fish community aspects such as fish abundance and diversity. The 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*.

Table 14. IBI Metrics (Boat Sites)
Total Number of Indigenous Fish Species
Percent Round-bodied Suckers
Number of Sunfish Species
Number of Sucker Species
Number of Intolerant Species
Percent Tolerant Species
Percent Omnivore Species
Percent Insectivore Species
Percent of Top Carnivore Species
Number of Individuals in a Sample
Percent of Simple Lithophilic Spawners
Percent of Individuals with DELTs

The second fish index used by the Ohio EPA is the Modified Index of Well-Being (MIwb). The MIwb (calculated using Formula 1 below) incorporates four fish community measures: numbers of individuals, biomass, the Shannon Diversity Index ($\overline{H}$) (Formula 2 below) based on sample numbers, and the Shannon Diversity Index ($\overline{H}$) based on sample weights.

Formula 1: $$MIwb = 0.5\ lnN + 0.5\ lnB + \overline{H}(No.) + \overline{H}(Wt.)$$

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

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

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

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

n_i = Relative numbers or weight of species

N = Total number or weight of the sample

The Cuyahoga River is located completely within the Erie-Ontario Lake Plains (EOLP) ecoregion and follows the EOLP fish community metrics scoring. The WWH IBI scoring criterion in the EOLP ecoregion is shown in Table 15, and a site is considered within non-significant departure if the score falls within 4 IBI units or 0.5 MIwb units of the criterion. Lists of the species diversity, abundance, 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.

Table 15. Fish Community Biology Scores for Boat Sites in the EOLP Ecoregion							
Ohio EPA Narrative	Very Poor	Poor	Fair	Marginally Good	Good	Very Good	Exceptional
IBI Score	12-15	16-25	26-35	36-39	40-43	44-47	48-60
MIwb Score	0-4.9	5.0-6.3	6.4-8.1	8.2-8.6	8.7-9.0	9.1-9.5	≥ 9.6
Ohio EPA Status	Non-Attainment			NSD	Attainment		
NSD – Non-Significant Departure of WWH attainment							

Results and Discussion

The NEORSD conducted sixteen electrofishing passes at nine sites on the Cuyahoga River in 2024. Figures 10 and 11 compare the IBI and MIwb scores at each site to results from the previous four years. There were no recent results for comparison in the ship channel as this area was last surveyed in 2016.

IBI scores were within non-significant departure (NSD) of the WWH criterion for four of the five sites upstream of the ship channel. RM 10.10 failed to meet the WWH criterion with an IBI score of 34 (*Fair*). RMs 8.60 and 10.75 both had IBI scores of 38 (*Marginally Good*), which is within NSD of the WWH criterion. RMs 11.30 and 13.15 had IBI scores of 40 and 42 (*Good*), respectively. MIwb scores at these sites ranged from 8.2 (*Good*) to 9.7 (*Exceptional*). The scores for both indices from the most recent five years for these sites showed similarly high interannual variability, with no discernible patterns with respect to changes over time. The reason for this variability is unclear.

Average IBI scores within the ship channel were all *Fair*, which does not meet the WWH criterion. However, because these sites are designated LRW, which has a target of exceeding *Very Poor* biological scores, they were considered to be in attainment of that use (Ohio EPA, 1987b). The MIwb scores at the ship channel sites ranged from *Fair* to *Marginally Good*. As with the IBI scores, these were also considered to be in attainment of the LRW use.

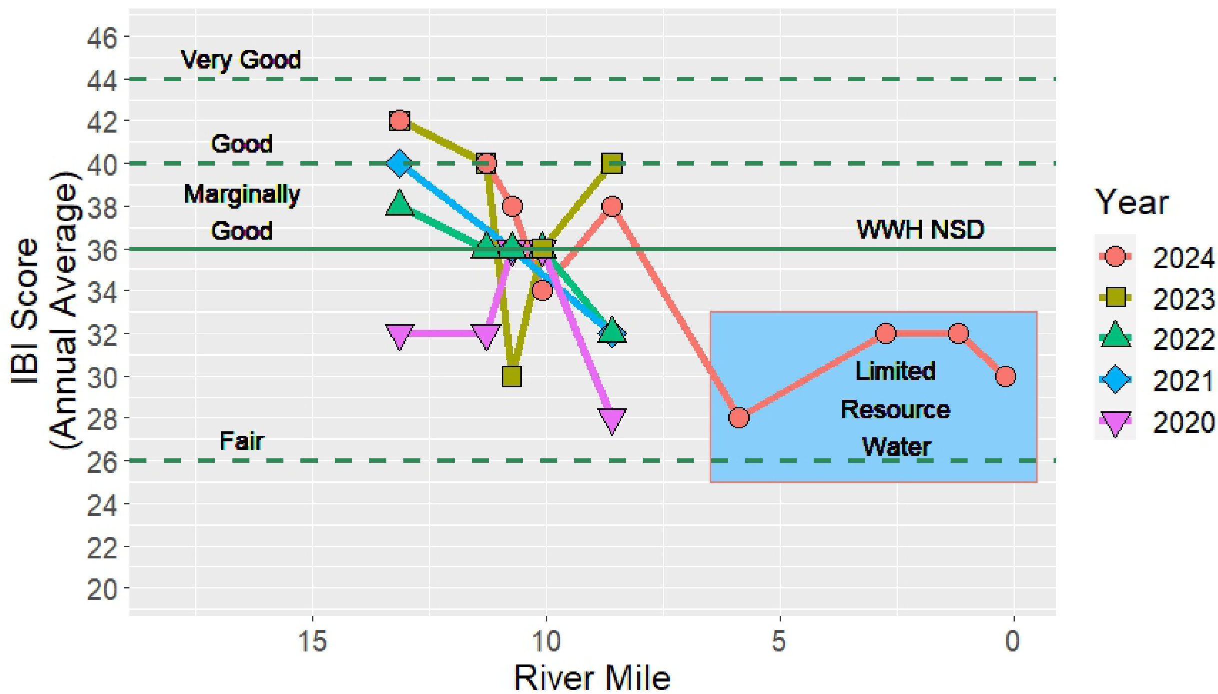

Figure 10. Cuyahoga River NEORSD Fish IBI scores from the last five years.

