

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2016 Doan Brook Environmental Monitoring Biological, Water Quality and Habitat Survey Results



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

Introduction

In 2016, the Northeast Ohio Regional Sewer District (NEORSD) conducted environmental assessments including water chemistry sampling, habitat assessments, and fish and macroinvertebrate community surveys on Doan Brook, a tributary to Lake Erie. The objective of this study was to conduct environmental monitoring on Doan Brook to evaluate the impact of CSOs and other environmental factors on the stream. During the 2016 sampling season, two stream sites were monitored, including river mile (RM) 0.75, which is downstream of St. Clair Avenue; and RM 6.70, upstream of Lee Road (Table 1). Sampling at both of these sites is required by the Ohio Environmental Protection Agency (Ohio EPA) National Pollution Discharge Elimination System (NPDES) Permit No. 3PA00002*HD (2016).

Sampling, which included water chemistry and habitat assessments, along with macroinvertebrate and fish surveys, was conducted by the NEORSD Environmental Assessment group of the Water Quality and Industrial Surveillance (WQIS) Division and occurred from June 15 through September 30, 2016 (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 NEORSD Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORSD study plan *2016 Doan Brook Environmental Monitoring* approved by Ohio EPA on May 17, 2016.

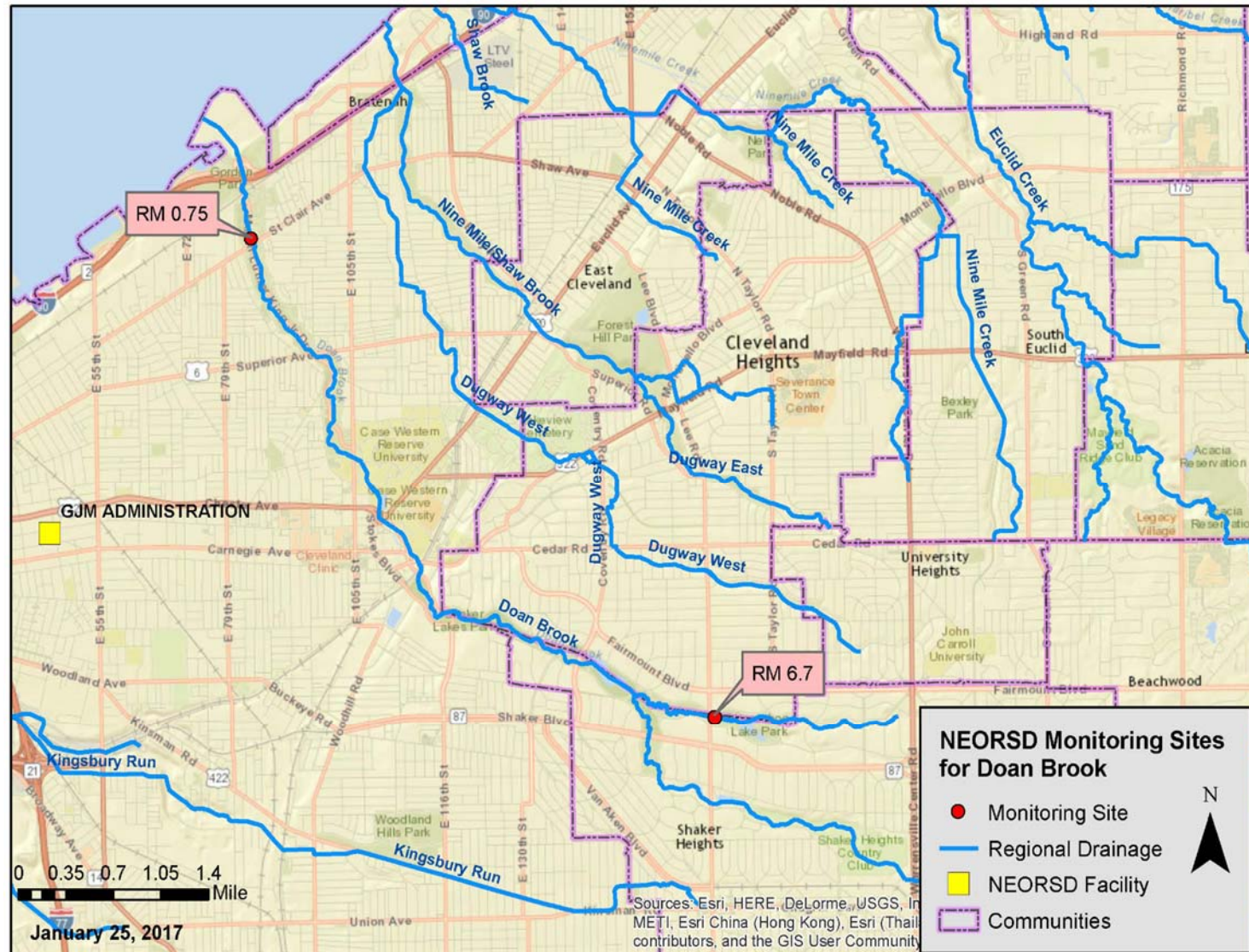
Table 1 indicates the sampling location for each study site with respect to river mile, latitude/longitude, description, and the types of surveys conducted. Figure 1 is a study area map, noting the location of each sampling location evaluated during the 2016 study. A digital photo catalog of the sampling locations is available upon request by contacting the NEORSD WQIS Division.

