

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2012 Doan Brook Environmental Monitoring Biological, Water Quality and Habitat Survey Results



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

Introduction

In 2012, the Northeast Ohio Regional Sewer District (NEORS D) conducted water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate surveys on Doan Brook at river mile (RM) 0.75, downstream of St. Clair Avenue. The data collected was evaluated to determine the extent to which the downstream biological communities may be impacted by combined sewer overflow (CSO) discharge points and other environmental impairments. Sampling was conducted by NEORS D 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 NEORS D study plan *2012 Doan Brook Environmental Monitoring* approved by Ohio EPA on May 15, 2012.

Macroinvertebrate and water chemistry sampling at RM 0.75 is required by Ohio EPA Permit No. 3PA00002*FD. Fish and habitat assessments are not required, but were conducted to determine the overall quality of water at this location.

Figure 1 is a map of the sampling location evaluated during the study, and Table 1 indicates the sampling location with respect to river mile, latitude/longitude, description, and the types of surveys conducted. A digital photo catalog of the sampling locations is available upon request by contacting the NEORS D Water Quality and Industrial Surveillance Division.



Figure 1. Doan Brook Sample Location

Table 1. 2012 Doan Brook Sample Site

Site Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Doan Brook	41.5330	-81.6296	0.75	Downstream of St. Clair Avenue	Cleveland North	Evaluate chemistry, habitat, fish, & macroinvertebrates in support of Ohio EPA Permit #3PA00002*FD

Water Chemistry and Bacteriological Sampling

Methods

Water chemistry and bacteriological sampling was conducted six times between June 19th, 2012 and July 24th, 2012, on Doan Brook at RM 0.75. Techniques used for sampling and analyses followed the Ohio EPA *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2012) and *Surface Water Field Sampling Manual* (2013). Chemical water quality samples from each site were collected with two 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles. One of the plastic bottles was field preserved with trace nitric acid and the other was field preserved with trace sulfuric acid. All water quality samples were collected as grab samples. Bacteriological samples were collected in sterilized plastic bottles. At the time of sampling, measurements for dissolved oxygen, pH, temperature, and conductivity were collected using a YSI 600XL sonde. Duplicate samples and field blanks were collected at randomly selected sites, at a frequency not less than 10% of the total samples collected. Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

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

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

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

The acceptable percent RPD is based on the ratio of the sample concentration and detection limit (Formula 2) (Ohio EPA 2013).

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

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 of the sampling events was done using EPA Method 245.1. Because the detection limit for this method is above the criteria for the Human Health Nondrinking and Protection of Wildlife Outside Mixing Zone Averages (OMZA), it generally cannot be determined if 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 river.

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

Results and Discussion

Due to an error in following sampling protocol, a field blank was not collected for QA/QC purposes at RM 0.75 in 2012. Because of this error, it is not known whether or not any data collected in 2012 would have been downgraded from Level 3 to Level 2 in accordance with Ohio EPA's validation protocol.

A duplicate sample was collected on July 2, 2012 at RM 0.75 for QA/QC purposes. The duplicate sample collected at RM 0.75 revealed only one parameter that was rejected due to an RPD that was greater than the acceptable RPD (Table 2).

Table 2. Unacceptable RPDs					
Date	Site	Parameter	Acceptable RPD (%)	Actual RPD (%)	Qualifier
7/2/2012	RM 0.75	Hg	93.9	95.7	Rejected

Paired parameters for all samples collected were also evaluated and compared for QA/QC purposes. These comparisons revealed that all of the data for chromium and hexavalent chromium were either estimated or rejected. 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.

Doan Brook is designated Warmwater Habitat (WWH), agricultural water supply, industrial water supply, and Class B primary contact recreation. The Class B 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, 2009a).

Water chemistry sampling at RM 0.75 in 2012 revealed mercury concentrations that resulted in 30-day averages that exceeded the Human Health Nondrinking Water and Protection of Wildlife Outside Mixing Zone Averages (OMZA) for all sampling periods (Table 2). Mercury may be introduced into Doan Brook from CSO discharges, and like all the watersheds in the area, urban runoff and atmospheric deposition (Table 3).

