NORTHEAST OHIO REGIONAL SEWER DISTRICT

2010 Doan Brook Environmental Monitoring

Prepared by
Water Quality and Industrial Surveillance
Division

Introduction

In 2010, the Northeast Ohio Regional Sewer District (NEORSD) conducted water quality sampling, habitat assessments, fish and benthic macroinvertebrate sampling on Doan Brook upstream and downstream of NEORSD owned combined sewer overflow (CSO) areas. The results from the upstream data were compared with the downstream data to determine the extent to which the downstream communities may be impacted by CSOs or other environmental impairments. Sites were also evaluated individually to see if there are any impacts from point and non-point sources of pollution. Sampling was conducted by NEORSD Level 3 Qualified Data Collectors certified by Ohio Environmental Protection Agency (EPA) in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORSD study plan *2010 Doan Brook Environmental Monitoring* approved by Ohio EPA on June 18, 2010.

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

Doan Brook is approximately 8.5 miles in length, originating east of Warrensville Road in Shaker Heights. The two branches flow through the upper Horseshoe Lakes in Shaker Heights, before joining the marsh at the Nature Center in Shaker Heights. The brook then flows through Lower Lake to west of Coventry Road into a mile-long culvert at Ambler Park in the City of Cleveland. Doan Brook then flows past the Cleveland Art Museum, through Rockefeller Park along Martin Luther King Boulevard, and under the Dike 14 Nature Preserve (formally a confined material disposal site) before finally entering Lake Erie.

Figure 1 is a map of the sampling locations evaluated during the study, and Table 1 indicates the sampling locations with respect to river mile (RM), latitude/longitude, description, and the types of surveys conducted.

