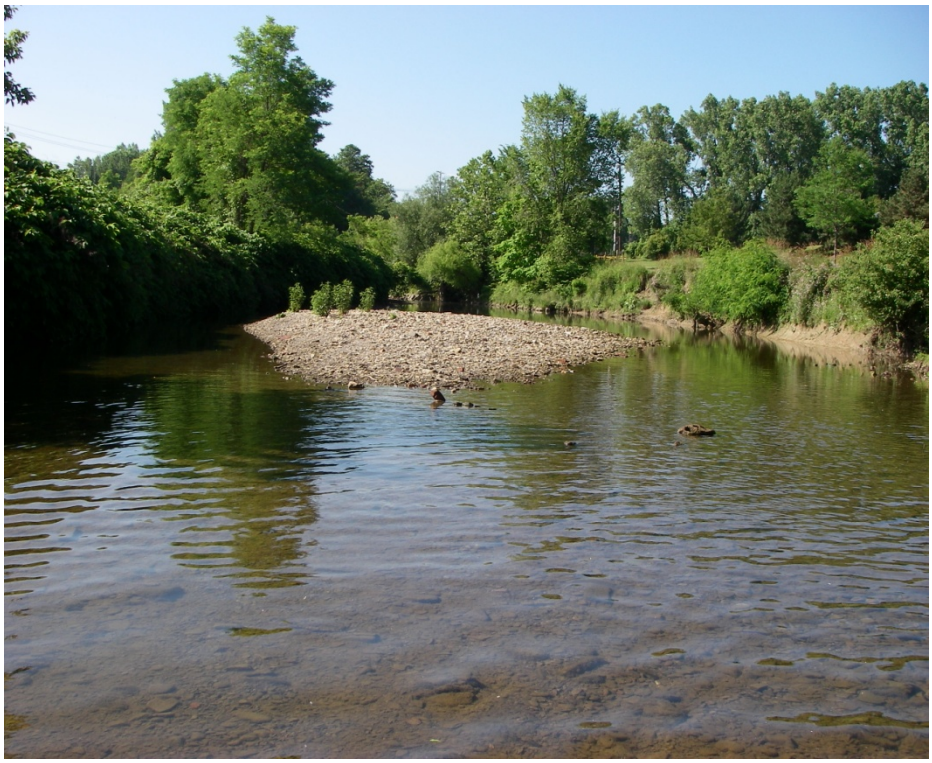
NORTHEAST OHIO REGIONAL SEWER DISTRICT

2010 Euclid Creek

Biological, Water Quality and Habitat Survey Results



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Introduction

The Northeast Ohio Regional Sewer District (NEORSD) has examined Euclid Creek's macroinvertebrate community and water chemistry for over a decade. The data was collected in support of NEORSD's combined sewer overflow permit (Ohio Environmental Protection Agency [Ohio EPA] National Pollutant Discharge Elimination System [NPDES] Permit No. 3PA00002*FD). Sites beyond that required by the permit were added in 2002 to determine conditions upstream of the permitted locations. Also, fish community surveys, along with habitat assessments, were included as supplemental data starting in 2007.

The 2010 sampling was completed in accordance with the study plan, titled *2010 Euclid Creek Environmental Monitoring* (NEORSD, 2010a), which was approved by the Ohio EPA on June 18, 2010. This study was completed to comply with permit requirements as well as to help determine the potential effects of the combined sewer overflows (CSOs) on the stream, identify other environmental factors which could affect the health of the downstream sites, and obtain additional baseline data for future infrastructure projects. Sampling and assessments were conducted by NEORSD Level 3 Qualified Data Collectors, certified by the Ohio EPA in Chemical Water Quality, Stream Habitat Assessment, Fish Community Biology, and Benthic Macroinvertebrate Biology. Table 1 indicates the sampling locations with respect to river mile (RM), latitude/longitude, description and surveys conducted. Figure 1 is a map of the study area.

Additional sampling occurred at RM 0.20 and was included as part of the 2010 study plan (J. DeShon, personal communication, August 6, 2010) submitted to the Ohio EPA to obtain baseline data. The sampling included fish, macroinvertebrates and habitat surveys. The restoration work would be overseen by the Friends of Euclid Creek and encompassing the oxbow area of the creek to a wetland. The project is called the "Wildwood Wetland and Stream Restoration Project."

Table 1. List of Sampling Locations.

