

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2018 Furnace Run Environmental Monitoring Biological, Water Quality, and Habitat Survey Results



**Prepared by
Water Quality and Industrial Surveillance Division**

Introduction

The lower Cuyahoga River has been designated as one of 42 Great Lakes Areas of Concern (AOC) by the International Joint Commission. Past monitoring of this area has indicated impairment of aquatic biota and was the basis for the establishment of Total Maximum Daily Loads (TMDLs) for the Lower Cuyahoga River. The causes of impairment to the river were classified as organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration (Ohio EPA, 2003). Recently, monitoring by the Northeast Ohio Regional Sewer District (NEORS) has shown recovery of the biological community in some reaches of the river. Further assessments throughout the watershed, including tributaries of the Cuyahoga River, is necessary to determine what areas may be still impaired.

In 2018, NEORS conducted environmental monitoring assessments including water chemistry sampling, habitat evaluation, and fish and macroinvertebrate community surveys on Furnace Run, a tributary to the Cuyahoga River. As part of NEORS's general watershed monitoring program, the study objective was to conduct environmental monitoring on Furnace Run, in addition to four other tributaries to the Cuyahoga River, as outlined in *2018 Cuyahoga River Tributaries Environmental Monitoring* study plan, approved by Ohio EPA on April 18, 2018. Portions of the collected tributary data will provide additional valuable information in support of continued monitoring efforts of the lower Cuyahoga AOC, and the potential delisting of some beneficial use impairments.

Sampling was conducted by the NEORS Environmental Assessment group of the Water Quality and Industrial Surveillance (WQIS) Division and occurred between June 15 through September 30, 2018 (through October 15 for fish sampling assessments), as required in the Ohio EPA *Biological Criteria for the Protection of Aquatic Life Volume III* (1987b). Sampling was conducted by NEORS Level 3 Qualified Data Collectors (QDCs) certified by Ohio EPA in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORS study plan.

A study area map, noting the sampling locations evaluated during the 2018 environmental monitoring season, are displayed in Figure 1. Each sampling location with respect to river mile, latitude/longitude, description, and the types of surveys conducted are indicated in Table 1. A digital photo catalog of the sampling locations is available upon request by contacting the NEORS WQIS Division.

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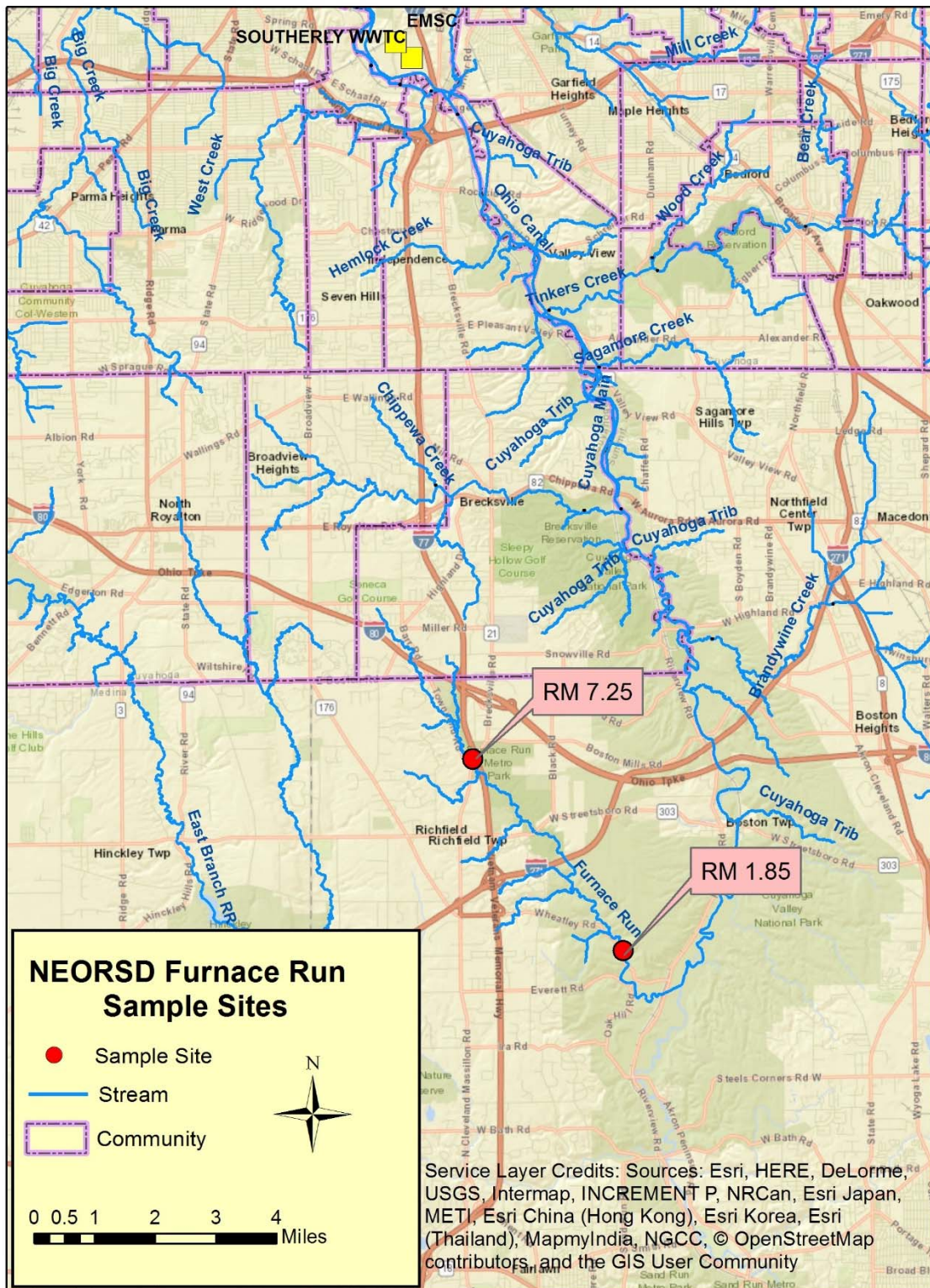