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Table 1. Doan Brook Evaluated Sites

Site Location	Latitude	Longitude	River Mile	Description	HUC 8	Purpose
Doan Brook	41.5330°	-81.6296°	0.75	Downstream of St. Clair Avenue	Ashtabula-Chagrin 04110003	Evaluate chemistry, habitat, fish, & macroinvertebrates in support of Ohio EPA Permit #3PA00002*HD and watershed assessment
Doan Brook	41.4838°	-81.5643°	6.70	Upstream of Lee Road	Ashtabula-Chagrin 04110003	Evaluate chemistry, habitat, fish, & macroinvertebrates in support of Ohio EPA Permit #3PA00002*HD and watershed assessment

Figure 1. 2016 Doan Brook Monitoring Sites



Water Chemistry Sampling

Methods

Five separate water chemistry and bacteriological sampling events were conducted between June 15 and July 12, 2016. Techniques used for sampling and analyses were conducted according to methods found in *Surface Water Field Sampling Manual for water quality parameters and flows* (Ohio EPA, 2015b). 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).

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

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

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

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

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

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 of 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 Doan Brook 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 site are available upon request from the NEORSWQIS Division.

Results and Discussion

For the 2016 study, one duplicate sample and one field blank were collected for quality assurance and quality control (QA/QC) purposes. The duplicate sample was collected at RM 6.70 on June 15, 2016. One parameter in the duplicate sample, total suspended solids (TSS), was rejected based on an RPD value outside of the acceptable RPD range (Table 2). The date in which this sample was collected was not considered wet weather¹. Therefore, the reason for the unacceptable difference between the samples remains unknown, but potentially could be due to lack of precision and consistency in sample collection and/or analytical procedures, environmental heterogeneity, and/or improper handling of samples.

One field blank sample was collected at RM 0.75 on July 5, 2016. For the field blank, there were two parameters that showed possible contamination. It is unclear how the field blank became contaminated and may be due to inappropriate sample collection, handling, and/or contaminated blank water. Table 3 lists water quality parameters that were listed as estimated based on Ohio EPA data validation protocol.

Table 2. Duplicate Parameter Analysis					
Date	Site	Parameter	Acceptable RPD (%)	Actual RPD (%)	Qualifier
6/15/2016	RM 6.70	TSS	26.2	40.1	Rejected

Table 3. Parameters Affected by Possible Blank Contamination
COD
Cr

Paired parameters for all samples collected from RM 0.75 and RM 6.70 were evaluated for QA/QC purposes. The comparisons revealed no rejected data for either sampling site, and only a few parameters with estimated data (Table 4). Because there were no exceedances associated with these parameters, qualification of these results did not significantly change the overall water chemistry assessment of Doan Brook.