Table 3. 2012 Doan Brook RM 0.75 Mercury Exceedances						
Site	Sample Date	Form (units)	Concentration	30-Day Average Concentration	OMZA Criterion Nondrinking	OMZA Criterion Wildlife
RM 0.75	6/19/2012	TR (µg/L)	j 0.007	0.01	0.0031	0.0013
RM 0.75	6/26/2012	TR (µg/L)	< 0.005	0.01	0.0031	0.0013
RM 0.75	7/2/2012	TR (µg/L)	j 0.006*	0.01	0.0031	0.0013
RM 0.75	7/10/2012	TR (µg/L)	j 0.015	0.01	0.0031	0.0013
RM 0.75	7/17/2012	TR (µg/L)	j 0.006	0.00	0.0031	0.0013
RM 0.75	7/24/2012	TR (µg/L)	< 0.005	--	--	--

Shading = 30-day period exceedance of the criterion
 * Indicates data rejected based on comparison to duplicate sample

The Class B Primary Contact Recreation criteria for Doan Brook include an *E. coli* criterion not to exceed a single sample maximum (SSM) of 523 colony-forming units per 100 milliliters (CFU/100mL) in more than ten percent of the samples taken during any thirty-day period, and a seasonal geometric mean (SGM) criterion of 161 CFU/100mL (Ohio EPA, 2009b) (Table 4). Doan Brook exceeded both the Class B Primary Contact Recreation SSM and the SGM criteria at RM 0.75; these exceedances were most likely caused by upstream CSO discharges during wet weather events.

Table 4. 2012 Doan Brook RM 0.75 <i>E. coli</i> Exceedances (colony-forming units/100mL)			
Sample Date	Result (cfu/100mL)	30-Day Average Concentration (cfu/100mL)	Single Sample Maximum % Days > 523 cfu/100mL
6/19/2012*	1833	31,762	40
6/26/2012	310	31,602	40

Table 4. 2012 Doan Brook RM 0.75 E. coli Exceedances (colony-forming units/100mL)			
Sample Date	Result (cfu/100mL)	30-Day Average Concentration (cfu/100mL)	Single Sample Maximum % Days > 523 cfu/100mL
7/2/2012*	155,800	39,426	50
7/10/2012	380	634	33.3
7/17/2012*	491	762	50
7/24/2012	1033	--	--
Seasonal Geomean	1604	--	--

*Wet weather event

Copper exceeded the aquatic life OMZA on July 2, 2012, during a wet weather event. (Table 5). The exceedance was most likely caused by CSOs discharging upstream of the RM 0.75 site.

Table 5. 2012 Doan Brook Copper Exceedance				
Site	Sample Date	Form (units)	Result	OMZM Criterion Aquatic Life
RM 0.75	7/2/2012*	TR (µg/L)	19.425	16.361

*Wet weather event

Habitat Assessment

Methods

Instream habitat assessments were conducted once on Doan Brook in 2012 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

* 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

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 or more suggests that sufficient habitat exists to support a fish community that attains the warmwater habitat criterion (Ohio EPA, 2003). A more detailed description of the QHEI can be found in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006). QHEI field sheets for each site are available upon request from the NEORSD WQIS Division.

Results and Discussion

The stream segment at RM 0.75 obtained a QHEI score of 63.5 (*Good*) (Table 6), indicating attainment of the warmwater habitat target of 60 and the potential to support a healthy fish and macroinvertebrate community. Cobble and gravel were the predominant substrate types. Sparse to moderate instream cover consisting of shallows, deep pools, boulders, and woody debris were present. This portion of the stream is channelized with low sinuosity, which detracts from the overall score.

Table 6. 2012 Doan Brook QHEI Results			
River Mile	Date	QHEI Score	Narrative
0.75	9/11/2012	63.5	<i>Good</i>

Electrofishing

Methods

One quantitative electrofishing pass was conducted at RM 0.75 in 2012. Sampling was conducted using the longline electrofishing technique and consisted of shocking all habitat types within a sampling zone while moving from downstream to upstream. The sampling zone was 0.15 kilometers. 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 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 were compiled and utilized to evaluate fish community health through the application of two Ohio EPA indices, the Index of Biotic Integrity (IBI) and the Modified Index of Well-Being (MIwb). 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 7.