Figure 1. Furnace Run Monitoring Locations

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Table 1. Furnace Run Evaluated Sites						
Site Location	Latitude	Longitude	River Mile	Description	HUC 8	Purpose
Furnace Run	41.2602	-81.63739	7.25	Upstream of Brecksville Road	04110002 - Cuyahoga	General watershed monitoring
Furnace Run	41.21384	-81.58733	1.85	Upstream of Wheatley Road	04110002 - Cuyahoga	General watershed monitoring

Water Chemistry Sampling

Methods

Five separate water chemistry and bacteriological sampling events were conducted between July 24th and August 22, 2018. Techniques used for sampling and analysis were conducted according to methods found in *Surface Water Field Sampling Manual for water quality parameters and flows* (Ohio EPA, 2018b). 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- μ m PVDF syringe filter. All water quality samples were collected as grab samples. Bacteriological samples were collected in sterilized plastic bottles preserved with sodium thiosulfate. At the time of sampling, measurements for dissolved oxygen, pH, temperature, and conductivity were collected using either a YSI 600XL sonde or YSI 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 = concentration of the parameter in the primary sample

y = 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, 2018b).

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

x = sample/detection limit ratio

Those RPDs that are 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 completed 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 OMZA, it generally cannot be determined if Furnace Run was in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine whether contamination was present above those levels typically found in the stream.

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

Results and Discussion

For the 2018 study, one duplicate sample and one field blank were collected for quality assurance and quality control (QA/QC) purposes. The duplicate sample was collected at Furnace Run RM 1.85 on July 24, 2018. No parameters in the duplicate sample were rejected based on RPD values outside of the acceptable RPD range.

One field blank sample was collected during the 2018 sampling season, at Furnace Run RM 7.25 on August 15, 2018. For the field blank, there was one parameter that showed possible contamination. It is unclear how the field blank became contaminated, and may be due to inappropriate sample collection, handling, and/or contaminated blank water. Table 2 lists the water quality parameter that was listed as rejected based on Ohio EPA data validation protocol.

Table 2. Parameter Affected by Possible Blank Contamination
TKN

Paired parameters for all samples collected from each of the two sampling locations within Furnace Run were evaluated for QA/QC purposes. The comparisons revealed no rejected data for the sampling sites, and two sets of parameters with estimated data, one pair on each of two sampling dates (Table 3). Because there were no exceedances associated with these parameters, qualification of these results did not significantly change the overall water chemistry assessment of Furnace Run.

Table 3. Paired Data Parameter Analysis						
Site	Date	Parameter	Data Pair	Acceptable RPD (%)	Actual RPD (%)	Qualifier
RM 7.25	8/15/2018	<i>TS</i>	<i>TDS</i>	15.0	5.4	Estimated
RM 1.85	8/1/2018	<i>Total P</i>	<i>DRP</i>	102.8	18.2	Estimated

Furnace Run is designated as Warmwater Habitat (WWH), Agricultural Water Supply (AWS), Industrial Water Supply (IWS), and Primary Contact Recreation (PCR). The water chemistry samples collected at each site were compared to the applicable Ohio Water Quality Standards for the designated uses to determine attainment (Ohio EPA, 2018a).