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.

Table 4. Paired Data Parameter Analysis

Date	Site	Parameter	Data Pair	Acceptable RPD (%)	Actual RPD (%)	Qualifier
6/15/2016	RM 6.70	NO_3+NO_2	NO_3	39.6	1.5	Estimated
6/21/2016	RM 6.70	NO_3+NO_2	NO_3	40.5	4.0	Estimated
7/5/2016*	RM 6.70	TS	TDS	14.9	1.9	Estimated

* - Wet-Weather Event

Doan Brook is designated Warmwater Habitat (WWH), Agricultural Water Supply, Industrial Water Supply, and Primary Contact Recreation. The primary contact recreational use criteria apply for *Escherichia coli* (*E. coli*). 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, 2015a).

Water chemistry sampling at RM 0.75 and RM 6.70 in 2016 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 Doan Brook from CSO discharges and urban runoff within the watershed.

The Primary Contact Recreation criteria for Doan Brook include an *E. coli* criterion not to exceed a Statistical Threshold Value (STV) of 410 colony-forming units per 100 milliliters (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). Doan Brook exceeded the primary contact recreation 90-day geometric mean at all sites. A wet-weather event occurred on July 4, 2016, and therefore, CSOs, and stormwater runoff may have contributed to these exceedances. The STV criterion was also exceeded for most of the 90-day periods throughout the study for RM 0.75. All sampling events at RM 6.70 met the STV criterion for the 90-day periods (Table 6).

Table 6. <i>E. coli</i> Exceedances				
Site	Sample Date	Sample Density (Most Probable Number /100ml)	90-Day Geometric Mean (Colony Counts /100ml)	Statistical Threshold Value (% Days >410 Colony Counts /100ml)
RM 0.75	6/15/2016	71,320	5,430.0	80.0
RM 0.75	6/21/2016	38,505	2,852.3	75.0
RM 0.75	6/28/2016	7,500	1,197.9	66.7
RM 0.75	7/5/2016*	1,071	478.7	50.0
RM 0.75	7/12/2016	214	214.0	0.0
RM 6.70	6/15/2016	193	190.6	0.0
RM 6.70	6/21/2016	118	189.9	0.0
RM 6.70	6/28/2016	124	222.6	0.0
RM 6.70	7/5/2016*	278	298.3	0.0
RM 6.70	7/12/2016	320	320.0	0.0

Shading = Exceedance of the criterion

* - Wet-Weather Event

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). NEORSR did not assess DO swings or benthic chlorophyll *a* in 2016; however, nutrients were assessed.

Table 7 shows the nutrient concentrations for the Doan Brook sites in 2016. 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 sites analyzed on Doan Brook exhibit “levels typical of developed lands; little or no risk to beneficial uses,” (Ohio EPA, 2015c). This indicates that neither phosphorous or nitrogen are of a significant concern as a primary source of impairment at these two sites.

Table 7. 2016 Doan Brook Nutrient Concentrations		
Site	Total Phosphorus Geometric Mean (mg/L)	Dissolved Inorganic Nitrogen Geometric Mean (mg/L)
RM 0.75	0.158	0.773
RM 6.70	0.041	0.154

Habitat Assessment

Methods

Instream habitat assessments were conducted once at each site on Doan Brook in 2016 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 60 (55 for headwaters) 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 RM 0.75 was assessed on June 16, 2016. A QHEI score of 51.0 was calculated with a narrative rating of *Fair* (Table 7), nearly attaining the WWH target of 55 and the potential to support a healthy fish community. Predominant substrate types included cobble and sand. Instream cover was nearly absent at the time of assessment, only including small amounts of overhanging vegetation, boulders, logs and woody debris, and deep pools (>70cm). When comparing this site with previous QHEI assessments, it should be noted that there was no longer a functional riffle at the site, which was present in 2014. This portion of the stream is also channelized with low sinuosity, which in addition to the minimal instream cover, detracts from the overall score.