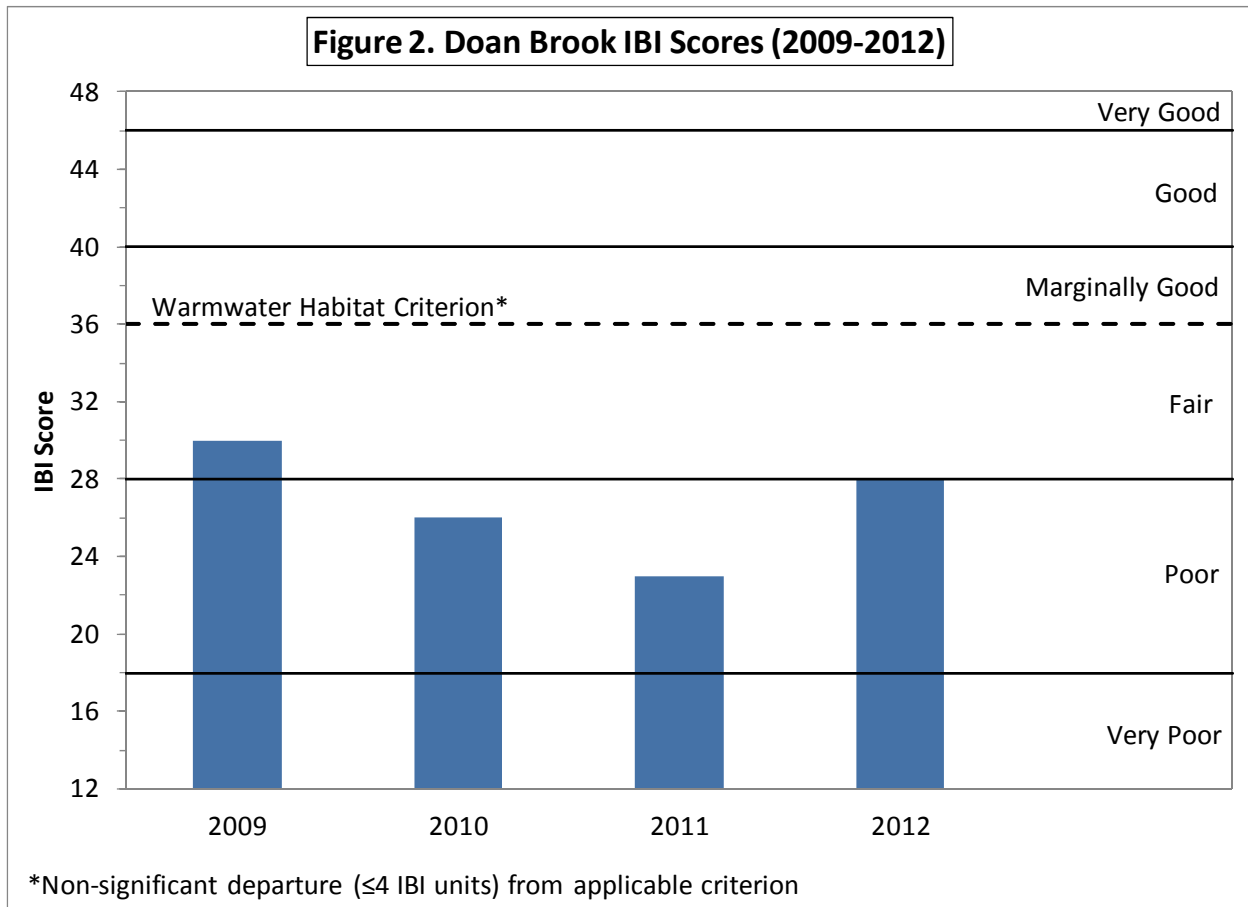
Table 7. IBI Metrics (Headwater)
Total number of Native Species
Number of Darters & Sculpins
Number of Headwater Species
Number of Minnow Species
Number of Sensitive Species
Percent Tolerant Species
Percent Pioneering Species
Percent Omnivores
Percent Insectivores
Number of Simple Lithophils
Percent DELT Anomalies
Number of Fish