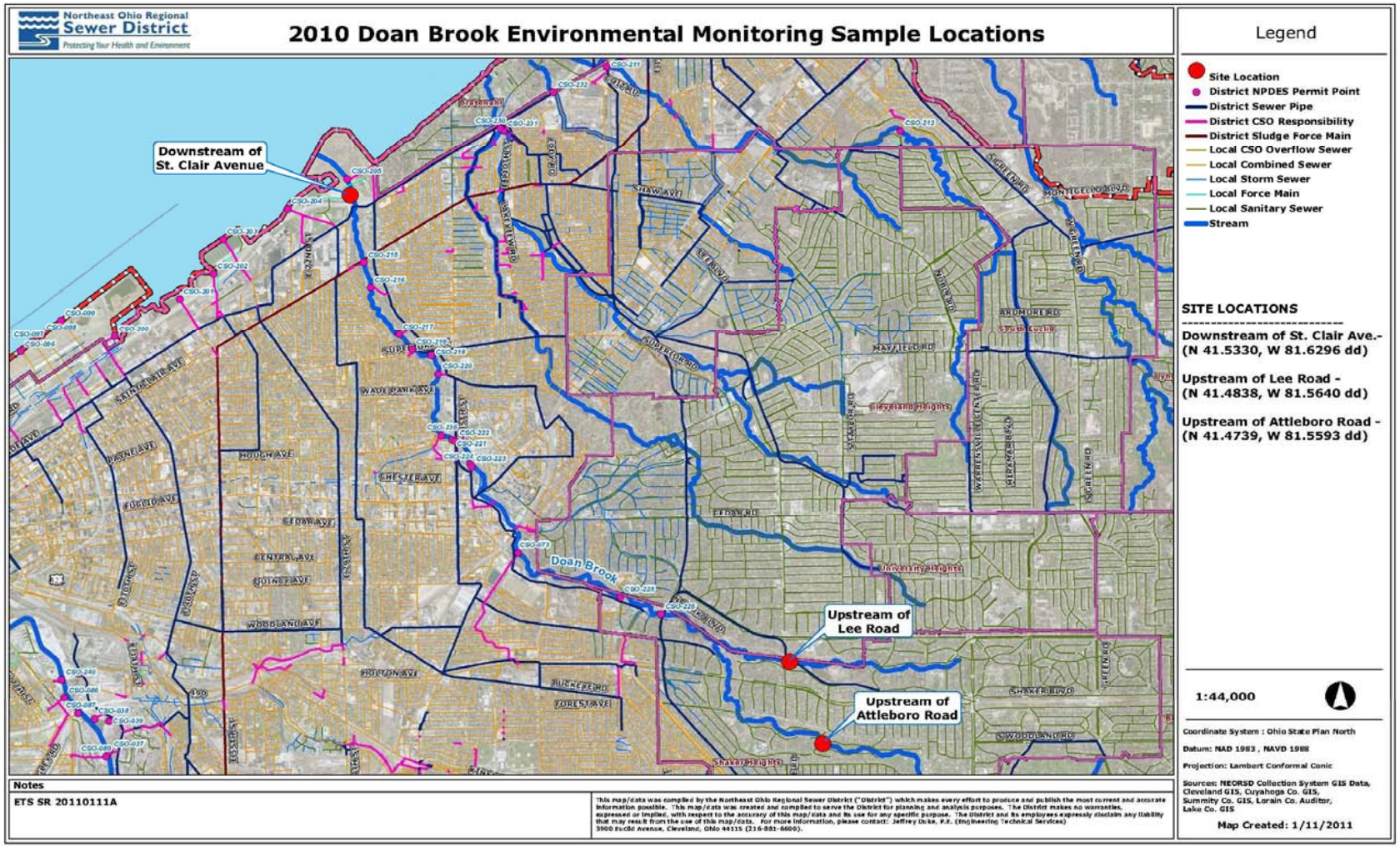

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment
2010 Doan Brook Environmental Monitoring Sample Locations
Downstream of St. Clair Avenue
Upstream of Lee Road
Upstream of Attleboro Road
Doan Brook
Legend
Site Location
District NPDES Permit Point
District Sewer Pipe
District CSO Responsibility
District Sludge Force Main
Local CSO Overflow Sewer
Local Combined Sewer
Local Storm Sewer
Local Force Main
Local Sanitary Sewer
Stream
SITE LOCATIONS
Downstream of St. Clair Ave.- (N 41.5330, W 81.6296 dd)
Upstream of Lee Road - (N 41.4838, W 81.5640 dd)
Upstream of Attleboro Road - (N 41.4739, W 81.5593 dd)
1:44,000
Coordinate System : Ohio State Plan North
Datum: NAD 1983 , NAVD 1988
Projection: Lambert Conformal Conic
Sources: NEORSD Collection System GIS Data, Cleveland GIS, Cuyahoga Co. GIS, Summity Co. GIS, Lorain Co. Auditor, Lake Co. GIS
Map Created: 1/11/2011
Notes
ETS SR 20110111A

Figure 1

Table 1.

Site Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Doan Brook	N41.5330°	W81.6296°	0.75	Downstream of St. Clair Avenue	Cleveland North	Evaluate chemistry, habitat, fish, & macroinvertebrates in support of Ohio EPA Permit #3PA00002*FD
Doan Brook	N41.4838°	W81.5643°	6.70	Upstream of Lee Road	Shaker Heights	Evaluate chemistry, habitat, fish, & macroinvertebrates upstream of NEORSD CSOs
Doan Brook, South Branch	N41.4739°	W81.5593°	1.40	Upstream of Attleboro Road	Shaker Heights	Evaluate chemistry, habitat, fish, & macroinvertebrates upstream of NEORSD CSOs

Water Chemistry and Bacteriological Sampling

In 2010, water quality samples, consisting of chemistry and bacteriological sampling, were collected from Doan Brook at the three locations listed in the above table. Five samples were collected at each site on Doan Brook from June 22, 2010 to July 27, 2010. All of the water chemistry sampling followed the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009a). Water quality monitoring of Doan Brook prior to the completion of NEORSD collection system capital improvement construction projects, such as the Doan Valley Storage Tunnel, will provide baseline data which, after work completion, will allow the NEORSD to demonstrate any improvements in water chemistry and the aquatic life community present in the brook resulting from the capital improvement projects.

Benthic and water column chlorophyll *a* sampling was also conducted once on September 30, 2010, at the three locations. A total of fifteen rocks were collected from each location in the river, scraped of the algae mass accumulated in a defined surface area on the rock, and composited for benthic chlorophyll *a* analysis. Grab samples were collected from the river in the same vicinity as the benthic samples for measurement of water column chlorophyll *a*. Field and chemical water quality parameters were measured together with the chlorophyll *a* samples and included total phosphorus, dissolved reactive phosphorus, nitrate & nitrite, alkalinity, turbidity and suspended solids.

For each water quality sampling event, a sample was collected in two 4-liter disposable polyethylene Cubitainers with disposable polypropylene lids, two 473 milliliter (mL) plastic bottles, and one 500-mL treated bacteriological bottle. One of the plastic bottles was field preserved with trace nitric acid and the other was field preserved with trace sulfuric acid. The 500 mL bottle was preserved with sodium thiosulfate. All samples were placed in a cooler with ice and stored in a locked vehicle until the samples were transferred to NEORSD's Analytical Services sample receiving area. All samples were released to an authorized Analytical Services employee with a Chain of Custody.

Field parameters were measured in stream. Field analyses included the use of aYSI-556 MPS Multi-Parameter Water Quality Meter or a YSI 600 XL sonde to measure dissolved oxygen, water temperature, conductivity and pH at the time of sampling. A Surface Water Condition Sampling Field Data Form was filled out for each site during each sampling event.

During the five sampling events, two sample duplicates and two field blanks were obtained for QA/QC purposes. The sample duplicates were collected at RMs 1.40 and 6.70. The sample field blanks were collected during the month of July. The field blank results appeared to be normal and did not show any signs of contamination during handling or transportation. The results from the sample duplicates were compared to the primary sample using relative percent difference (RPD), see Formula 1:

Formula 1)

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

X= is the concentration of an analyte in the primary sample

Y= is the concentration of the same analyte in the duplicate sample

An RPD was calculated for each of the 43 individual chemical parameters reported on the Certificates of Analysis. The acceptable RPD between duplicate and primary samples is less than or equal to 30 percent. Any difference greater than 30 percent was investigated as to the cause of the disparity. After evaluating the RPD values, sixteen potential disparities were found: aluminum (61.36%), BOD (150%), COD (98%), beryllium (66.6%) cadmium (66.6%), chromium (87%), iron (45.9%), manganese (49.53%), lead (78%), titanium (69.76%), zinc (47.26%), vanadium (44%), ammonia (73.97% and 68.57%), total suspended solids (150.51%). All the reported concentrations of the above chemical parameters were less than 10 times their practical quantitation limit (PQL) except iron, which was greater than 10 times the PQL. The higher RPD values were most likely due to the low concentrations measured for those parameters. The higher RPD for iron cannot be explained by differences in extremely low concentrations, and the reason for the discrepancy is unknown.