The site at RM 6.70 was assessed on June 24, 2016. A QHEI score of 69.5 was calculated with a narrative rating of *Excellent*, thereby exceeding the WWH target (Table 8). Gravel was the dominant substrate type at this stream segment. The moderate instream cover was diverse and included undercut banks, overhanging vegetation, rootwads, boulders, logs and woody debris, and some shallows and backwaters. High sinuosity, a lack of channelization of the stream, and the presence of riffles were beneficial contributing factors to the overall score.

River Mile	Date	QHEI Score	Narrative
0.75	6/16/2016	51.0	<i>Fair</i>
6.70	6/24/2016	69.5	<i>Excellent</i>

Fish Community Assessment

Methods

One quantitative electrofishing pass was conducted at both RMs 0.75 and 6.70 on Doan Brook in the 2016 sampling season. Sampling 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 kilometers for each site. The methods that were used followed Ohio EPA protocol methods as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Fish collected during the surveys were identified, weighed, and examined for the presence of anomalies, including DELTs (deformities, eroded fins, lesions, and tumors). All fish were then released to the waters from which they were collected, except for vouchers and those that could not be easily identified in the field.

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of the Ohio EPA Index of Biotic Integrity (IBI). The IBI incorporates 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 sites are listed in Table 9.

Table 9. Index of Biotic Integrity 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 Fish

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

Results and Discussion

For the 2016 sampling event, the fish community within the Doan Brook RM 0.75 sampling reach obtained an IBI score of 32, narratively *Fair* (Table 10). While the score has improved in comparison to the previous sampling event in 2014 (28, *Fair*), the fish community failed to meet the WWH IBI criterion (Figure 2). Of the fish collected in the sample that were designated pollution tolerance values by the Ohio EPA (Ohio EPA, 1987a), 100% were classified between moderately tolerant and highly tolerant (increasing from 96% in 2014). These values do not account for the 45 round goby (*Neogobius melanostomus*) collected during the assessment, which is an invasive species, accounting for 47.4% of the total sample fish population. Other dominant species collected during the assessment include green sunfish (*Lepomis cyanellus*) and northern bluegill sunfish (*Lepomis macrochirus*). Water quality degradation indicated by exceedances of *E. coli* may have been a contributing factor to the dominant presence of pollution-tolerant fish species and the absence of pollution-intolerant species.

The fish community at RM 0.75 showed improvement in relation to DELT anomalies. There were no DELT anomalies recorded from any fish collected at this site in 2016. The declining QHEI score of 51 (compared to 62, narratively *Good*, in 2014), which is only considered in the *Fair* category, and the associated absence of abundant instream cover and habitat, also may have directly correlated with the poor composition of the fish community at RM 0.75.