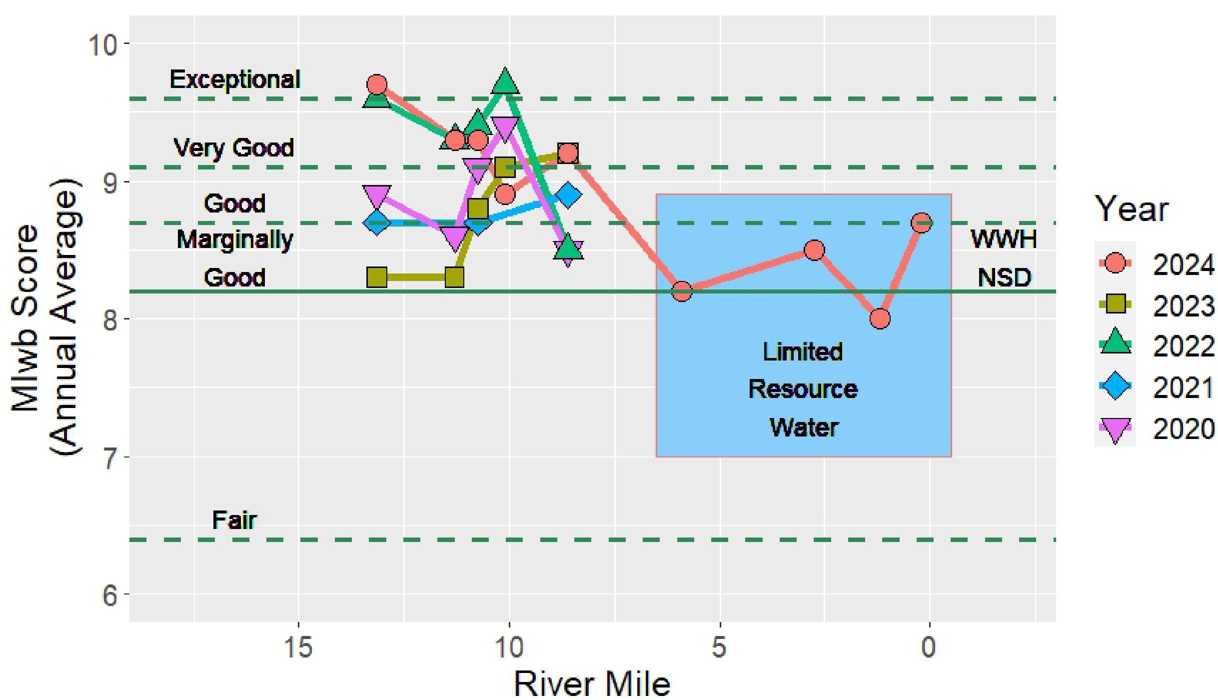

Figure 11. Cuyahoga River NEORSD Fish MIwb scores from the last five years.

A total of 55 fish species were collected on the Cuyahoga River in 2024. Table 16 provides the species list including whether the species was collected within the ship channel or upstream, species pollution tolerance categories, total counts, and total biomass (kg). There were 50 species collected within the sites upstream of the ship channel and 37 collected within the ship channel. Within all sites the most predominant species by fish count were Sand Shiner (*Notropis stramineus*) (13.7%), Common Shiner (*Notropis cornutus*) (11.3%), and Central Stoneroller Minnow (*Campostoma anomalum*)(9.9%). The most predominant species by biomass within all sites were Common Carp (*Cyprinus carpio*) (28.4%), Flathead Catfish (*Pylodictis olivaris*) (9.6%), and Smallmouth Bass (*Micropterus dolomieui*) (8.5%). The three most predominant species upstream of the ship channel by fish count were Sand Shiner (16.7%), Common Shiner (13.3%) and Central Stoneroller Minnow (11.7%). The three predominant species by biomass upstream of the ship channel were Smallmouth Bass (13.6%), Common Carp (12.2%), and Northern Hog Sucker (*Hypentelium nigricans*) (11.64%). Within the ship channel the three predominant species by fish count were Eastern Gizzard Shad (*Dorosoma cepedianum*) (31.2%), Common Emerald Shiner (*Notropis atherinoides*) (10.7%), and Northern Bluegill Sunfish (*Lepomis macrochirus*) (7.0%). The three predominant species by biomass within the ship channel were Common Carp (47.8%), Bigmouth Buffalo (*Ictiobus cyprinellus*) (16.1%), and Flathead Catfish (7.6%). Ten moderately intolerant and three intolerant species were collected upstream of the ship channel. Six moderately intolerant and one intolerant species were collected within the ship channel.

Table 16. 2024 Cuyahoga River Fish Species List

Common Name	Species Name	Pollution Tolerance	Fish Count	Total Mass (kg)	Ship Channel	Upstream of Ship Channel
Bigmouth Buffalo	*Ictiobus cyprinellus*	--	6	35.153	X	
Bigmouth Shiner	*Notropis dorsalis*	--	1	0.003		X
Blacknose Dace	*Rhinichthys atratulus*	Tolerant	19	0.023	X	X
Bluntnose Minnow	*Pimephales notatus*	Tolerant	279	0.586	X	X
Bowfin	*Amia calva*	--	1	1.23	X	
Brook Silverside	*Labidesthes sicculus*	Moderately Intolerant	2	0.005		X
Central Quillback Carpsucker	*Carpiodes cyprinus*	--	12	0.953	X	X
Central Stoneroller Minnow	*Campostoma anomalum*	--	526	1.712	X	X