Stream Location	Latitude	Longitude	River Mile	Description	Purpose
Euclid Creek	N41.5855°	W81.5629°	0.20	Upstream of the confluence of Lake Erie	Evaluate fish, macroinvertebrates, and habitat prior to restoration work.
Euclid Creek	N41.5833°	W81.5594°	0.55	Downstream of Lakeshore Avenue	Ohio EPA Permit No. 3PA00002*FD
Euclid Creek	N41.5738°	W81.5470°	1.65	Upstream of St. Clair Avenue	Evaluate water chemistry, macroinvertebrates, fish and habitat upstream of CSOs
Euclid Creek	N41.5658°	W81.5358°	2.70	Upstream of Highland Road	Evaluate water chemistry, macroinvertebrates, fish and habitat upstream of CSOs

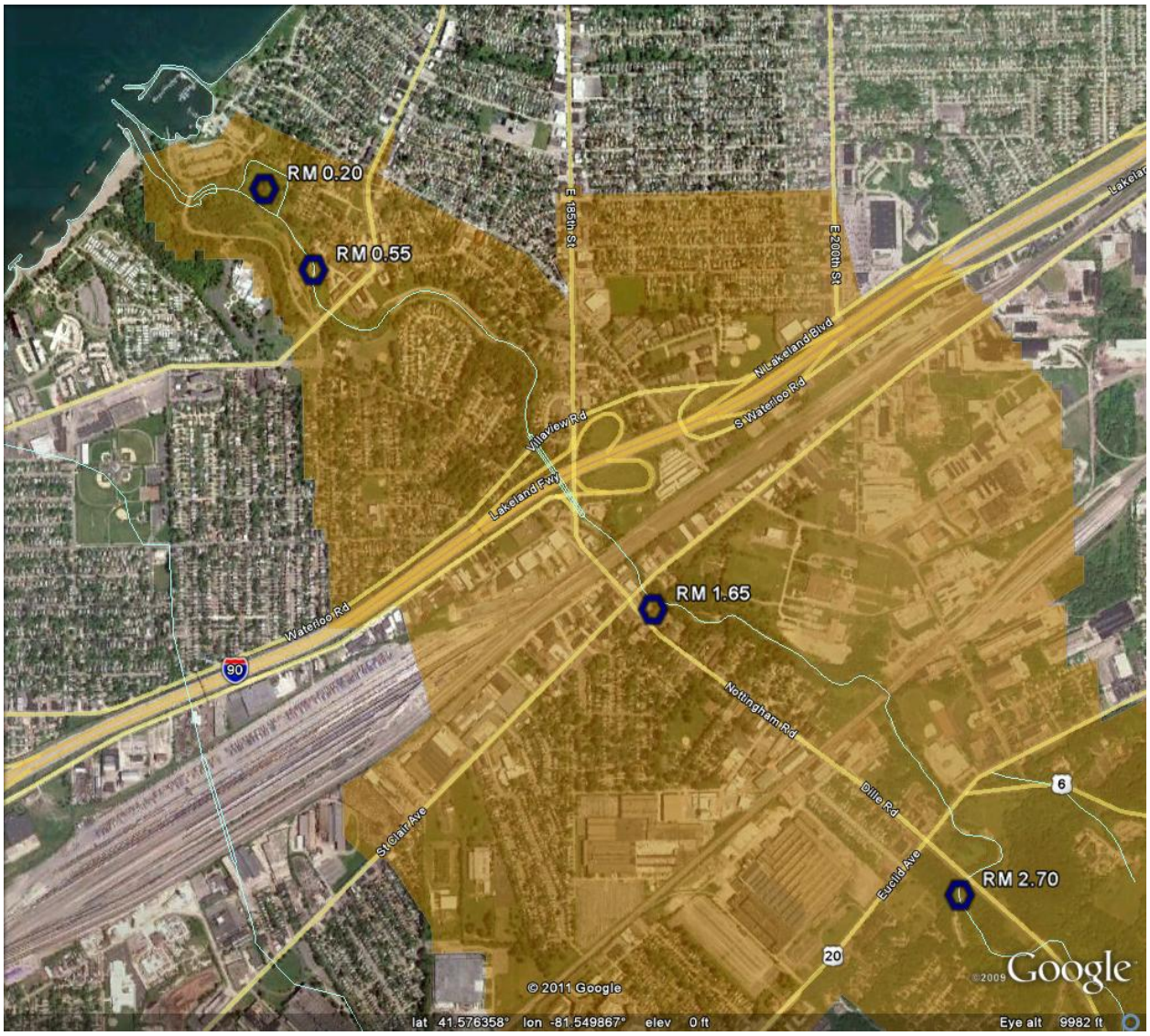

Figure 1. Map of the study area, the Euclid Creek watershed drainage area is shown in orange.