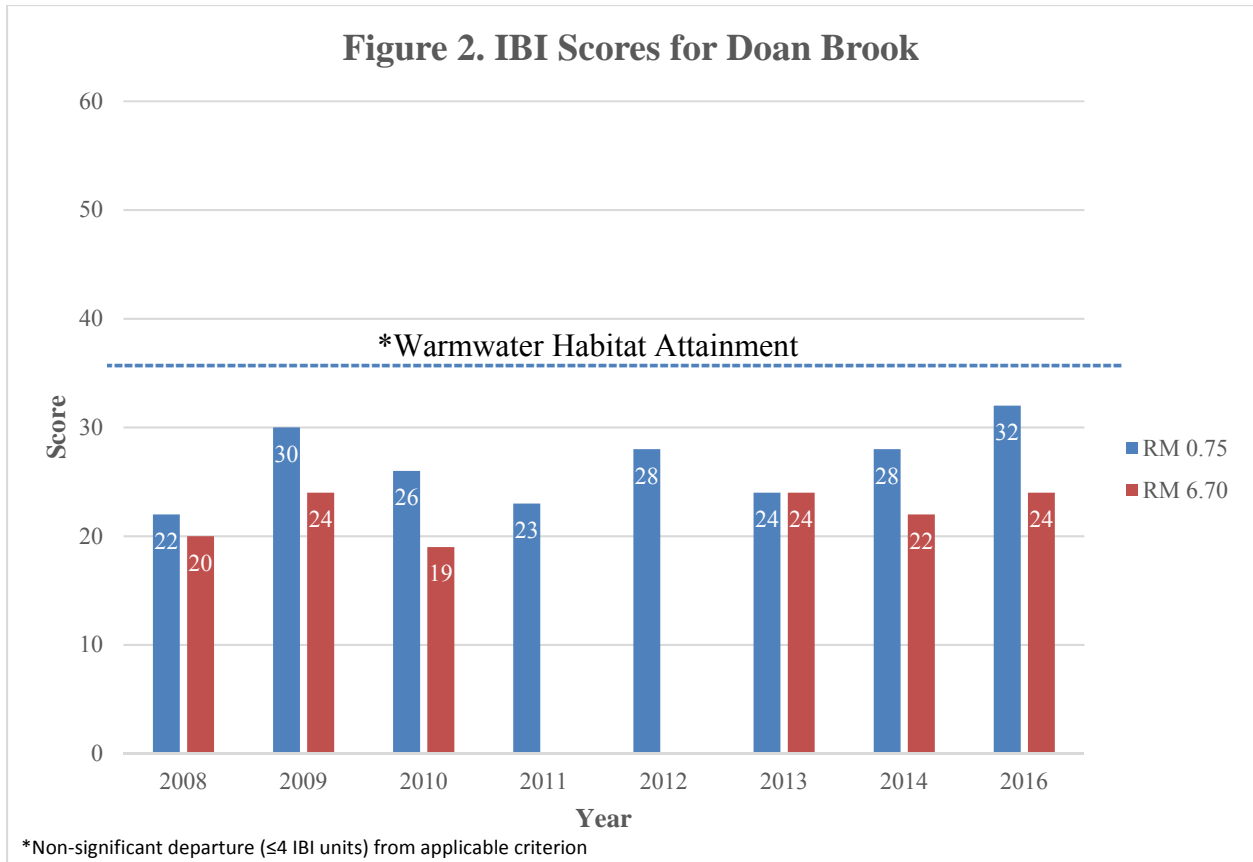
The fish community within the Doan Brook RM 6.70 sampling reach resulted in an IBI score of 24 with a narrative rating of *Poor* (Table 10). This score is only a two-point improvement from the fish assessment conducted in 2014 (22, narratively *Poor*). Furthermore, this sampling reach has had a narrative rating of *Poor* from the beginning of recorded sampling which began in 2008 (Figure 2). All fish collected from the sample reach at RM 6.70 (that have a designated pollution tolerance value), were classified as highly tolerant to pollution. The chemical water quality exceedances of *E. coli* at RM 6.70, in addition to downstream migration barriers within Doan Brook may have been a major contributing factor to the low fish species population diversity and the dominance of pollution-tolerant species.

Within the sample reach of RM 6.70, only four different fish species were collected. This number is a slight improvement from the last sampling event in 2014, when only two fish species were collected. The dominant species present at RM 6.70 was the creek chub (*Semotilus atromaculatus*), which accounted for 90% of the total fish collected at the sampling site. The other species found in the sampling reach at the time of collection

included blacknose dace (*Rhinichthys atratulus*), central stoneroller minnow (*Campostoma anomalum*), and green sunfish (*Lepomis cyanellus*). Similar to RM 0.75, no DELT anomalies were recorded among the fish at the time of collection.

Relating the QHEI score obtained in 2016 for RM 6.70 of 69.5, narratively *Excellent*, it would be assumed that the habitat is more than capable of sustaining a high quality fish community population. However, the urbanization of Doan Brook, in combination with culverting of sections of the stream, fish migration barriers, and a lack of a healthy fish community downstream, may be the largest contributing factors to diminished diversity among the fish population at the sampling reach at RM 6.70.