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Water chemistry sampling in 2018 for Furnace Run RM 7.25 and RM 1.85 revealed mercury concentrations that were below the method detection limit for EPA Method 245.1. It is expected that the use of EPA Method 1631E, a low-level method, instead of EPA Method 245.1, would have resulted in exceedances of the criteria throughout the sampling period. Mercury may be introduced into Furnace Run from urban runoff and atmospheric deposition within the watershed.

The Primary Contact Recreation criteria for Furnace Run includes an *Escherichia coli* (*E. coli*) criterion not to exceed a Statistical Threshold Value (STV) of 410 colony counts/100mL in more than ten percent of the samples taken during any 90-day period, and a 90-day geometric mean criterion of 126 colony counts/100mL (Ohio EPA, 2015a). Furnace Run exceeded the primary contact recreation 90-day geometric mean at both sampling locations. In accordance with 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. Wet-weather sampling events¹ occurred on July 24, August 1, August 8, and August 22, 2018, and therefore, stormwater runoff may have contributed to these exceedances. *E. coli* exceedances may also have been impacted by possible failing home septic systems in the surrounding residential areas. The STV criterion was also exceeded for the 90-day period for both sampling locations on Furnace Run, as RM 7.25 and RM 1.85 averaged above the maximum ten percent allowed (Table 4). Apart from the probable mercury exceedances and the exceedances for *E. coli*, the sampling locations on Furnace Run met all other water quality criteria for the 2018 season.

Table 4. 2018 Chippewa Creek *E. coli* Densities (MPN/100mL)

Date	RM 7.25	RM 1.85
7/24/2018*	1716	1891.5
8/1/2018*	86	122
8/8/2018*	508	468
8/15/2018	210	429
8/22/2018*	1730	1623
90 Day Geometric Mean	486.4	596.0
<div style="display: flex; align-items: center;"> <div style="width: 20px; height: 10px; background-color: #c6e0b4; border: 1px solid black; margin-right: 5px;"></div> Exceeds statistical threshold value (STV) </div> <div style="display: flex; align-items: center; margin-top: 5px;"> <div style="width: 20px; height: 10px; background-color: #ffffcc; border: 1px solid black; margin-right: 5px;"></div> Exceeds geometric mean criterion for 90-day period </div>		
<small>*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.</small>		

¹ Wet-weather sampling events: 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.

In 2015, the Ohio EPA Nutrients Technical Advisory Group released a proposed Stream Nutrient Assessment Procedure (SNAP) designed to determine the degree of impairment in a stream due to nutrient enrichment. SNAP assigns designations for quality of surface waters based on factors including dissolved oxygen (DO) swings, benthic chlorophyll *a*, total phosphorous, and dissolved inorganic nitrogen (Ohio EPA, 2015c). NEORSD did not assess DO swings or benthic chlorophyll *a* in 2018; however, nutrients were assessed.

Table 5 shows the mean calculated nutrient concentrations for the Furnace Run sampling locations assessed in 2018. The results of dissolved inorganic nitrogen and total phosphorous were compared to Table 2 listed in the SNAP document. According to this section of SNAP, both Furnace Run RM 7.25 and RM 1.85 exhibit “background levels typical of least disturbed conditions” (Ohio EPA, 2015). This indicates that neither phosphorus nor nitrogen are of a significant concern as a primary source of impairment at these sampling sites.

Table 5. 2018 Furnace Run Nutrient Concentrations		
Site	Total Phosphorus Geometric Mean (mg/L)	Dissolved Inorganic Nitrogen Geometric Mean (mg/L)
Furnace Run RM 7.25	0.033	0.210
Furnace Run RM 1.85	0.022	0.144

Habitat Assessment

Methods

In 2018, instream habitat assessments were conducted once at the stream segments within Furnace Run using the Qualitative Habitat Evaluation Index (QHEI). The QHEI was developed by the Ohio EPA to assess aquatic habitat conditions that may influence the presence or absence of fish species by evaluating the physical attributes of a stream. The index is based on six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank condition, pool and riffle quality, and stream gradient. The QHEI has a maximum score of 100, and a score of 55 or more suggests that sufficient habitat exists to support a fish community that attains the WWH criterion. A more detailed description of the QHEI can be found in Ohio EPA’s *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006). QHEI field sheets for each site are available upon request from the NEORSD WQIS Division.