Table 16. 2024 Cuyahoga River Fish Species List

Common Name	Species Name	Pollution Tolerance	Fish Count	Total Mass (kg)	Ship Channel	Upstream of Ship Channel
Channel Catfish	*Ictalurus punctatus*	--	24	31.468	X	X
Common Carp	*Cyprinus carpio*	Tolerant	55	136.036	X	X
Common Emerald Shiner	*Notropis atherinoides*	--	130	0.391	X	X
Common Shiner	*Notropis cornutus*	--	603	2.492	X	X
Common White Sucker	*Catostomus commersonii*	Tolerant	443	11.595	X	X
Creek Chub	*Semotilus atromaculatus*	Tolerant	29	0.124	X	X
Eastern Gizzard Shad	*Dorosoma cepedianum*	--	423	31.582	X	X
Flathead Catfish	*Pylodictis olivaris*	--	21	46.167	X	X
Freshwater Drum	*Aplodinotus grunniens*	Moderately Tolerant	12	19.913	X	X
Golden Redhorse	*Moxostoma erythrurum*	Moderately Intolerant	88	4.284	X	X
Golden Shiner	*Notemigonus crysoleucas*	Tolerant	41	0.636	X	
Goldfish	*Carassius auratus*	Tolerant	13	4.44	X	
Grass Carp	*Ctenophargngodon idella*	--	3	22.533		X
Green Sunfish	*Lepomis cyanellus*	Tolerant	19	0.362	X	X
Green Sunfish X Hybrid	HYBRID	--	1	0.05		X
Greenside Darter	*Etheostoma blenniodes*	Moderately Intolerant	57	0.605		X
HYBRID X Sunfish	HYBRID	--	3	0.152		X
Johnny Darter	*Ethestoma nigrum*	--	17	0.024		X
Largemouth Bass	*Micropterus salmoides*	--	41	4.437	X	X
Mimic Shiner	*Notropis volucellus*	Intolerant	40	0.064	X	X
Northern Bluegill Sunfish	*Lepomis macrochirus*	Moderately Tolerant	84	5.888	X	X
Northern Fathead Minnow	*Pimephales promelas*	Tolerant	43	0.14		X

Table 16. 2024 Cuyahoga River Fish Species List

Common Name	Species Name	Pollution Tolerance	Fish Count	Total Mass (kg)	Ship Channel	Upstream of Ship Channel
Northern Hog Sucker	*Hypentelium nigricans*	Moderately Intolerant	220	30.379		X
Northern Logperch Darter	*Percina caprodes*	Moderately Intolerant	148	1.696	X	X
Northern Pike	*Esox lucius*	--	2	3.088		X
Northern Rockbass	*Ambloplites rupestris*	--	17	1.974	X	X
Pumpkinseed Sunfish	*Lepomis gibbosus*	Moderately Tolerant	21	0.543	X	X
Rainbow Darter	*Ethestoma caeruleum*	Moderately Intolerant	31	0.042	X	X
Rainbow Trout	*Oncorhynchus mykiss*	--	1	1.814		X
Redear Sunfish	*Lepomis microlophus*	--	1	0.06		X
Rosyface Shiner	*Notropis rubellus*	Intolerant	30	0.064		X
Round Goby	*Neogobius melanostomus*	--	158	0.723	X	X
Sand Shiner	*Notropis stramineus*	Moderately Intolerant	728	1.486	X	X
Shorthead Redhorse	*Moxostoma macrolepidotum*	Moderately Intolerant	162	10.634	X	X
Silver Redhorse	*Moxostoma anisurum*	Moderately Intolerant	11	13.281		X
Silverjaw Minnow	*Ericymba buccata*	--	40	0.082		X
Smallmouth Bass	*Micropterus dolomieui*	Moderately Intolerant	246	40.866	X	X
Spotfin Shiner	*Cyprinella spiloptera*	--	407	1.81	X	X
Spotted Sucker	*Minytrema melanops*	--	15	1.715	X	X
Stonecat Madtom	*Noturus flavus*	Intolerant	1	0.021		X
Walleye	*Sander vitreus*	--	2	0.715	X	X
Warmouth Sunfish	*Lepomis gulosus*	--	2	0.105	X	X

Table 16. 2024 Cuyahoga River Fish Species List						
Common Name	Species Name	Pollution Tolerance	Fish Count	Total Mass (kg)	Ship Channel	Upstream of Ship Channel
Western Mosquitofish	*Gambusia affinis*	--	1	0.003		X
White Bass	*Morone chrysops*	--	27	4.22	X	X
White Perch	*Morone americana*	--	7	0.172	X	X
Yellow Bullhead	*Ictalurus natalis*	Tolerant	3	0.191		X
Yellow Perch	*Perca flavescens*	--	3	0.3	X	

The NEORSD has been conducting fish surveys as part of the Ohio EPA Credible Data Program since 2006. Figures 12 and 13 show all historical NEORSD IBI and MIwb data for the Cuyahoga River over time with RM represented as a color gradient. These visualizations show that while there has been little change in fish community scores over time upstream of the ship channel, there has been a trend towards improvement within the ship channel. Historically, scores within the *Poor* range were common within the ship channel. In 2024, IBI narrative rating scores within the ship channel were all *Fair* to *Good* while MIwb scores have ranged from *Fair* to *Good*. It should be noted that this may not be a statistically significant change. There are too few data points to determine statistical significance, and these sites have demonstrated high interannual variability in fish metric scores over time.