Table 10. Doan Brook IBI Scores 2008 -2016			
Site	Year	IBI Score	Narrative Rating
RM 0.75	2008	22	<i>Poor</i>
RM 0.75	2009	30	<i>Fair</i>
RM 0.75	2010	26	<i>Poor</i>
RM 0.75	2011	23	<i>Poor</i>
RM 0.75	2012	28	<i>Fair</i>
RM 0.75	2013	24	<i>Poor</i>
RM 0.75	2014	28	<i>Fair</i>
RM 0.75	2016	32	<i>Fair</i>
RM 6.70			
RM 6.70	2008	20	<i>Poor</i>
RM 6.70	2009	24	<i>Poor</i>
RM 6.70	2010	19	<i>Poor</i>
RM 6.70	2013	24	<i>Poor</i>
RM 6.70	2014	22	<i>Poor</i>
RM 6.70	2016	24	<i>Poor</i>



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), also referred to as EPT taxa, inhabiting available habitats at the time of HD retrieval. Sampling was conducted at all of the Doan Brook 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 HDs to be installed is six weeks.

The macroinvertebrate samples were sent to Third Rock Consulting of Lexington, Kentucky, for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as defined by the Ohio EPA (1987b). Lists of the species collected during the quantitative and qualitative sampling at each site are available upon request from the NEORSWQIS 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 11), 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 11. 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

The HD samplers were successfully recovered from both the RM 0.75 and RM 6.70 sampling sites during the 2016 season. Combined with qualitative macroinvertebrate sampling on the day of HD retrieval, this allowed for a calculated ICI score to assess each sampling site.

The macroinvertebrate community at Doan Brook RM 0.75 received an ICI score of 16 with a narrative rating of *Fair*, for 2016 (Table 12). Within the collected sample, only one EPT taxon, represented by a single organism from the Trichoptera species *Hydroptila sp.*, was present on the collected HD. There were no EPT taxa collected in the qualitative sample. All of the macroinvertebrate taxa collected in both the HD and qualitative sample are designated as facultative to tolerant to pollution according to the Ohio EPA Macroinvertebrate Taxa List (Ohio EPA, 2016). Of the total 26 taxa collected between the quantitative HD and the qualitative sample, 11 taxa were classified as moderately tolerant or tolerant of pollution. Unfortunately, the 2016 score of 16 is on trend with RM 0.75's consistent decline of the macroinvertebrate community (Figure 3).