Results and Discussion

The stream segment at Furnace Run RM 7.25 was assessed on August 2, 2018. A QHEI score of 85 was calculated with a narrative rating of *Excellent* (Table 6), far exceeding the target score of 55 for WWH. Cobble, followed by gravel, were the dominant substrates found within the stream reach (Table 7). Small amounts of sand and boulders were also found throughout. According to field investigation, the stream reach contained a moderate to extensive amount of instream cover that may be utilized for resident or transient fish populations as places of refuge. While diverse in composition, the quality of the instream cover was marginal for most types and included undercut banks, overhanging vegetation, slow-water shallows, rootmats, rootwads, pools with a depth greater than 70 centimeters, oxbows/backwaters, and logs/woody debris. Overall, the stream reach exhibited largely positive characteristics including moderate sinuosity and good development of the channel itself, with only marginal amounts of bank erosion, and a moderate to wide riparian buffer surrounded by a forested flood plain. Minimal negative impacts to this stream reach support the potential for sustaining a healthy fish community.

The stream segment at Furnace Run RM 1.85 was assessed on August 2, 2018. A QHEI score of 77.50 was calculated with a narrative rating of *Excellent* (Table 6), exceeding the WWH target score of 55. While cobble and gravel dominated the stream reach substrate composition; sand, hardpan, and silt were also present throughout (Table 7). Additionally, boulders were present in the pools of the stream evaluation area. Indicated during field assessment, a moderately extensive amount of instream cover for resident and transient fish was present. While the cover was extensive, the quality of each type was nominal and included undercut banks, overhanging vegetation, slow water shallows, rootmats, pools with a depth greater than 70 centimeters, oxbows/backwaters, and logs/woody debris. The lack of quality cover is even further magnified when considering the embeddedness of the substrate. Normal-to-moderately embeddedness can have a potentially negative impact on the biota of the stream, as excessive silt and sand may block the small crevices in the substrate where fish can hide and find macroinvertebrates that reside there as a food source. The source of the sediment causing the embeddedness may be a result of the moderate erosion of the right stream bank, which provides an explanation as to why the best areas of the present riffle averaged only between 5-10cm deep.

Table 7. Furnace Run Qualitative Habitat Evaluation Index Scores and Physical Attributes

			WWH Attributes											MWH Attributes																			
														High Influence						Moderate Influence													
River Mile	QHEI Score	Habitat Rating	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High 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 Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total Moderate Influence Attribute	
7.25	85.00	Excellent	x	x		x	x	x	x		x	x	8		x				1				x							x			2
1.85	77.50	Excellent	x	x		x	x	x	x		x		7				x		1										x	x		2	

Fish Community Assessment

Methods

Two quantitative electrofishing passes were conducted at each sampling site on Furnace Run for the 2018 sampling season. Because Ohio EPA was also conducting assessments in Cuyahoga River tributaries, NEORSD investigators collaborated with their field teams to complete electrofishing sampling events at Furnace Run RM 7.25. This data may also be used as a part of a benchmarking field study. Both NEORSD and Ohio EPA were responsible for completing one sampling event each, and the data from both organizations was averaged to assess the attainment criterion. Both sampling passes for Furnace Run RM 1.85 were conducted by NEORSD.

Sampling by the NEORSD Environmental Assessment group was conducted using longline electrofishing techniques and consisted of shocking all habitat types within a sampling zone while moving from downstream to upstream. The sampling zone was 0.15 kilometers² for both RMs 7.25 and 1.85. The sampling techniques used followed Ohio EPA protocol methods as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Fish collected during the surveys were identified and examined for the presence of anomalies including DELTs (deformities, eroded fins, lesions, and tumors). All fish were then released to the waters from which they were collected, except for vouchers and those that could not be easily identified in the field.

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of the Ohio EPA Index of Biotic Integrity (IBI). The IBI incorporates 12 community metrics representing structural and functional attributes. The structural attributes are based upon fish community aspects such as fish numbers and diversity. Functional attributes are based upon fish community aspects such as feeding strategies, environmental tolerances, and disease symptoms. These metrics are individually scored by comparing the data collected at the survey site with values expected at reference sites located in a similar geographical region. The maximum possible IBI score is 60 and the minimum possible score is 12. The summation of the 12 individual metrics scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional, Good, Marginally Good, Fair, Poor, or Very Poor*. The 12 metrics utilized for headwater sampling locations are listed in Table 8.

² The sampling zone for the September 9, 2018, electrofishing pass completed by Ohio EPA was 0.165 kilometers.