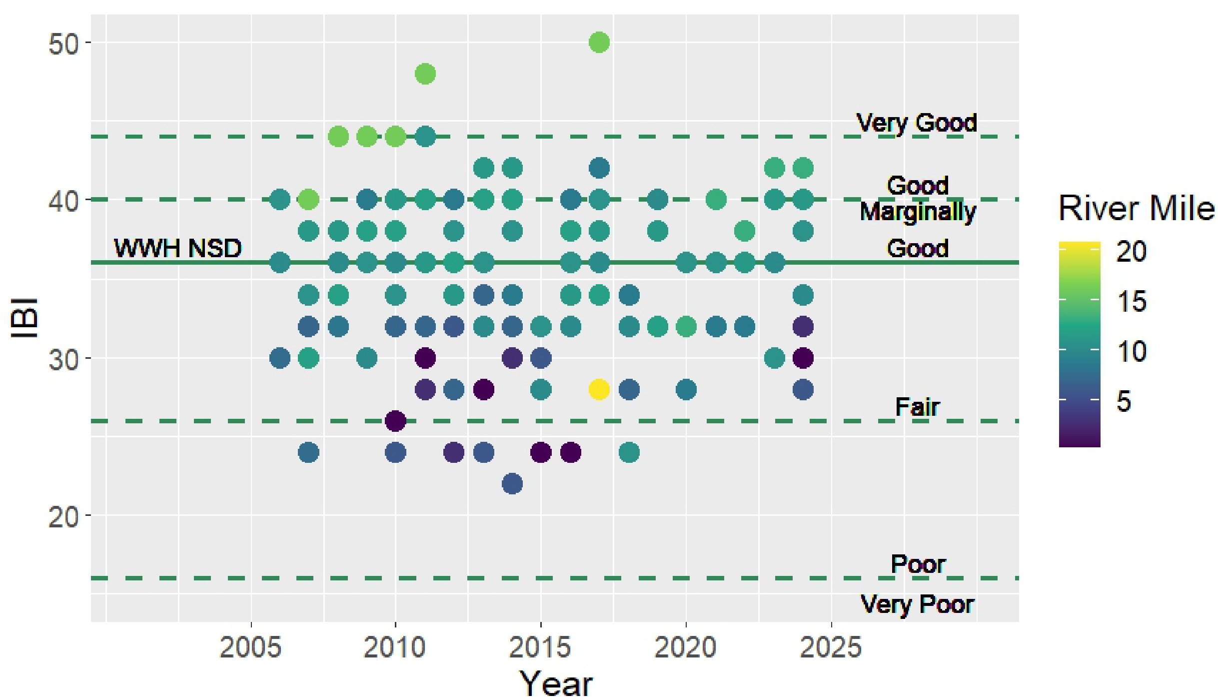

Figure 12. Cuyahoga River Historical NEORSD Fish IBI scores.

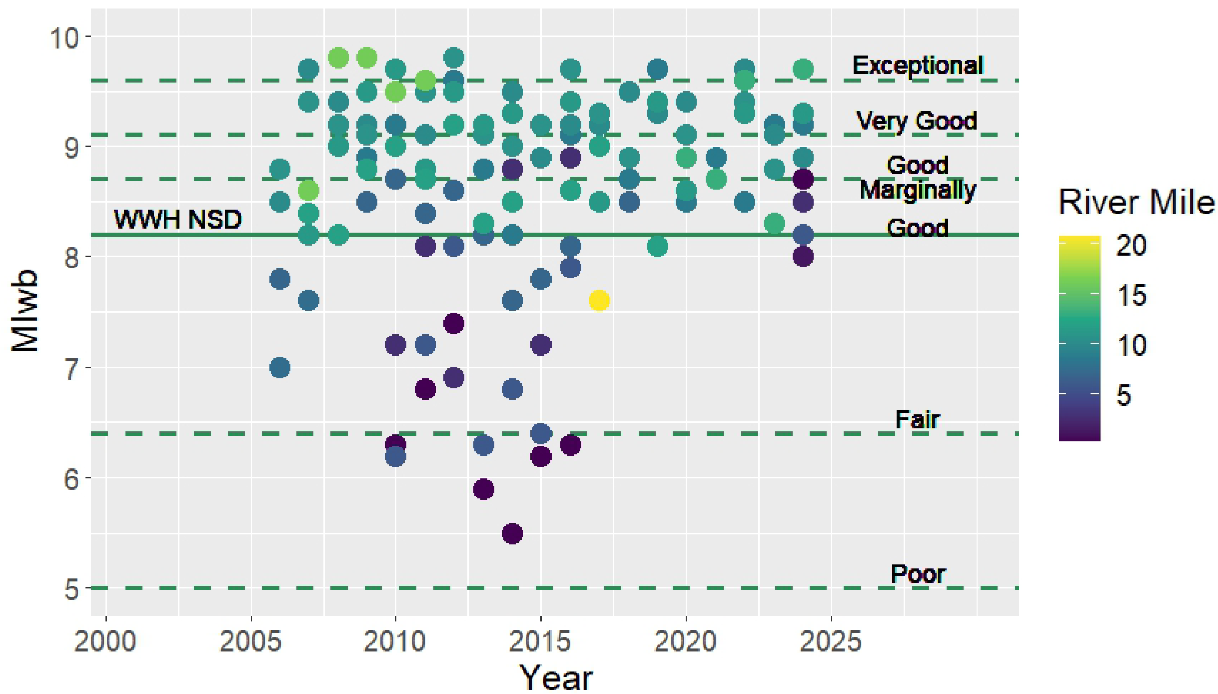

Figure 13. Cuyahoga River Historical NEORSD Fish MIwb scores.

Macroinvertebrate Community Biology Assessment

Methods

Macroinvertebrates were sampled quantitatively using modified Hester-Dendy (HD) samplers in conjunction with a qualitative (qual.) 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, LLC 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 the 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 17), 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 results 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 shown below in Table

20 and a site is within non-significant departure if the score falls within 4 ICI units of the biocriterion.

Table 17. ICI Metrics
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

Table 18. ICI Range for EOLP Ecoregion								
Ohio EPA Narrative	Very Poor	Poor	Low Fair	Fair	Marginally Good	Good	Very Good	Exceptional
ICI Score	0-6	8-12	14-20	22-28	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

HDs were deployed at all sites in 2024. The HD at RM 0.20 was found to be missing at the time of sample retrieval. Therefore, a narrative rating was assigned to this site in 2024 based on results from the qualitative sample. The qualitative sample data was compared to expectations developed by NEORSD using threshold limit models (NEORSD, 2023). These models were developed using QDC Level 3 macroinvertebrate data provided by the Ohio EPA from the Erie Ontario Lake Plain ecoregion (EOLP) from the ten-year period between 2005 and 2014 (threshold limit model analysis available upon request). Table 19 provides the expectation threshold limits for qualitative total taxa, qualitative EPT taxa, and qualitative sensitive taxa metrics, grouped by drainage area category.