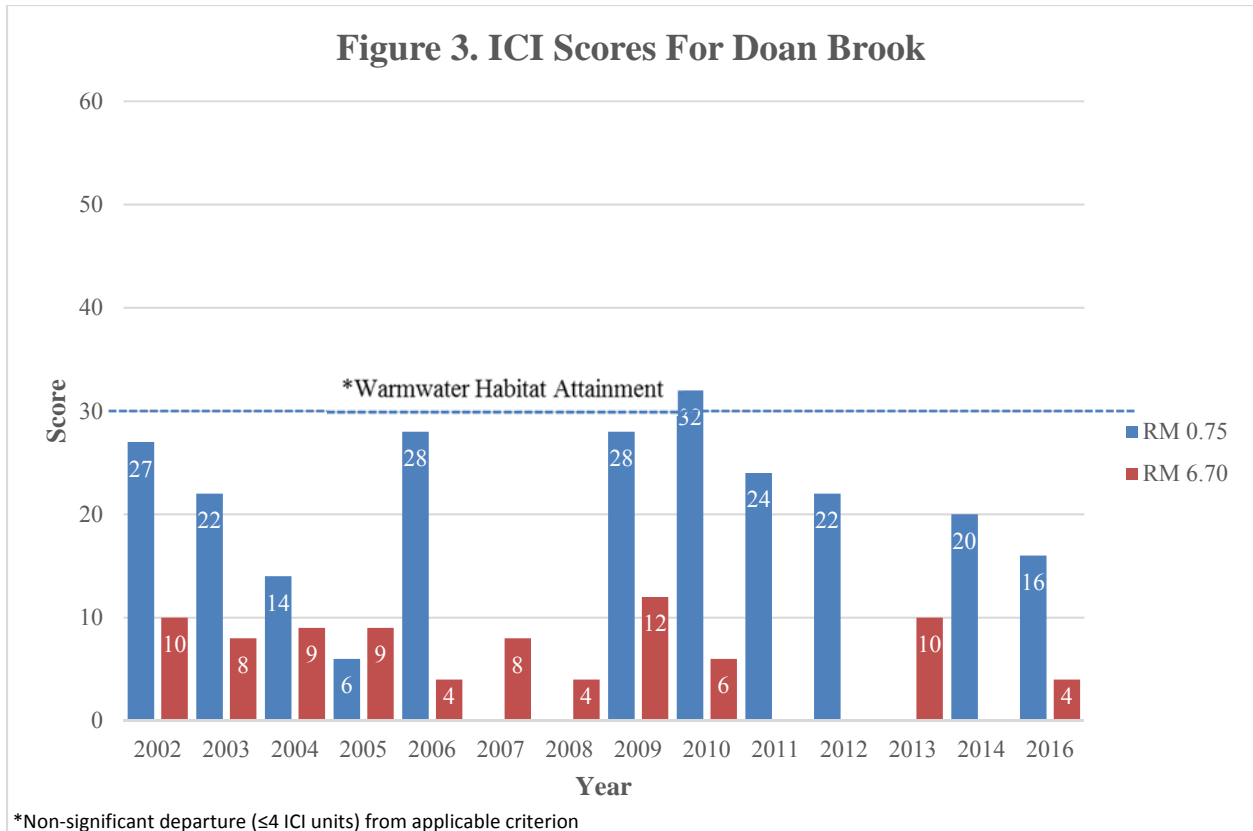
The macroinvertebrate community at Doan Brook RM 6.70 received an ICI score of 4 with a narrative rating of *Very Poor*, for 2016. Low taxa diversity, dominance of pollution-tolerant taxa, and lack of EPT taxa presence were all contributing factors to this score. Of the 13 total taxa collected from the HD sampler, no EPT taxa were collected. Only one EPT taxon, *Hydroptila sp.*, was collected during qualitative sampling. The dominant taxon found in the HD sample, accounting for 66.6% of the total organisms collected, was *Dicrotendipes simpsoni*, a pollution-tolerant species from the Family

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Chironomidae (non-biting midges). All 13 taxa identified from the HD sampler as well as all 8 taxa collected from the qualitative sample were designated between facultative and tolerant regarding pollution. When RM 6.70 was last sampled in 2014, the HD sampler was lost; therefore, a narrative score of *Poor* was assigned based on best professional judgement. Additionally, when the site was assessed in 2013, HD sample collection resulted in an ICI score of 10, with a narrative rating of *Poor*. The current 2016 sample aligns with the year to year ICI score fluctuation from *Poor* to *Very Poor*.

Table 12. 2002-2016 Invertebrate Community Index (ICI) Scores		
Sample Year	RM 0.75 ICI Score (Narrative Rating)	RM 6.70 ICI Score (Narrative Rating)
2002	27 [#] (<i>Fair</i>)	10 [#] (<i>Poor</i>)
2003	22 [#] (<i>Fair</i>)	8 [#] (<i>Poor</i>)
2004	14 [#] (<i>Fair</i>)	9 [#] (<i>Poor</i>)
2005	6 [#] (<i>Very Poor</i>)	9 [#] (<i>Poor</i>)
2006	28 [#] (<i>Fair</i>)	4 [#] (<i>Very Poor</i>)
2007	++	8 [#] (<i>Poor</i>)
2008	++	4 [#] (<i>Very Poor</i>)
2009	28 (<i>Fair</i>)	12 (<i>Poor</i>)
2010	32 (<i>Fair</i>)	6 (<i>Very Poor</i>)
2011	24 (<i>Fair</i>)	++
2012	22 (<i>Fair</i>)	++
2013	** (<i>Poor</i>)	10 (<i>Poor</i>)
2014	20 (<i>Fair</i>)	** (<i>Poor</i>)
2015	++	++
2016	16 (<i>Fair</i>)	4 (<i>Very Poor</i>)