Water Chemistry Sampling

Methods

Water chemistry sampling was conducted once per week from June 22, 2010 to July 20, 2010 at RMs 0.55, 1.65 and 2.70. An additional water chemistry sample was completed on July 27, 2010 at RM 0.55. RM 0.55 and RM 0.14 were studied as part of the *2010 Lake Erie Bacteriological Sampling of Edgewater, Euclid and Villa Angela*

Beaches project study plan (NEORSD, 2010b), and the results for that project can be found in the NEORSD *Lake Erie Bacteriological Sampling Results of Edgewater, Euclid and Villa Angela Beaches* report (NEORSD, 2011). Lastly on October 7, 2010, a chlorophyll *a* sampling event was completed in anticipation of potential future criteria. All field sheets and certificate of analyses sheets are available upon request to NEORSD's Water Quality and Industrial Surveillance (WQIS) division.

The water samples for this study were collected in-stream using two 4-liter Cubitainers, two 473 mL plastic bottles and one 500 mL sterilized bacteriological bottle. All of the bottles were individually filled in-stream. For each sampling event, one of the 473 mL plastic bottles was field preserved with trace nitric acid and the other was preserved with trace sulfuric acid. The Cubitainers were left unpreserved. All of the samples were placed into a cooler with a layer of ice in it. Also, the samples were kept in a locked vehicle when not attended. The samples were relinquished with a chain of custody to an authorized employee in the NEORSD Analytical Services sample receiving area.

Samples were collected using methods described by Ohio EPA (2009). Field analysis included the use of a Yellow Springs Incorporated (YSI) 600XL Data Sonde, which measured dissolved oxygen, water temperature, conductivity and pH at the time of sampling. For quality assurance and quality control, field blanks and sample duplicates were collected twice during the study.

Results and Discussion

When the samples were compared to the Water Quality Standards, it was found that the *E. coli* densities had exceeded all applicable criteria (Ohio EPA, 2010). At each site, the seasonal geometric mean exceeded the criterion of 126 colony-forming units per 100 mL (CFU/100mL). The percentage of samples exceeding 298 CFU/100mL was also greater than 10% for all of the 30-day periods starting on days samples were collected at each site. Table 2 shows the *E. coli* results for this project. There have been several documented improper connections to Euclid Creek within the study area (K. Granlund & F. Rivera, personal communication, October 14, 2010). The improper connections could be one of the causes for the elevated *E. coli* results; some potential additional sources could include combined sewer overflows, home treatment systems and urban runoff.

The Euclid Creek total maximum daily load (TMDL) (Ohio EPA, 2005) established a target value for nutrients; specifically, total phosphorus has a recommended 70 micrograms per liter (µg/L) target value. All three of the water chemistry sampling locations had an average phosphorus concentration of 77 µg/L.

Table 2. *E. coli* (colony-forming units per 100 milliliters) results for all sites.				
Date	Wet Weather Event[1]	RM 0.55	RM 1.65	RM 2.70
June 22, 2010	Yes	EC 86,500	EC 100,000	57,000
June 29, 2010	Yes	1,000	447	360
July 6, 2010	No	730 700	490	260
July 13, 2010	Yes	5,400	4,500	3,100
July 20, 2010	No	910	1,945	5,600 6,200
July 27, 2010	No	800	--	--
-- No sample was taken EC stands for estimated count.				

Table 3 shows the results for the chlorophyll *a* sampling completed on October 7, 2010. The benthic chlorophyll *a* for each site was converted to a density for RMs 0.55, 1.65 and 2.70, having values of 57.7, 39.0 and 59.4 milligrams per square meter (mg/m^2), respectively. Milter (2010) suggests a management target level of no more than 182 mg/m^2 for benthic chlorophyll *a* to maintain the minimum dissolved oxygen levels in a stream.

Table 3. Euclid Creek Chlorophyll *a* Sampling Results: Collected October 7, 2010					
Sample ID	Location	Sample Type	Chlorophyll *a* (µg/L)	Total Phosphorus (µg/L)	Nitrate + Nitrite (µg/L)
R-1010060005	RM 0.55	Benthic	952.78		
R-1010060008	RM 0.55	Water Column	1.500		
R-1010060011	RM 0.55	Water Chemistry		52	713
R-1010060006	RM 1.65	Benthic	684.27		
R-1010060009	RM 1.65	Water Column	1.227		
R-1010060012	RM 1.65	Water Chemistry		48	743
R-1010060007	RM 2.70	Benthic	967.65		
R-1010060010	RM 2.70	Water Column	1.260		
R-1010060013	RM 2.70	Water Chemistry		48	711
R-1010060014	Blank	Blank	j0.505		
j - Result is greater than the method detection limit but less than the quantitation limit					

[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 were considered wet weather samples. Precipitation was measured from the National Weather Service website, http://weather.gov.