Table 19. NEORSD Recommended Expectation Threshold Limits for Narrative Rating Assignments in the EOLP				
Drainage Category	Designation	Qualitative Total Taxa	Qualitative EPT Taxa	Qualitative Sensitive Taxa
Headwater (0-20 miles^2)	EWH	38	12	6
	WWH	27	7	2
	Fair	23	4	1
Wadable (20-200 miles^2)	EWH	51	18	12
	WWH	41	11	6
	Fair	33	8	2
Small River (200-1,000 miles^2)	EWH	44	16	10
	WWH	36	11	7
	Fair	29	9	5

RM 0.20 has a drainage area of 813 square miles, which places it in the Small River drainage area category. This site is located at the very downstream end of the Cuyahoga River ship channel and lacustuary zone. Twenty qualitative taxa were collected at this site, which falls below the Fair expectation. A single EPT taxa, *Hydroptila sp,* was collected at this site, which falls well below the expectation of 9. This was likely due to lack of current and habitat in the dredged, channelized section of river. Zero sensitive taxa were collected at this site, which falls well below the expectation of 5. Pollution tolerance categories of the taxa collected ranged from facultative to tolerant. The site was assigned a field narrative rating of *Very Poor* at the time of sample collection. Amphipods and zebra mussels were noted as the predominant organisms. Based on these findings, the site was assigned a narrative rating of *Poor* in 2024, which was still considered to be in attainment of the LRW designated use.

Figure 14 provides the last five years of macroinvertebrate data collected by the NEORSD along the Cuyahoga River. For sampling events where only a narrative rating was available, the lowest ICI score in the narrative rating range was used for graphing purposes. With the exception of the ship channel, the ICI scores in the last five years all met the WWH macroinvertebrate criterion. Scores upstream of the ship channel ranged from 36 (*Good*) to 56 (*Exceptional*) with an average score of 44 (*Very Good*). The WWH criterion does not apply within the ship channel. ICI scores decreased from upstream to downstream in that section of the river, but because they fell in the *Poor* or *Fair* range, were in attainment of the LRW designated use. The lower scores in the ship channel were likely due to the absence of suitable macroinvertebrate habitat, low to undetectable current velocity, and predominance of silt and muck substrates in this channelized section of river.

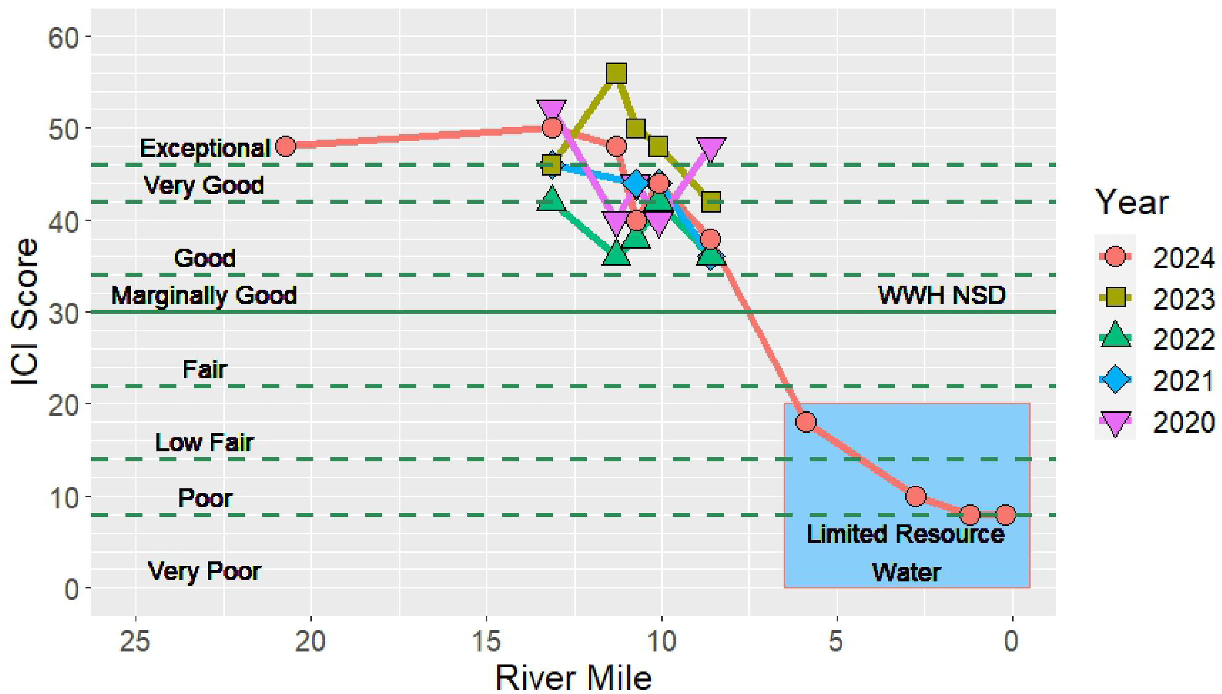

Figure 14. Cuyahoga River ICI scores over the last 5 years.

Table 20 provides detailed statistics of the 2024 macroinvertebrate results. Figure 15 shows macroinvertebrate community compositions at all sites in 2024 for which the HD samplers were recovered. Taxa diversity, as well as numbers and percent compositions of EPT and sensitive taxa, decreased from upstream to downstream. This was particularly evident beginning at the start of the ship channel with RM 5.90. Community compositions shifted drastically within the ship channel compared to upstream as expected due to slow currents, poor habitat, and heavy sediment. Upstream of the ship channel, mayfly and caddisfly taxa made up between ~55-75% of the macroinvertebrate count on the HD samplers. RMs 10.10 and 8.60, which are located downstream of the Southerly WWTC, performed similarly to the upstream site at RM 10.75, indicating that the WWTC effluent was not negatively impacting the downstream biological communities.