Results and Discussion

Doan Brook is designated Warmwater Habitat (WWH), agricultural water supply, industrial water supply, and primary contact recreation. The Lake Erie Drainage Basin (LEDB) human health non-drinking water criteria and the wildlife criteria also apply to each site. 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).

Mercury analysis for all of the samples was completed using EPA Method 245.1. Because the detection limit for this method is above the criteria for the Human Health Nondrinking water 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 contamination above those levels typically found in the brook. For the data that was collected in 2010, the sites at RMs 1.40 and 0.75 had mercury concentrations that resulted in 30-day averages that exceeded the Human Health Nondrinking water and Protection of Wildlife Outside Mixing Zone Averages (OMZA) (Tables 2 and 3). It is expected that the use of EPA Method 1631E for all of the samples would have resulted in exceedances throughout the sampling.

Table 2.
RM 0.75 Mercury Results

Sample Date	Mercury								
	Method	**MDL** (µg/L)	**PQL** (µg/L)	**Concentration** [1]TR (µg/L)	**Adjusted Concentration** TR (µg/L)	**30-day period**	**Average Concentration**	**OMZA Criterion (Wildlife)**	**OMZA Criterion (Nondrinking)**
6/22/2010	EPA 245.1	0.005	0.050	J 0.009	0.009	6/22/10-7/22/10	0.006	0.0013	0.0031
6/29/2010	EPA 245.1	0.005	0.050	<0.005	0.0025	6/29/10-7/29/10	0.005	0.0013	0.0031
7/06/2010	EPA 245.1	0.005	0.050	<0.005	0.0025	7/06/10-8/05/10	0.005	0.0013	0.0031
7/13/2010	EPA 245.1	0.005	0.050	J 0.013	0.013	7/13/10-8/12/10	0.006	0.0013	0.0031
7/20/2010	EPA 245.1	0.005	0.050	<0.005	0.0025	7/20/10-8/19/10	0.003	0.0013	0.0031
7/2720/10	EPA 245.1	0.005	0.050	<0.005	0.0025	--	--	--	--

[1]TR= Total Recoverable
Shaded area= 30-day period exceedance of criterion

Table 3.

RM 1.40 Mercury Results

Sample Date	Mercury								
	Method	**MDL** (µg/L)	**PQL** (µg/L)	**Concentration** [1]TR (µg/L)	**Adjusted Concentration** TR (µg/L)	**30-day period**	**Average Concentration**	**OMZA Criterion (Wildlife)**	**OMZA Criterion (Nondrinking)**
6/22/2010	EPA 245.1	0.005	0.050	J 0.024	0.024	6/22/10-7/22/10	0.018	0.0013	0.0031
6/29/2010	EPA 245.1	0.005	0.050	<0.005	0.0025	6/29/10-7/29/10	0.017	0.0013	0.0031
7/06/2010	EPA 245.1	0.005	0.050	J 0.015	0.015	7/06/10-8/05/10	0.022	0.0013	0.0031
7/13/2010	EPA 245.1	0.005	0.050	J 0.047	0.047	7/13/10-8/12/10	0.025	0.0013	0.0031
7/20/2010	EPA 245.1	0.005	0.050	<0.005	0.0025	7/20/10-8/19/10	0.018	0.0013	0.0031

[1]TR= Total Recoverable
Shaded area= 30-day period exceedance of criterion

Doan Brook at RMs 1.40 and 6.70 was in non-attainment of the *E. coli* criteria for Class B primary contact recreation use by exceeding the single sample maximum criterion of 523 colony-forming units per 100 milliliters (CFU/100 ml) in more than ten percent of the samples taken in a 30-day period for four thirty-day periods. Also, all sites were in non-attainment of the seasonal geometric mean criterion of 161 CFU/100 mL. RM 0.75 exceeded the *E. coli* criterion for Class B primary contact recreation use for all five 30-day periods from June 22, 2010 thru August 18, 2010. Table 4 lists the *E. coli* sample results for each site.

Table 4.

Sample Date	St. Clair Ave. RM 0.75	Attleboro Road RM 1.40	Lee Road RM 6.70	Precipitation[1]
	E. coli (CFU/100 mL)			Total Inches
6/22/2011	158,100	45,000	1,360	1.30
6/29/2011	200,000	496.5	193	0.56
7/06/2011	64,000	1,164	210	0.00
7/13/2011	4,400	7,091	1,646.5	1.04
7/20/2011	1,520	13,600	1,340	0.14
7/27/2011	600	-	-	0.67

[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 of rain, samples collected that day and the following two days are considered wet weather samples. Rainfall data taken from the following NEORSD rain gages: Wade Park (RWK), Cleveland Heights (RCL), and Shaker Heights (RSG).

The NEORSD 2010 Community Discharge Program Status Report lists 31Sanitary Sewer Overflows (SSOs) tributary to Doan Brook. These SSOs are located in the cities of Cleveland Heights and Shaker Heights (Table 5).