Results and Discussion

In 2012, Doan Brook RM 0.75 obtained an IBI score of 28 (*Fair*) and failed to meet the WWH IBI criterion of 40 (Table 8 and Figure 2). Of the fish collected, 88% were considered moderately to highly pollution tolerant. The sample consisted mainly of common white sucker, brown and yellow bullheads, green sunfish, creek chub and goldfish. The 2012 score increased slightly from an average score of 23 (*Poor*) in 2011, but remained consistent with IBI scores obtained in previous years (Table 7). The number of DELT anomalies present on fish collected in 2012 decreased from an average of 15% DELTs in 2011 to 0% DELTs in 2012. Degraded water quality as indicated by mercury, copper and *E. coli* exceedances at RM 0.75 may be contributing to the abundance of pollution-tolerant fish species and lack of pollution-intolerant species at RM 0.75. A QHEI score of 63.5 (*Good*) indicates that necessary instream habitat is present to support a robust fish community; however, Doan Brook is subject to flash

flooding during rain events which may prevent fish communities from establishing permanent populations.

Table 8. 2009-2012 Doan Brook IBI Scores				
Year	2009	2010	2011	2012
IBI Score	30	26	23	28
Narrative	Fair	Poor	Poor	Fair



Macroinvertebrate Sampling

Methods

Quantitative macroinvertebrate sampling was performed 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. 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 Midwest Biodiversity Institute (MBI) of Columbus, Ohio, for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as defined by the Ohio EPA (1987b). Lists of the species collected during the quantitative and qualitative sampling at each site are available upon request from WQIS.

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

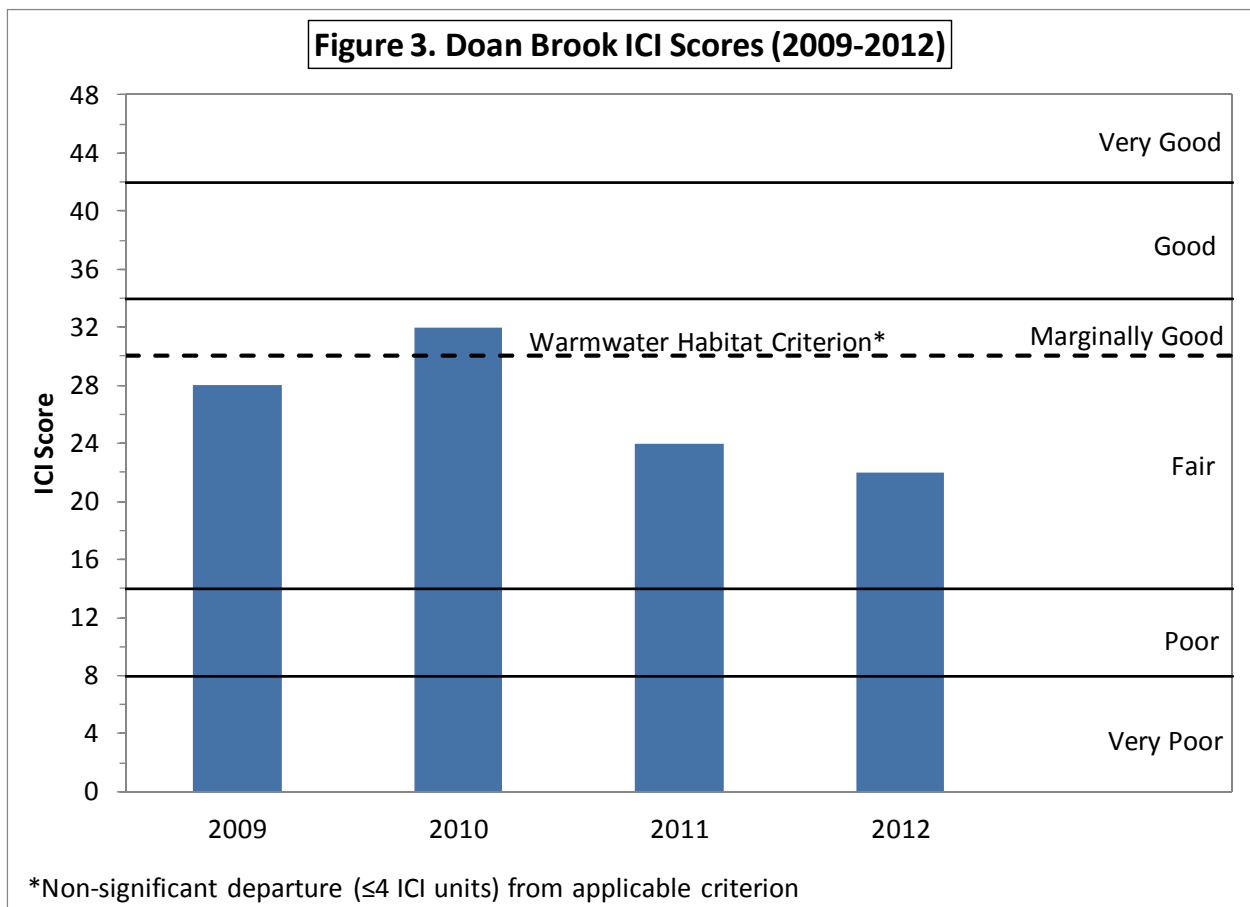
Table 9. ICI Metrics
Total number of taxa
Number of mayfly taxa
Number of caddisfly taxa
Number of dipteran taxa
Percent mayflies
Percent caddisflies
Percent Tanytarsini midges
Percent other diptera and non-insects
Percent tolerant organisms (as defined)
Number of qualitative EPT taxa