Table 20. Macroinvertebrate Community Assessment Results

RM	Density Qt. (ft^2) / Ql.	Ql. / Total Taxa	Ql. EPT / Sens. Taxa	Qt. % Tol. / % Sens. Taxa	Predominant Orgs. on Natural Substrate	ICI	Narrative Rating
20.75	3138 / H-M	64 / 75	22 / 18	1.2 / 22.1	Baetidae, Heptageniidae, Leptohyphidae, Hydropsychidae	48	*Exceptional*
13.15	3007 / H	64 / 70	22 / 22	0.5 / 22.5	Baetidae, Hydropsychidae, Chironomidae	50	*Exceptional*
11.30	2610 / H-M	58 / 65	21 / 18	1.3 / 40.7	Baetidae, Hydropsychidae	48	*Exceptional*
10.75	2842 / M-L	47 / 59	18 / 18	5.6 / 18.1	Baetidae, Heptageniidae, Hydropsychidae	40	*Good*
10.10	2089 / H-M	54 / 62	19 / 18	3.3 / 26.3	Baetidae, Hydropsychidae	44	*Very Good*
8.60	2443 / H-M	42 / 58	16 / 19	5.7 / 23.1	Baetidae, Hydropsychidae	38	*Good*
5.90	2292 / L	28 /38	4 / 3	40.6 / 0.2	Chironomidae, Zygoptera	18	*Low Fair*
2.75	3116 / M-L	37 / 49	2 / 1	37.9 / 0.0	Hemiptera, Gastropoda, Bivalvia	10	*Poor*
1.20	2477 / M-L	22 / 29	1 / 1	82.0 / 0.0	Oligochaeta, Chironomidae	8	*Poor*
0.20	NA / L	20 / NA	2 / 0	NA / NA	Hirudinea, Dreissena polymorpha	NA	*Poor*

Qt. - Quantitative sample collected on Hester-Dendy artificial substrate.
Ql. - Qualitative sample collected from natural stream substrate.

Qualitative sample relative density: L=Low, M=Moderate, H=High

Sensitive Taxa: Taxa listed on the Ohio EPA Macroinvertebrate Taxa List (2019) as *Moderately Intolerant or Intolerant*

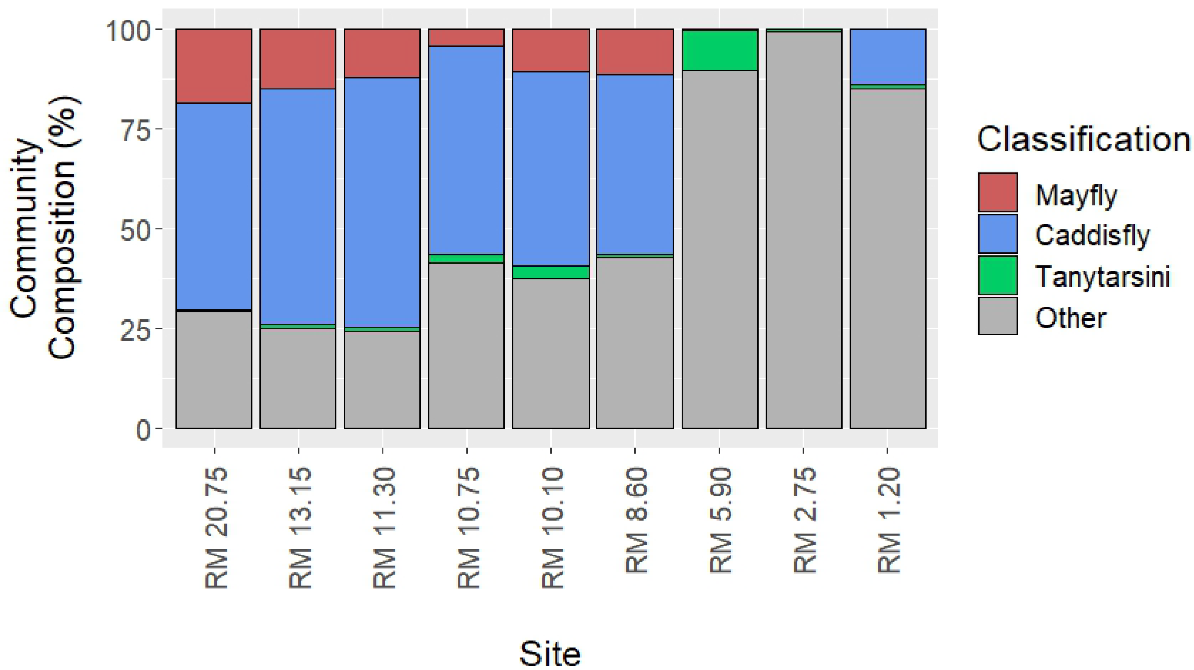

Figure 15. Macroinvertebrate Community Compositions in 2024.

The NEORSD has been conducting macroinvertebrate surveys as part of the Credible Data Program since 2006. In order to visualize long-term trends in ICI scores, all historical NEORSD macroinvertebrate data on the Cuyahoga River is provided in Figure 16. Again, for historical sampling events where only a narrative rating was available, the lowest ICI score in the narrative rating range was used for graphing purposes. This figure shows ICI scores over time with river mile represented as a color gradient. ICI scores of sites within the ship channel have not improved over time. This is not surprising as the ship channel does not provide adequate habitat to support healthy macroinvertebrate communities. For sites upstream of the ship channel, there is a visible trend of increasing ICI scores over time. This may be due to multiple factors including reduction of CSO volumes by actions taken by NEORSD and the City of Akron, as well as improvements in habitat and stream connectivity following removal of the Station Road dam (removed in 2020).