Table 5.
Sanitary Sewer Overflows (SSO's) on Doan Brook

Community	SSO #	Location
Cleveland Heights	CH-1, CH-2	Fairmount at North Woodland.
Cleveland Heights	CH-32	Fairmount at Arlington.
Cleveland Heights	CH-38	Fairmount at Marlboro.
Cleveland Heights	CH-35	2393 Coventry, west of Fairmount.
Cleveland Heights	CH-33	Fairmount at Fairfax.
Cleveland Heights	CH-36	North Park and Coventry.
Cleveland Heights	CH-37	Fairfax at North Park Blvd..
Cleveland Heights	CH-42	12537 Cedar Road
Cleveland Heights	CH-09	Bradford and Lee Road
Cleveland Heights	CH-05,CH-06, CH-07	Fairmount at South Fairmount
Cleveland Heights	CH-03	Fairmount at Wellington
Cleveland Heights	CH-13	Hampshire Lane at Euclid Hts. Blvd.
Cleveland Heights	CH-39	3012 North Woodland
Cleveland Heights	CH-04	Fairmount at Dartmoor
Cleveland Heights	CH-08	Fairmount at Lee Road
Cleveland Heights	CH-45	2764 Fairmount
Cleveland Heights	CH-46	Edgehill at Euclid Hts. Blvd.
Cleveland Heights	CH-15	Coventry at Cedar Road
Cleveland Heights	CH-24	3003 Euclid Hts. Blvd.
Cleveland Heights	CH-49	2765 Fairmount east of Church Ave.
Cleveland Heights	CH-47	2528 Stratford north of Monmouth
Cleveland Heights	CH-23	2828 Berkshire east of Coventry
Shaker Heights	HL-02	South Park Blvd. at Attleboro
Shaker Heights	VA-09	Ingleside and Fernway
Shaker Heights	S1X1,S1X2	Shaker at Lee Road
Shaker Heights	S1HX	South Park Blvd. at Lee Road
Shaker Heights	DV-45	South Woodland at West Park

The elevated densities of *E. coli* from sampling at RM 0.75, RM 1.40 and RM 6.70 may be attributable to overflow events during wet weather, SSO's listed above or unknown blockages in the collection system that may have caused overflows during dry weather.

Doan Brook at RM 0.75 exceeded the WWH aquatic life use outside mixing zone maximum (OMZM) copper criterion of 12.14 µg/L. Copper was measured at 13.69 µg/L

on June 22, 2010, during a wet weather sampling event. According to Cleveland Museum of Art Associate Director Paul Kremisky, Wade Park Pond is treated with Cutrine-Plus (which contains copper sulfate) annually, from May through September, for aquatic vegetation control (personal communication on November 23, 2011). The pond can overflow into Doan Brook during wet weather events which may have been the cause of the copper exceedence. The discharge from the pond enters Doan Brook upstream of RM 0.75.

Doan Brook at RM 1.40 exceeded the OMZM copper criterion and exceeded the OMZA for two 30-day periods (July 13-August 11 and July 20- August 18). Copper was measured at 15.36 µg/L on June 22, 2010, during a wet weather sampling event, exceeding the OMZM criterion of 9.87 µg/L. Copper values of 13.19 µg/L and 16.15 µg/L were obtained on July 13 and July 20, exceeding the OMZA criteria of 12.59 µg/L and 12.36 µg/L, respectively. It was not determined what caused the copper exceedences at RM 1.40, however, it may be influencing the elevated levels at RM 0.75.

Results from the benthic and water column chlorophyll *a* sampling are shown in Table 6 from the three locations on Doan Brook. This was the first year chlorophyll *a* data was collected. The data will be used to establish baseline levels for nutrients.

Table 6.
Chlorophyll *a* Sampling Results on Doan Brook

	Unit	September 30, 2010		
		RM 0.75	RM 1.40	RM 6.70
Benthic Chlorophyll *a*	mg/m^2	59.3	80.0	25.9
Water Column Chlorophyll *a*	µg/L	-	1.287	59.350
Alkalinity	mg/L $CaCO_3$	105.9	150.2	74.5
Total Suspended Solids	mg/L	0.9	0.9	5.5
Turbidity	NTU	9.32	5.44	15.09
Total Phosphorus	mg/L	0.103	0.124	0.087
Soluble Reactive Phosphorus	mg/L	0.078	0.099	0.035
Nitrate +Nitrite	mg/L	0.536	0.823	0.6
Dissolved Oxygen	mg/L	9.45	Meter malfunction	Meter malfunction

RM 1.40 had the highest benthic chlorophyll *a* concentration (80 mg/m²) and RM 6.70 had the lowest concentration (25.9 mg/m²). All three sites on Doan Brook (Table 5) were below the target value of 107 mg/m² for the protection of biological integrity (Miltner, 2010). Benthic chlorophyll *a* levels are correlated to the amount of nutrients

and the amount of sunlight penetrating through the open canopy surrounding the stream. RM 1.40 had the highest open canopy (75%) and RM 6.70 the lowest open canopy (25%) of the three sites sampled. This correlates to the greater open canopy at RM 1.40 allowing more sunlight in and higher benthic chlorophyll *a* values, compared to the lower open canopy and lower values obtained at RM 6.70. Dissolved Oxygen data could not be obtained on September 30, 2010 due to a meter malfunction.