Table 8. Index of Biotic Integrity (IBI) Metrics
Headwater
Total Number of Native Species
Number of Darters & Sculpins
Number of Headwater Species
Number of Minnow Species
Number of Sensitive Species
Percent Tolerant Species
Percent Pioneering Species
Percent Omnivores
Percent Insectivores
Number of Simple Lithophils
Percent DELT Anomalies
Number of Individuals (less Tolerant Organisms)

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

Results and Discussion

For the 2018 electrofishing events, the Furnace Run RM 7.25 stream segment averaged an IBI score of 43, narratively *Good*, therefore meeting the IBI WWH criterion (Table 9). The first electrofishing pass, completed on August 2, 2018 by NEORSD, resulted in an IBI score of 40, narratively *Good* (Table 9 and Figure 2). Of all specimens assessed during the sampling event, no DELTs were reported. Within the sample population, 24.10% of the individuals collected were classified as pioneering species. Pioneering species in high densities are often present in heavily impacted streams or streams that have temporally-related unavailable habitat. A proportion of this quantity (about 1/5 of the sample population) may indicate the likelihood of some negative environmental stressors within the stream, which contradicts the *Excellent* QHEI analysis. The presence of three different darter species including johnny darter (*Etheostoma nigrum*), barred fantail darter (*Etheostoma flabellare*), and rainbow darter (*Etheostoma caeruleum*), also positively contributed to the overall IBI score. The rainbow darter is also classified as a sensitive species, but was the only sensitive taxon present within the sample population. The lack of sensitive species and a low proportion of insectivorous taxa within the sample population caused the respective metrics to score poorer, thereby lowering the overall IBI score.

The second electrofishing pass for Furnace Run RM 7.25, completed September 5, 2018 by Ohio EPA, achieved an IBI score of 46, narratively *Very Good* (Table 9 and Figure 2), which was an improvement to the score calculated from the first electrofishing event. This increase in overall score may be attributed to sampling effort, weather, or seasonal

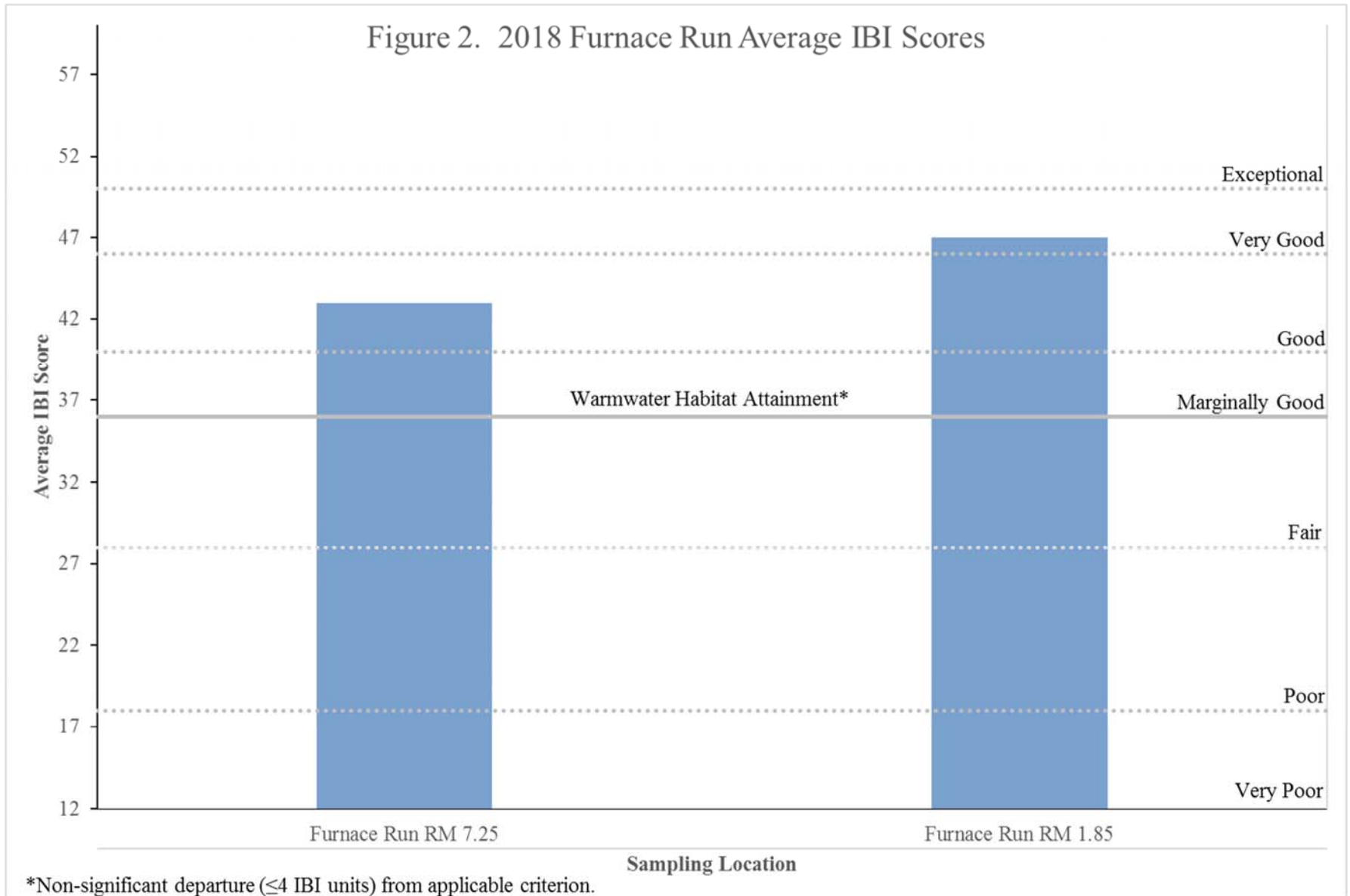
population drifts. Three additional taxa were collected, including northern hog sucker (*Hypentelium nigricans*), northern fathead minnow (*Pimephales promelas*), and bluntnose minnow (*Pimephales notatus*), for a total of 15 taxa, compared to 12 collected during the first event. The addition of the two new minnow species positively impacted the Minnow Species metric, and therefore contributed to the increase of the overall IBI score. The proportion of insectivorous taxa within the sample population also increased, providing an additional positive contribution to the overall score. However, like the first electrofishing pass, a minimal number of sensitive species (two taxa) were present in the sample population. This low incidence of sensitive species caused the respective metric to score lower, thereby lowering the overall IBI score. While the QHEI analysis assessed the stream reach at Furnace Run RM 7.25 with an excellent capability to sustain a healthy and diverse fish population, there are some indications that environmental stressors may be impacting the fish community composition.