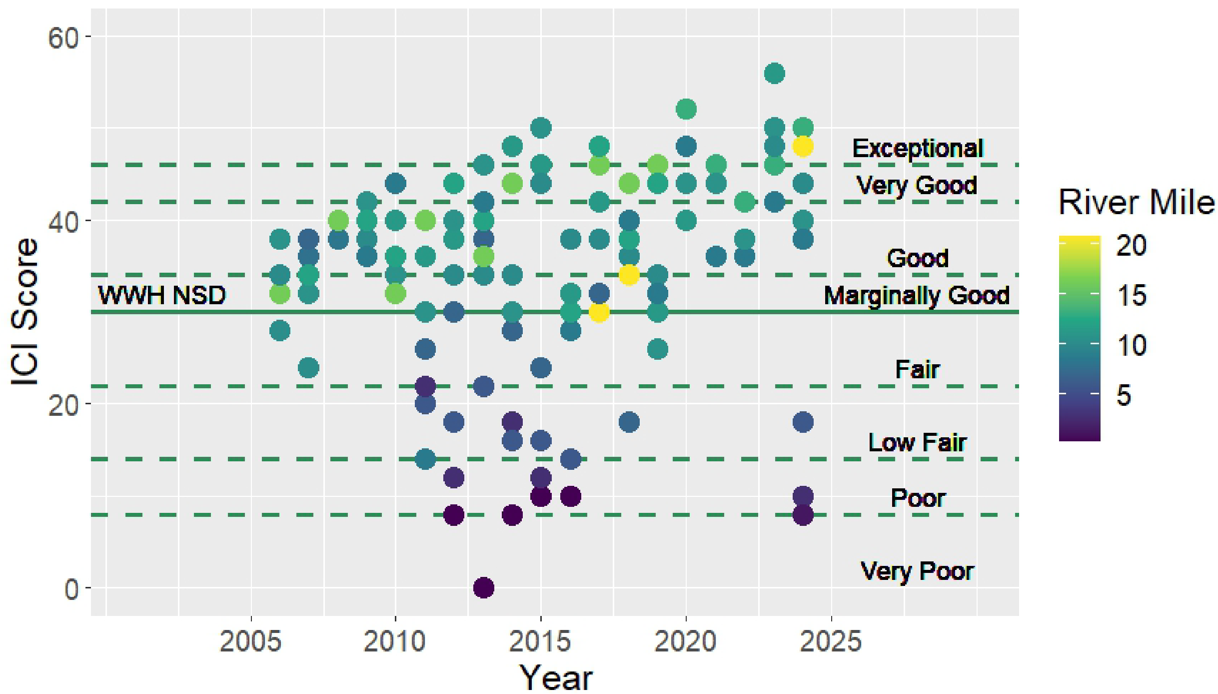

Figure 16. Historical NEORSD ICI scores on the Cuyahoga River.

In order to determine if the positive trend in historical ICI scores upstream of the ship channel was statistically significant, a Wilcoxon rank sum test was performed on historical NEORSD macroinvertebrate data. The data was bracketed into five-year periods in order to provide enough data points per group for statistical analysis. Sampling locations have varied considerably from year to year due to changes in study plan design and the ability or lack thereof to obtain property owner permissions for sampling. To control for the possibility that the addition or removal of a sampling location over time may skew the results, only sites that were sampled consistently throughout the entire time span of the data set were included. Four sites met this criterion, two of which were located downstream of the Southerly WWTC (RMs 8.60 and 10.10) and two upstream (RMs 10.75 and 11.30).

Figure 17 shows a boxplot of the historical ICI results from these sites along with statistical results. ICI results from 2020-2024 were significantly improved compared to all other five-year periods. There were no other statistically significant changes between the three earlier five-year periods. The increase in ICI scores may be at least partially attributed to the removal of the Station Road dam which occurred in 2020. This dam removal resulted in improved connectivity between these sites and the section of river located in the Cuyahoga Valley National Park. This likely resulted in improved migration and colonization of sensitive and EPT taxa from the national park to the lower sections of the river. These findings indicate that water quality on the Cuyahoga River in the NEORSD service area supports good to exceptional macroinvertebrate community assemblages upstream of the ship channel.

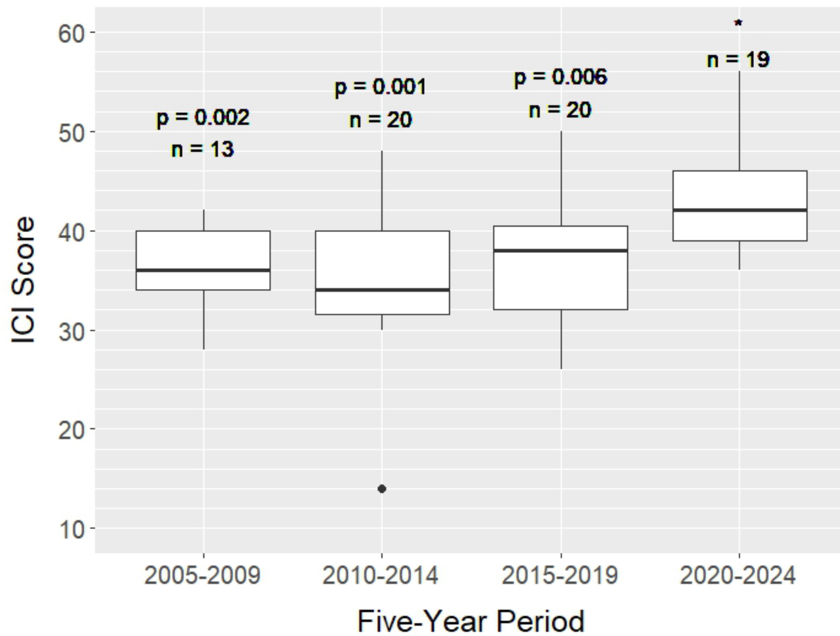

Figure 17. Boxplots of historical results taken from RMs 11.30, 10.75, 10.10, and 8.60 with Wilcoxon rank sum comparisons between the most recent 5-year period and previous 5-year periods.