** HD Not Retrieved – Narrative Rating Assigned ++ - No Sample Collected # -Based on 2-Sample Averaged ICI (Early Season -Late Season)



Conclusions

The results of the water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys conducted by NEORS D indicate that the Doan Brook watershed may be impacted by a variety of environmental stressors and various aquatic habitat limitations, as mentioned previously.

Bacteriological sampling within the Doan Brook sampling sites showed elevated densities of *E. coli*, which is regarded as an indicator of poor water quality conditions. Resulting from these water quality conditions, high proportions of pollution-tolerant fish and macroinvertebrates dominated their respective communities within the stream. Wet-weather flows that originate upstream from combined sewer overflows and stormwater runoff from upstream golf courses and recreational lake areas may contribute to the elevated levels of *E. coli* found within Doan Brook. In addition, Doan Brook has a high number of illicit discharges upstream of Horseshoe Lake. This ongoing problem (which is currently being worked on through the efforts of NEORS D), may be another contributing factor to the poor water quality conditions in Doan Brook.

The fish community at Doan Brook also appears to have been directly impacted by the diminished water quality present in the stream. Between the year 2008 to 2016, all

fish sampling events for RM 0.75 have resulted in IBI scores between the *Fair* and *Poor* narrative ranges. All sampling events for RM 6.70 have never resulted in a score above *Poor* for the above-mentioned years. While the habitat of Doan Brook can reasonably sustain higher quality and more diverse fish populations, overground runoff from lawns and nearby golf courses may be a contributing issue to affecting the water quality, in addition to the fish migration barrier challenges. These sites will not be able to attain the WWH criterion for IBI unless there is an improvement in the water quality.

The macroinvertebrate communities at RMs 0.75 and 6.70 scored in the *Fair* and *Very Poor* ranges, respectively, for the 2016 sampling season. The low ICI scores for both sites may be attributed to poor water quality conditions that continue to compromise Doan Brook. *E. coli* densities above the acceptable levels may be preventing Doan Brook from supporting a more robust and diverse macroinvertebrate population.

A green infrastructure project was completed in 2016 around RM 3.00 of Doan Brook to manage stormwater discharge from the nearby Fairhill neighborhood. The aim of the installation of bioretention ponds near RM 3.00 is to help alleviate flow of stormwater and runoff directly discharged to Doan Brook. This ability to have more control of stormwater flow should increase the possibility of minimizing flash flooding that may have been a contributing factor to the low quality and non-diverse macroinvertebrate and fish populations. Continued post-installation monitoring will be beneficial to determine the impact on the overall health of Doan Brook.

Doan Brook did not meet the necessary standards for Aquatic Life Use and received Non-Attainment status for all sampling sites during the 2016 sampling season (Table 13). Stream habitat in Doan Brook met the Ohio EPA WWH target for RM 6.70, and neared the target for RM 0.75; however, the biological communities did not meet attainment for either site assessed. Therefore, water quality may need to improve before the biotic communities can do likewise.

Table 13. 2016 Doan Brook 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
0.75	NON	32 <i>Fair</i>	16 <i>Fair</i>	52.0 <i>Fair</i>	<i>E. coli</i>
6.70	NON	24 <i>Poor</i>	4 <i>Very Poor</i>	69.5 <i>Excellent</i>	<i>E. coli</i>
WWH biocriterion attainment: IBI score of 40; ICI score of 34					
Non-significant departure: ≤4 IBI units; ≤4 ICI units					
*Narrative rating based on best professional judgment and habitat evaluation					

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Analytical Services Division – Completed analysis for all water chemistry sampling

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