For the 2018 electrofishing events, the Furnace Run RM 1.85 stream segment averaged an IBI score of 47, narratively *Very Good*, therefore meeting the IBI WWH criterion (Table 9). The first electrofishing pass, completed on August 2, 2018, resulted in an IBI score of 46, narratively *Very Good* (Table 9 and Figure 2). No DELTs were reported in any of the specimens collected. Sixteen taxa were collected during the sampling event, all of which were native species. The sample population was dominated by taxa ranging from intermediate to high pollution tolerance. The central stoneroller minnow (*Campostoma anomalum*), a taxon intermediate in pollution tolerance, accounted for almost half of the specimens collected. This dominance is further confirmed by a low number of species classified as sensitive, including the northern hog sucker, sand shiner (*Notropis stramineus*), and rainbow darter. The proportion of omnivorous species in the sample was quantified as 2.90%, offering a significant positive contribution to the overall IBI score. This metric is inversely related to stream health, as lower proportions of omnivores suggest less likelihood of disruption in the food chain in a system caused by environmental stressors, and this is also consistent with the low percentage of pioneering species in the sample at 5.90%. There is also a correlation with the higher proportion of insectivores, whose presence is more desired in larger densities in the stream.

The second electrofishing pass for the Furnace Run RM 1.85 stream segment, completed on September 13, 2018, achieved an IBI score of 48, narratively *Very Good* (Table 9 and Figure 2). Field investigation reported one deformity in a central stoneroller minnow specimen. The overall sample population size nearly doubled in comparison to the first electrofishing event, yet the taxa distribution was proportionally consistent. Again, the increase in overall sample size may be attributed to weather, or seasonal population drifts. In this sampling event, however, two new taxa were present in the sample population, spotfin shiner (*Cyprinella spiloptera*) and pumpkinseed sunfish (*Lepomis gibbosus*), for a total of 18 taxa in the sample, which provided the increase in the overall IBI score. All remaining metrics analyzed for this sample population remained consistent in proportion and score compared to the first sampling event.

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Table 9. 2018 Furnace Run IBI Results					
	1st Pass		2nd Pass		Average
River Mile	Date	IBI <i>(Narrative Rating)</i>	Date	IBI <i>(Narrative Rating)</i>	IBI <i>(Narrative Rating)</i>
Furnace Run RM 7.25	8/2/2018	40 (Good)	9/5/2018*	46 (Very Good)	43 (Good)
Furnace Run RM 1.85	8/2/2018	46 (Very Good)	9/8/2017	48 (Very Good)	47 (Very Good)
Bold = meets WWH criterion [IBI ≥40 (Headwater Site)] * - Sample collected by Ohio EPA					



Macroinvertebrate Community 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) taxa, also referred to as EPT taxa, inhabiting available habitats at the time of HD retrieval. Sampling was conducted at the Furnace Run sampling locations listed in Table 1. Methods for sampling followed the Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b). The recommended period for HD deployment is six weeks.