Conclusions

Incredible progress has been made on the aquatic life recovery in the lower Cuyahoga River. From a stream that was once devoid of aquatic life, most sections of the Cuyahoga River mainstem are meeting statewide biocriteria for the protection of aquatic life. Where the WWH criteria apply upstream of the ship channel, four of the five sites fully assessed were in full attainment of the aquatic life criteria (Table 21). The remaining site was in partial attainment with only the IBI score failing to meet the WWH criterion. All Cuyahoga River sites upstream of the ship channel met the WWH target for the QHEI. RM 10.10 failed to meet the ALU biocriterion for the IBI fish metric only, RMs 10.75 and 8.60 were within non-significant departure, and the remaining two sites were in attainment of the IBI WWH criterion. All five sites upstream of the ship channel were in attainment of the MIwb WWH criterion. Macroinvertebrate community metrics have continued to improve over time upstream of the ship channel, achieving scores in the *Good to Exceptional* range. ICI scores in the most recent several years have improved significantly following the removal of the Station Road dam in 2020. Little to no improvement was seen in biological communities within the Cuyahoga River ship channel, as expected. Lack of habitat and predominance of silt/muck substrates remains a limiting factor for biological communities there. However, as these sites are all designated LRW and had biological scores or narrative ratings that were at least *Poor* or better, they were in attainment of that designated use.

Table 21. 2024 Cuyahoga River ALU Attainment Status

River Mile	DA (mi^2)	Attainment Status	IBI Score	MIwb Score	ICI Score/ Narrative Rating	QHEI Score	Cause(s)	Source(s)
Cuyahoga River (19-001-000) - WWH								
20.75	583	--	--	--	52^{E}	--		
13.15	703	FULL	42	9.7^{E}	54^{E}	81.00		
11.30	730	FULL	40	9.3^{ENS}	52^{E}	65.00		
10.75	743	FULL	38^{NS}	9.3^{ENS}	40	75.25		
10.10	744	PARTIAL	34*	8.9	44^{ENS}	71.50	Pollutants in urban stormwater	Urban runoff/stormwater, Atmospheric deposition/ urbanization
8.60	745	FULL	38^{NS}	9.2^{ENS}	38	76.75		
Cuyahoga River (19-001-000) – LRW^{L}								
5.90	787	FULL	28*	8.2^{NS}	18*	33.00		
2.75	806	FULL	32*	8.5^{NS}	10*	33.00		
1.20	807	FULL	32*	8.0*	8*	27.50		
0.20	813	FULL	30*	8.7	*Poor**	28.00		

^{NS} Non-significant departure of WWH biocriterion (≤ 4ICI; ≤ 4IBI; ≤ 0.5 MIwb units)
^{ENS} Non-significant departure from EWH biocriterion (≤ 4ICI; ≤ 4IBI; ≤ 0.5 MIwb units)
^{E} Meets EWH biocriterion
* Significant departure from the WWH biocriterion (>4 ICI; >4 IBI; >0.5 MIwb units).
^{L} Scores above *Very Poor* are considered to meet criteria

As in years past, assessments in 2024 showed water quality impairments at all sites which may be preventing the establishment of a healthier biological community. Following significant wet-weather events, *E. coli* densities exceeded WQS at all sample locations with the exception of the downstream sites at RMs 1.20 and 0.20 (Tables 4). These two sites met the recreational use criteria for the first time in the history of monitoring by NEORSD. This may be related to the completion of the Westerly Storage Tunnel which captured discharges from CSO-080 in 2024. This resulted in an approximately 36% reduction in CSO discharge volumes from NEORSD-operated CSOs on the Cuyahoga River. The remaining *E. coli* exceedances are unfortunately common in urbanized watersheds due to common trench sewer I&I, improper sanitary connections, CSOs, failing household sewage treatment systems, and urban stormwater runoff. Effluent from Southerly was found to have a dilutionary effect and actually resulted in decreased *E. coli* densities in the river downstream of the WWTC compared to upstream. This was particularly evident during rain events where the WWTC was not in a state of bypass overflow (Figure 4 and Table 7).

Two mercury results were above the method detection limit in 2024. However, 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. Periodic toxic concentrations of mercury due to urban runoff may be one of the causes for the low abundance of intolerant fish species in the Cuyahoga River mainstem. Nutrient enrichment may also potentially be a hinderance to biological performance, as geometric mean concentrations exceeded the proposed large river nutrient WQS (Table 7). Nutrient enrichment can promote excess algal growth. However, daily DO swings remained below the large river WQS threshold.

The Cuyahoga River AOC remedial action plan outlines numerous restoration plans and actions to meet the goal of removing and remediating beneficial use impairments. These actions focus on restoring biological and habitat impairments that will continue to improve water quality throughout the Cuyahoga River. In 2023, the US EPA authorized the removal of the fish tumors and deformities impairment designation (DELTs). This and other continued efforts are significant milestones in the continued recovery of the biological health of the Cuyahoga River.

In addition, the local municipalities participating in the Member Community Infrastructure Program (MCIP) and continued efforts by NEORSD towards the CSO long-term control plan (LTCP), as part of *Project Clean Lake*, will improve water quality problem through the reduction in sanitary sewer overflows and surcharged sewers, elimination of common trench sewers, illicit discharges, and areas of clustered septic systems. The NEORSD Regional Stormwater Management Program will continue to invest in projects within the Cuyahoga River watershed to address bank erosion and stabilization, floodplain expansion, habitat restoration, and stormwater management. The NEORSD Stormwater Management Program and the MCIP projects are critical to effectively manage urban stormwater runoff and the associated negative effects on the Cuyahoga River. These efforts will help to manage stormwater runoff and peak flow rates, control erosion and excess sedimentation, and reduce the influx of toxic metals and nutrients. As projects are completed, continued biological, habitat, and water chemistry monitoring by the NEORSD will demonstrate the overall water quality improvements. Future watershed monitoring will be used to evaluate the implementation of these and other changes, as well as assess the related impacts on the quality of the river.

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