Habitat Assessment

Methods

The Qualitative Habitat Evaluation Index (QHEI) score was calculated for sites on Doan Brook on the main branch at RMs 6.70 and 0.75 and on the south branch at RM 1.40. The QHEI, developed by Ohio EPA, is used to assess the aquatic habitat conditions at each sample location by providing an evaluation of the physical components of a stream. The index is based on six metrics: stream substrate, instream cover, stream channel morphology, riparian and bank condition, pool and riffle quality, and stream gradient. These metrics describe the physical attributes of a stream and may be important in explaining why fish species are present or absent. A more detailed description of the QHEI can be found in Ohio EPA's (2006), *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)*. The Ohio Environmental Protection agency has set a QHEI target goal of 60 for WWH with a score of ≥60 indicating adequate habitat diversity to support a warmwater community of fish. The QHEI field sheets for these sites are available upon request from WQIS.

Results and Discussion

Doan Brook at RM 6.70 received a QHEI score of 67 (*Good*), which showed adequate habitat diversity. Gravel and cobble were the predominant substrate types, and the moderate instream cover consisted of limited overhanging vegetation, rootmats, rootwads, deep pools, boulders, and logs and woody debris. Bank erosion was moderate on each river bank and riparian width was moderate. Channel development was fair and riffle and run embeddedness was moderate. The site is surrounded by residential homes. QHEI scores maintained the same narrative rating (*Good*) as scored in 2008 and 2009 (Table 8).

Doan Brook at RM 1.40 obtained a QHEI score of 67.5 (*Good*). Gravel and sand were the best substrate types present. Instream cover consisted of undercut banks, shallows, rootmats, deep pools, rootwads, boulders, and woody debris. The stream is a straight channel with no sinuosity present. This site met the Ohio EPA's target for warmwater habitat streams in 2010 and 2009 (Table 6). QHEI scores maintained the same narrative rating (*Good*) as scored in 2008 and 2009.

The QHEI at Doan Brook RM 0.75 scored a 62.5 (*Good*). Gravel and sand were the predominant substrate type with sparse instream cover consisting of shallows, deep pools, boulders, and woody debris. There was little to no bank erosion and the surrounding area is residential/park. A functional riffle was present at this site in 2010, in contrast to no riffle in 2008. This site scored a 51 in 2008 due to poor channel development and lack of a functional riffle (Table 7).

Table 7.
2008-2010 Qualitative Habitat Evaluation Index Scores

River Mile	2008	Narrative Rating	2009	Narrative Rating	2010	Narrative Rating
6.70	65.0	*Good*	56.5	*Good*	67.0	*Good*
1.40	59.0	*Good*	66.0	*Good*	67.5	*Good*
0.75	51.0	*Fair*	62.0	*Good*	62.5	*Good*

Electrofishing

Methods

In 2010, electrofishing passes were conducted two times at each headwater site (drainage area <20 square miles) in accordance to the Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III: Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities* (1987b).

At each Doan Brook site, longline electrofishing techniques were used to shock all habitat types within a sampling zone. This zone was 0.15 kilometers in length, and shocking consisted of moving from downstream to upstream. Fish were identified to species level and counted and examined for the presence of external anomalies including deformities, erosions, lesions, and tumors (DELTs). A list of these results is available upon request from WQIS.

Results from electrofishing sampling were used to calculate the Index of Biotic Integrity (IBI). The IBI is used to assess fish community health at a site. Twelve metrics comprise the IBI for headwater sites:

1. Number of Native Species
2. Number of Darter Species
3. Number of Headwater Species
4. Number of Minnow Species
5. Number of Sensitive Species
6. Proportion of Tolerant Species

7. Proportion of Omnivores
8. Proportion of Insectivores
9. Proportion of Pioneering Species
10. Number of Individuals
11. Number of Simple Lithophilic Species
12. Proportion that are Diseased, Deformed, have Eroded Fins, Lesions or Tumors (DELTs)

The summation of the twelve individual metric scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional, Good, Marginally Good, Fair, Poor or Very Poor.* The maximum possible IBI score is 60 and the minimum possible score is 12. An IBI score of ≥36 at headwater sites indicates attainment of the WWH biocriterion in the Erie Ontario Lake Plain ecoregion.

Results and Discussion

In 2010, Doan Brook at RM 6.70 received an average IBI score in the *Poor* range (19), failing to meet the WWH IBI criterion of 36 (Figure 2). At RM 6.70, green sunfish and creek chubs were the only species collected. Creek chubs comprised 94% of the total fish collected. Creek chubs also dominated the total catch in 2008 (92%) and 2009 (98%); however, in those years, a small proportion of common white suckers, central stoneroller minnows and blacknose dace were also collected. IBI scores of 20 (*Poor*) and 22 (*Poor*) were obtained in 2008 and 2009, respectively. The 2010 QHEI score of 67 (*Good*) shows the habitat being able to support WWH species; however, poor water quality from bacterial contamination may be an issue and may explain why a better diversity of fish was not present.

In 2010 RM 1.40 had an average IBI score of 23 with a rating of "Poor" (Table 8) based on two electrofishing sampling events. Four hundred forty-four green sunfish, which are highly pollution-tolerant species dominated the fish community at this site. In 2008 and 2009, green sunfish still dominated the total catch comprising 99%; however, four goldfish were collected on September 25, 2009, at this site. IBI scores of 22 (*Poor*) and 24 (*Poor*) were obtained in 2008 and 2009, respectively.