Results and Discussion

Doan Brook RM 0.75 obtained an ICI score of 22 and a narrative rating of *Fair* (Table 10) in 2012. A total of 27 taxa were collected, with 81% of the sample consisting of Dipterans and non-insects. Tanytarsini midges comprised 16.6% of the sample in 2012, compared to 6.9% in 2011; however, the percentage is still significantly lower than the 40.9% collected in 2010. Mayflies of the family *Baetidae* and caddisflies, including

Hydropsychidae, compromised 1.9% and 0.5% of the sample, respectively. Tolerant organisms compromised 31.3% of the sample and included *Oligochaeta* and *Polypedium illinoense*. Bacteria and metals pollution, combined with the transient nature of the substrate at RM 0.75, is most likely preventing more pollution-sensitive species from colonizing the area.

Table 10. 2009-2011 Averaged Invertebrate Community Index Scores								
River Mile	2009	Narrative Rating	2010	Narrative Rating	2011	Narrative Rating	2012	Narrative Rating
0.75	28	Fair	32	Good	24	Fair	22	Fair



Conclusions

Bacteriological sampling showed elevated *E. coli* densities at RM 0.75, an indication of generally poor water quality conditions in Doan Brook. As a result, a relatively high percentage of pollution-tolerant fish and macroinvertebrate species were present in the stream. Flows originating from sanitary sewer overflows, illicit discharges, and CSOs may be contributing to the elevated levels of *E. coli* and other pollutants.

The macroinvertebrate community in Doan Brook received a *Fair* rating in 2012. Twenty-seven total macroinvertebrate taxa were collected, compared to 22 total taxa collected in 2011. The increase in ICI score for 2012 may be attributed to the HD not being disturbed throughout the six-week sample period, as it was dislodged and washed downstream in 2011. Contamination from sanitary sewage and metals pollution may still be preventing Doan Brook RM 0.75 from supporting a more diverse macroinvertebrate community.

The fish community also appeared to be impacted from degraded water quality. From 2009 thru 2012, four longline electrofishing passes were completed at the Doan Brook site (RM 0.75). Of the four passes completed, two rated *Poor* for the IBI fish community scores. A *Fair* value was obtained in 2009 and again in 2012. Eight out of the eleven species of fish collected at RM 0.75 in 2012 were highly pollution-tolerant fish. Because the habitat in Doan Brook met Ohio EPA's target for warmwater habitat, it is not expected that the fish community will be in attainment of the warmwater habitat criterion until water quality improves in the stream.

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