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

The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI) (Ohio EPA 1987b, DeShon 1995). The ICI consists of ten community metrics (Table 10), each with four scoring categories. Metrics 1-9 are based on the quantitative sample, while Metric 10 is based on the qualitative EPT taxa. The total of the individual metric scores result in the overall score. This scoring evaluates the community against Ohio EPA's reference sites for each specific eco-region.

Table 10. 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

Results and Discussion

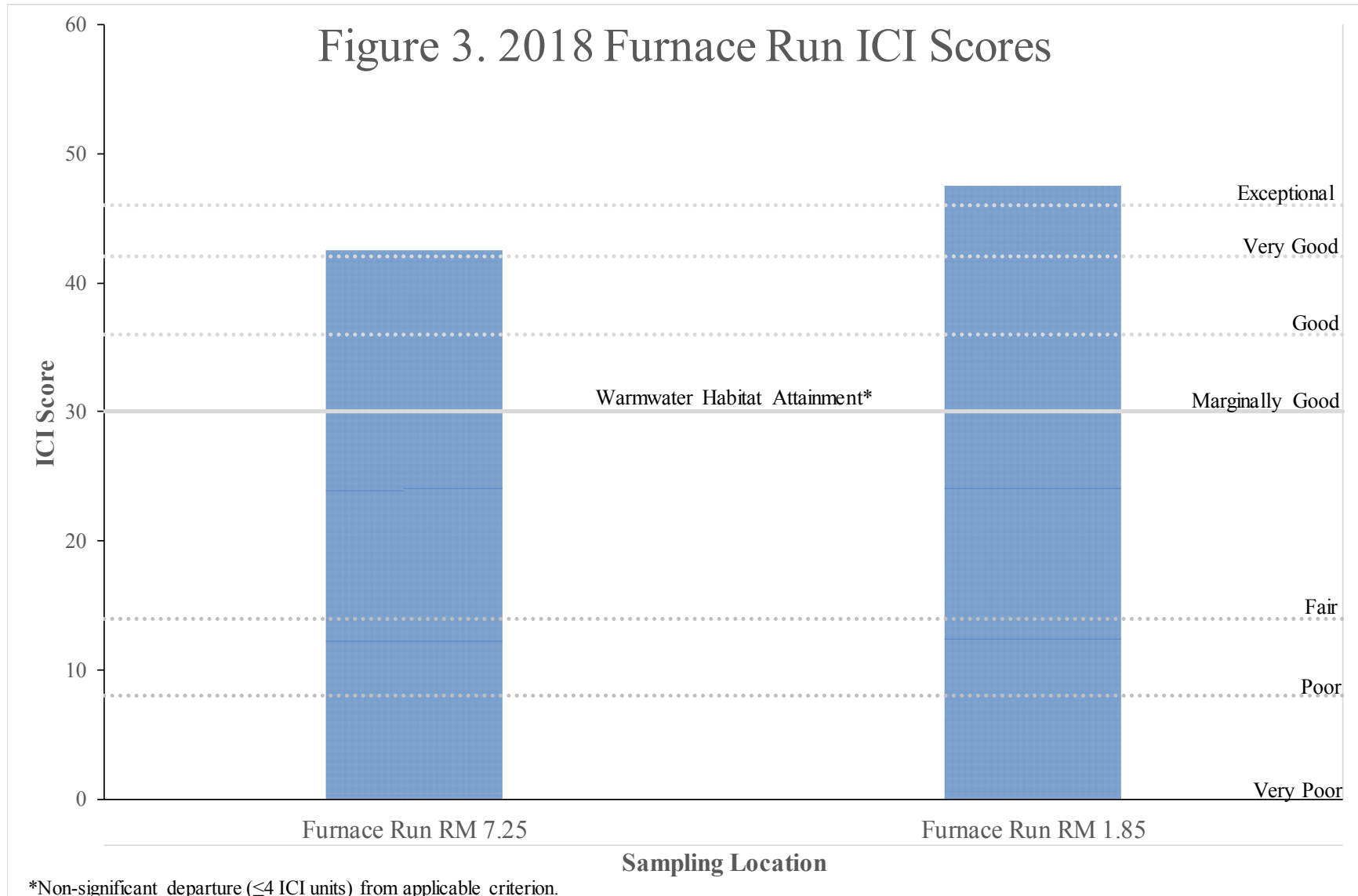
The HD samplers were successfully recovered from all sampling locations on Furnace Run in the 2018 season. Combined with qualitative macroinvertebrate sampling

on the day of HD retrieval, this allowed for a calculated ICI score to assess each of the sampling sites.