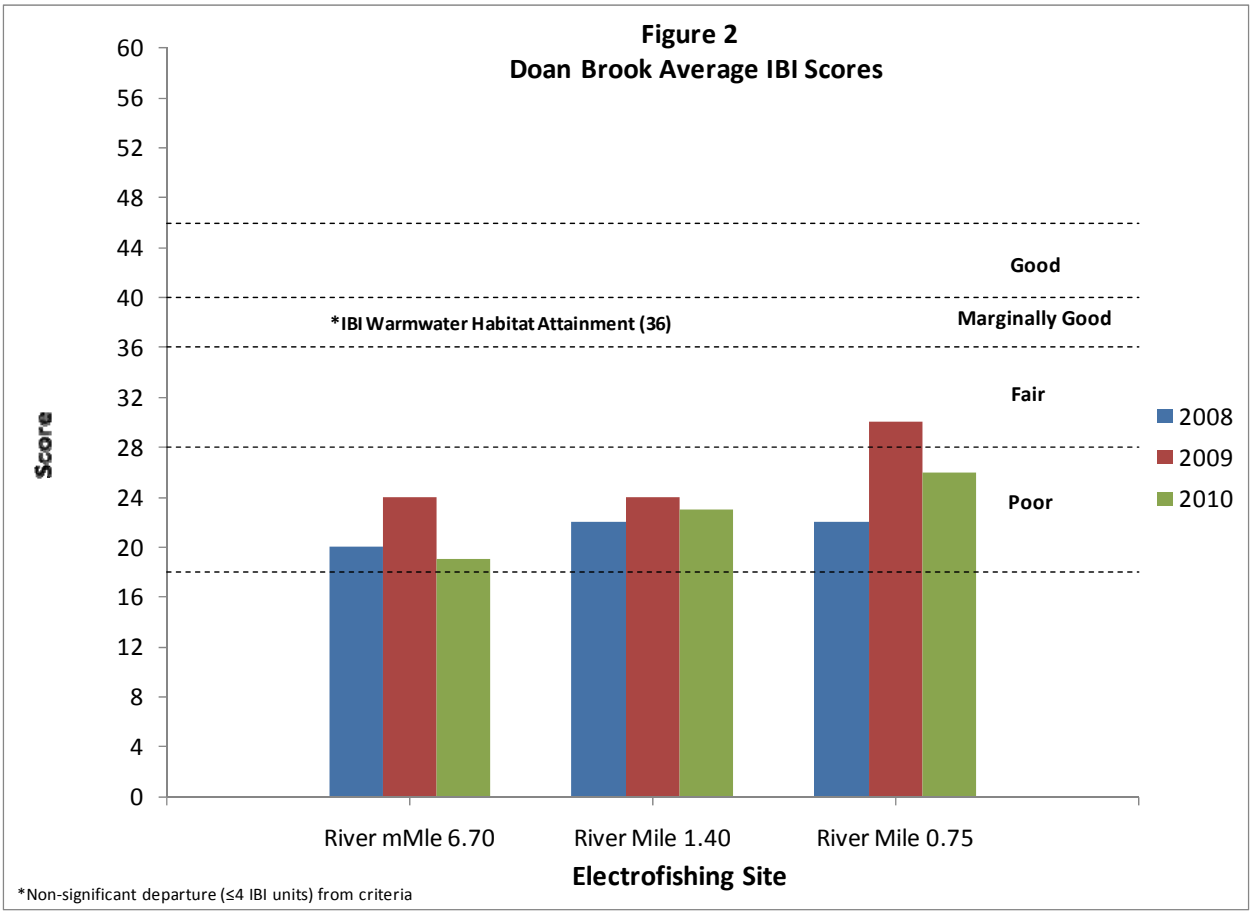
In 2010, RM 0.75 obtained an average IBI score in the *Poor* range (26). Of the fish collected, 70% were highly pollution tolerant, consisting of common white suckers, brown and yellow bullheads, northern bluegill sunfish, green sunfish, creek chubs and goldfish. The bluegill sunfish and pumpkinseed sunfish were the only moderately pollution-tolerant fish collected. The score decreased slightly in 2010 from a score of 30 (*Fair*) obtained in 2009. The decreased score was likely due to a lower score in the proportion of DELT anomalies metric, correlating to deformed and eroded tails and lesions on the brown and yellow bullheads. Seven out of sixteen bullheads collected on

June 29, 2010, had DELT anomalies present. 2008 IBI scores were also within the *Poor* range.

From 2008 thru 2010, nine passes for longline electrofishing were completed at the three Doan Brook sites and out of the nine passes completed, eight rated *Poor* for the IBI fish community scores (Table 8). A *Fair* value was obtained once, in 2009, at St. Clair Avenue RM 0.75. Since 2008, highly pollution tolerant fish consisting of green sunfish and creek chubs have dominated the species composition at all sites sampled on Doan Brook.

Table 8.
2008-2010 Averaged Index of Biotic Integrity Scores

River Mile	2008	Narrative Rating	2009	Narrative Rating	2010	Narrative Rating
6.70	20	*Poor*	24	*Poor*	19	*Poor*
1.40	22	*Poor*	24	*Poor*	23	*Poor*
0.75	22	*Poor*	30	*Fair*	26	*Poor*



Macroinvertebrate Sampling

Methods

Macroinvertebrates were sampled quantitatively for one six-week period in 2010 using a modified Hester-Dendy artificial substrate sampler (HD), in conjunction with a qualitative assessment performed during retrieval. The modified HD is a type of sampling that has been utilized by the Ohio EPA since 1973 (DeShon, 1995).

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the Ohio EPA, the ICI is a modification of the Index of Biotic Integrity for fish (OEPA, 1987a).

The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa

Macroinvertebrate qualitative samples were sent to Aquatic Macroinvertebrate Taxonomy for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008). The taxa lists and enumerations are available upon request.

Results and Discussion

All three HDs were installed and removed at the three sites on Doan Brook and an ICI score was calculated for each site (Table 9).

Table 9.
2008-2010 Averaged Invertebrate Community Index Scores (ICI)

River Mile	2008	Narrative Rating	2009	Narrative Rating	2010	Narrative Rating
6.70	4	*Poor*	12	*Poor*	6	*Poor*
1.40	8	*Poor*	20	*Fair*	34	*Good*
0.75	--	--	28	*Fair*	32	*Marginally Good*
--HD Lost / *Flow <0.3 ft/sec						

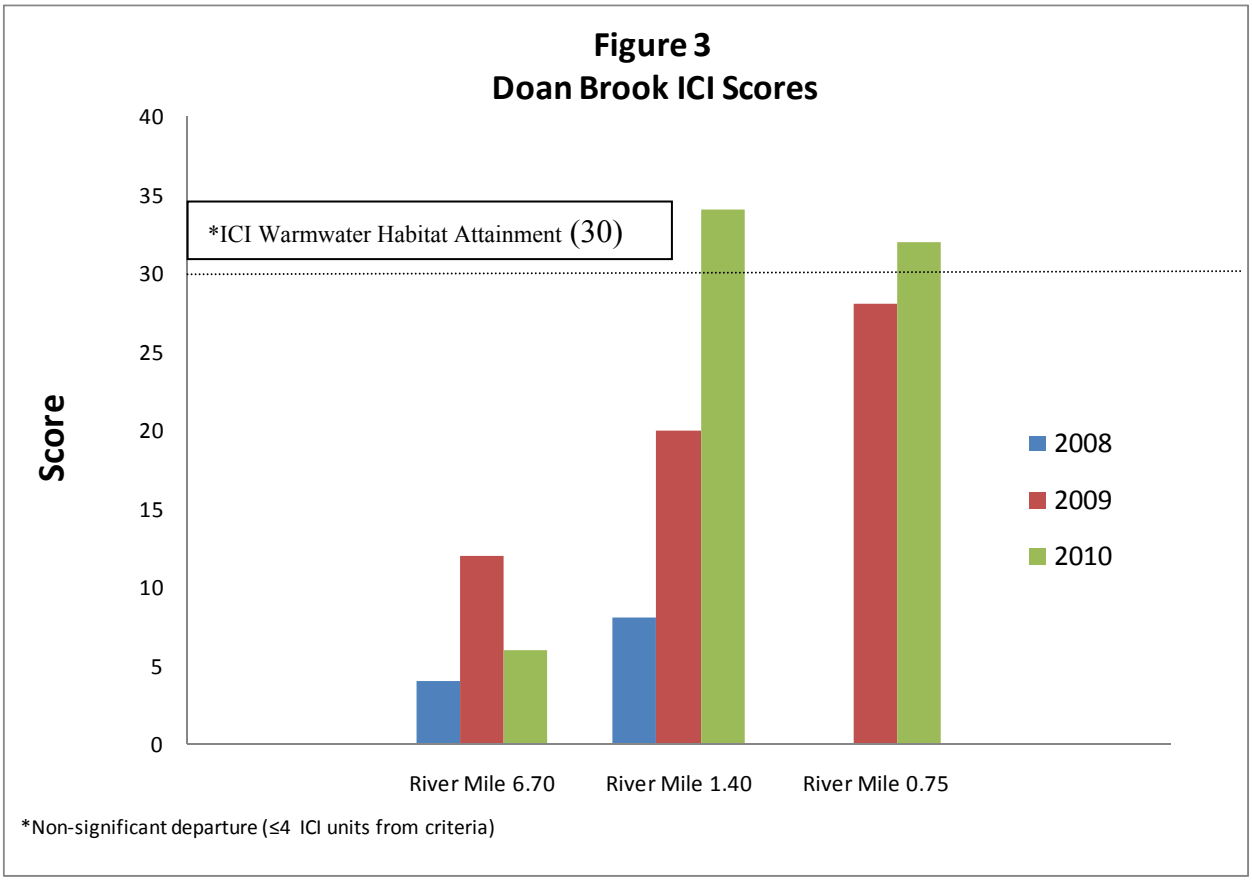
Doan Brook RM 0.75 received an ICI score of 32 with a narrative rating of *Marginally Good*. An ICI score of ≥30 indicates non-significant departure of attainment from WWH biocriterion in the Erie Ontario Lake Plain ecoregion. The highest scoring metrics (scores of 6) were for the percent caddisflies composition (5.6%) and percent Tanytarsini midge composition (40.9%). In 2009, an ICI score of 28 (*Fair*) was calculated for this site. Aquatic worms, midges and black flies comprised the majority of macroinvertebrates collected. The higher ICI score in 2010 was due to an increase in two ICI metric scores which were the total number of taxa metric score and percent other Diptera and non-insects metric score. In 2010, thirty-one taxa were collected compared to twenty-three taxa collected in 2009.