The stream segment at Furnace Run RM 7.25 resulted in an ICI score of 46 with a narrative rating of *Exceptional* (Table 11 and Figure 3), therefore exceeding the WWH criterion of 34. A total of 56 taxa were collected between the HD and qualitative sample. Of these taxa, twelve representative species from the EPT were present, including five Ephemeropterans: *Baetis flavistriga*, *Baetis intercalaris*, *Stenonema femoratum*, *Maccaffertium terminatum*, and *Caenis sp.*; and seven Trichopterans: *Chimarra aterima*, *Nyctiophylax sp.*, *Polycentropus sp.*, *Cheumatopsyche sp.*, *Ceratopsyche morosa*, *Hydropsyche depravata group*, *Hydropsyche depravata group*, and *Hydroptila sp.* Eight of these EPT taxa were found in the HD sample alone. While EPT taxa only accounted for 5.12% of the total number of organisms collected from the HD sampler, the quantity of mayfly taxa and individuals had a greater negative impact on the total ICI than any metrics involving caddisflies. It is important to note, however, that the diverse presence of EPT taxa in the total sample equates to 21.4% of the total taxa. A strong proportion of EPT taxa may indicate good water quality in the stream. Congruent with the presence of quality water taxa is a low proportion of tolerant organisms within the sample population. While tolerant organisms will exist in good quality systems, their limited presence here may be confirmation of a healthy stream system.

The stream segment at Furnace Run RM 1.85 resulted in an ICI score of 50 with a narrative rating of *Exceptional* (Table 11 and Figure 3), therefore exceeding the WWH criterion of 34. In total, between the HD and qualitative sampling, 63 macroinvertebrate taxa were collected. Like Furnace Run RM 7.25, there was a strong presence of EPT taxa in the sample population, comprised of 16 total taxa collected in the HD and the qualitative sample. A notable collection during qualitative sampling was the green stonefly (*Sweltsa sp.*). Plecopterans are extremely sensitive to pollution and environmental disruptions in the stream and are often only found in well-oxygenated streams with well-developed riffles. Coupled with several other intolerant Ephemeropterans and Trichopterans, general overall diversity in the sample population, and a low incidence of as-defined tolerant organisms (0.99% of the sample); these are indications of a potentially healthy stream system.

Table 11. Invertebrate Community Index (ICI) Scores	
River Mile	ICI Score (<i>Narrative Rating</i>)
Furnace Run RM 7.25	46 (<i>Very Good</i>)
Furnace Run RM 1.85	50 (<i>Exceptional</i>)
Bold – Attainment of WWH criterion	



Conclusions

The results of the water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys conducted by NEORSD in 2018 indicate that the Furnace Run watershed may have been slightly impacted by a variety of environmental or human stressors. Both sampling locations that were evaluated, RMs 7.25 and 1.85, resulted in full Aquatic Life Use Attainment.

Bacteriological sampling within the Furnace Run sampling locations revealed elevated densities of *E. coli*, which is regarded as an indicator of poor water quality conditions. These water quality exceedances may be attributed to stormwater runoff including outfalls, failing home septic systems in the nearby area, or a private utility operated wastewater treatment facility in the Briarwood development area in the Village of Richfield, Ohio. The Village of Richfield is currently in negotiations with the privately held utility to reroute the wastewater via pump stations (to be built) that will ultimately be treated at the NEORSD's Southerly Wastewater Treatment Center. Resulting from these water quality conditions, the fish communities at each sampling site may have been disturbed through population shifts toward more pollution-tolerant species.

Habitat conditions within some of the sampling locations may have presented a minor challenge to the biological community and may have prohibited the support of more high-quality or sensitive/intolerant fish communities. Sparseness of in-stream cover for fish, unstable substrate, and bank erosion may have impacted the stream biota composition.

Bacteriological issues may be able to be improved to achieve attainment of water quality status, therefore improving the overall quality of the in-stream biological community. The quality of habitat, however, and the associated impacts to the fish and macroinvertebrate communities, may not be easily remediated. Issues with erosion and lack of instream cover may be impacted by human influence. Ultimately, elimination of environmental stressors will be required to improve water quality and create permanent positive changes in the biological communities.

Table 12. 2018 Furnace Run Survey Results

River Mile	Aquatic Life Use Attainment Status	Average IBI Score (Narrative Rating)	ICI Score (Narrative Rating)	QHEI Score (Narrative Rating)	Water Quality Exceedances
7.25	FULL	43 (Good)	46 (Very Good)	85.00 (Excellent)	<i>E. coli</i>
1.85	FULL	47 (Very Good)	50 (Exceptional)	77.50 (Excellent)	<i>E. coli</i>

Bold – Attainment of the WWH Biocriterion (IBI score of 40, ICI score of 34, QHEI score target of 55)
 Non-significant departure: ≤4 IBI units; ≤4 ICI units

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NEORSD Analytical Services Division – Completed analysis for all water chemistry sampling

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