Doan Brook at RM 1.40 received the highest ICI score of the three sites sampled. An ICI score of 34 (*Good*) was calculated. The WWH biocriterion of 34 was achieved at the site. ICI metric scores of 6 were obtained for percent mayfly composition score (23.6%), percent Tanytarsini midge composition score (22.4%), and percent tolerant organisms score (1%). A total of 793 mayflies and midges were collected at this site comprising taxa *Baetis flavistriga* and *Paratendipes* species, this is an indication of good water quality taxa. With a total of only 16 oligochaeta organisms, which are considered pollution tolerant, out of 1644 organisms collected, and the low number of other pollution-tolerant organisms collected, this site is indicative of a healthy stream. In 2009, an ICI score of 20 (*Fair*) was obtained. In 2009, a metric score of 6 was obtained only for the percent caddisflies composition (1.3%). Twenty taxa were collected in 2010 compared to 17 taxa collected in 2009.

Doan Brook RM 6.70 received an ICI score of 6 (*Poor*). The WWH biocriterion was not obtained at this site. The macroinvertebrate community was predominated by organisms from the taxa Tubellaria and Oligochaeta. Oligochaeta are designated pollution tolerant and can predominate in degraded streams (Ohio EPA, 1987a). A total number of 3512 out of 4492 organisms (78% of the sample) were comprised of these two taxa. Twelve taxa were collected in 2010 compared to 17 taxa collected in 2009. ICI scores have been unstable from 2008 through 2010 with scores of 4, 12 and 6, respectively.

In 2010, two out of three Doan Brook sites attained the WWH ICI biocriterion for macroinvertebrates. RM 0.75 and RM 1.40 met the biocriterion, and RM 6.70 did not. All three Doan Brook sites were in non-attainment of WWH biocriteria for macroinvertebrates in 2009.

Some of the ICI metrics at RMs 0.75 and RM 1.40 in 2010 attained scores of six and these metric values are comparable to exceptional stream communities. The percent Tanytarsini midges at these two sites have not changed dramatically in 2009 and 2010. These organisms are pollution sensitive and decline or even disappear under minor pollution stresses. This may indicate a lack of major stressors on the stream from 2008 to 2009.



Conclusions

Chemical and bacteriological sampling showed poor results at the three Doan Brook sample sites. From 2008 thru 2010, the poorly rated fish communities, fish primarily consisting of highly pollution tolerant species, are the only species present. Elevated

densities of *E. coli* are an indication of the presence of sanitary sewage contamination. The contaminants in sanitary sewage may have an impact on pollution sensitive fish and macroinvertebrates. Elevated *E. coli* densities from sampling during wet and dry weather at RM 0.75, RM 1.40 and RM 6.70 and may be due to overflows from CSOs and SSOs in the watershed.

Flows originating from sanitary sewage overflows in the local collection system may also be contributing to elevated levels of *E. coli*.

A potential impact at RM 6.70 may have been from the Duck Creek Energy Incorporated gas/oil well drilling company stripping the riparian zone of brush and trees, narrowing the riparian width and degrading the floodplain quality by tree removal. This removal of canopy of trees may have contributed to a disturbance to the biota in the stream. ICI scores increased from 2008 thru 2010, with the exception of RM 6.70 (Figure 3). ICI scores for RM 6.70 have been unstable.

It is hard to identify the negative impacts to Doan Brook that would explain why IBI scores are *Poor*/*Fair* at all sampling sites with good QHEI scores and ICI scores being *Poor* at RM 6.70. Documented CSO's, SSO's, urban and stormwater runoff into streams all carry pollutants into streams that have adverse effects on the fish and macroinvertebrates. These effects results in lower fish and macroinvertebrate biotic community index scores.

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Reference List

DeShon, JE. (1995). Development and application of the Invertebrate Community Index (ICI). In Davis and Simon (Eds.), *Biological assessment and criteria, tools for water resource planning and decision making* (pp. 217-243). Boca Raton, FL: Lewis Publishers.

Ohio EPA. 1987a. *Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters* (Updated January 1988; September 1989; November 2006; August 2008). Division of Water Quality Monitoring and Assessment. Columbus, Ohio.

Ohio EPA. 1987b. *Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities* (Updated September 1989; March 2001; November 2006; and August 2008). Division of Water Quality Monitoring and Assessment. Columbus, Ohio.

Ohio EPA. 2006. *Manual for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI).* Ohio Environmental Protection Agency, Division of Surface Water. Columbus, Ohio.

Ohio EPA. 2009a. State of Ohio Water Quality Standards *Ohio Administrative Code* Chapter 3745-1. Revision: Adopted December 15, 2009; Effective March 15, 2010. Ohio Environmental Protection Agency, Division of Surface Water, Standards and Technical Support Section. Columbus, Ohio.

Ohio EPA. 2009b. *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices.* Ohio Environmental Protection Agency, Division of Surface Water, Division of Environmental Services. Columbus, Ohio.