Habitat Assessment

Methods

To assess the habitat, a Qualitative Habitat Evaluation Index (QHEI) score was determined for each of the sites. The QHEI, as described by Ohio EPA (2006), is used in conjunction with fish community assessments to help determine if habitat exists for fish to be present at a site. The index is based on several metrics, which include: stream substrate; in-stream cover; stream channel morphology; riparian and bank condition; pool and riffle quality; and stream gradient. These metrics characterize the physical attributes of a stream as they relate to the fish population and their habitat usage. QHEI sheets and the digital photo catalog for each site evaluated can be made available upon request by contacting the WQIS division.

The Ohio EPA (2003) has suggested target scores for habitat assessment based upon QHEI scores all over the State of Ohio. A score less than 45 suggests that the habitat does not exist for the fish community to achieve the warmwater habitat (WWH) criteria. A QHEI score of at least 60 suggests that the habitat exists in which the fish community may achieve the WWH criteria. Lastly, a score of 75 or greater suggests that habitat conditions exist that could support exceptional warmwater communities of fish. The scores do not necessarily reflect the actual fish communities present at a site (Ohio EPA, 2006).

Results and Discussion

The two most downstream sites, RM 0.20 and 0.55, are located near the mouth of Lake Erie, and the flow of water at these locations can be influenced by the lake. After discussing the location with Environmental Supervisor William Zawiski of the Ohio EPA Division of Surface Water, it is believed that the sites are most likely within a lacustuary zone (Personal communication, October 27, 2010). However, since the area is still listed as a WWH by Ohio EPA (2010), the sites are compared to WWH.

The QHEI scores since 2008 are shown in Table 4 for comparison. The most noticeable difference is the score for RM 0.55, which fell below the WWH target value of 60 in 2010. When comparing the metrics between the two years, no one factor stood out as the reason for causing the drop in 2010; it was due to several small differences that added up. It was noted by the field crew that the creek was also at low flow in 2010. The habitat at RM 2.70 and RM 1.65 were consistent with the previous year's assessment.

Table 4. 2008 to 2010 Euclid Creek QHEI Scores			
River Mile	Scores		
	2008	2009	2010
0.20	--	--	58.5
0.55	68.0*	67.5*	54.0
1.65	64.5*	75.0*	74.0*
2.70	58.5	61.5	57.5
*Site met OEPA QHEI WWH target score			

Electrofishing

Methods

Electrofishing passes were conducted three times at RMs 0.55, 1.65, and 2.70. Sampling was conducted using longline electrofishing techniques and consisted of shocking all habitat types within a sampling zone, which was 0.20 kilometers in length, while moving from downstream to upstream. An electrofishing boat was utilized for sampling at RM 0.20, which consisted of shocking all habitat types within the sampling zone while moving from upstream to downstream. The sampling zone was 0.5 kilometers long. The methods that were used followed the methods described in Ohio EPA (1987b).

During sampling, fish were collected, identified, weighed, and examined for the presence of any deformities, eroded fins, lesions, and tumors (DELTs). All fish were then released to the waters from which they were collected, except for vouchers and any specimens that could not be easily identified in the field. Specimens that could not be positively identified were sent to The Ohio State University Museum of Biological Diversity for verification by the Curator and/or Associate Curator of Fish. Field data sheets for sampling are available upon request by contacting the WQIS division.

The results that were obtained from electrofishing were evaluated using two Ohio EPA indices, the Index of Biotic Integrity (IBI) and the Modified Index of Well Being (MIwb). The IBI is made up of a total of 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 groups, pollution tolerances and specific disease symptoms. These metrics are individually scored by comparing the data collected at the survey site with values recorded from reference sites located in a similar geographical region. Ohio has a total of five different geographical regions; the Greater Cleveland area is located within the Erie/Ontario Lake Plain (or EOLP). Each community metric is split into three

scoring categories which include: one, the lowest; three; and five, the highest. The summation of the 12 individual metrics equals the IBI score, which corresponds to a narrative rating based upon the geographical region.

The second index utilized by the Ohio EPA is the Modified Index of Well-being (MIwb). The MIwb, which is calculated using Formula 1 below, incorporates four fish community measures: numbers of individuals, biomass, and the Shannon Diversity Index (Formula 2 below) based on numbers and weight of fish. The result of the mathematical calculation is the MIwb score, which also corresponds to a narrative rating based upon the geographical region.

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

N = Relative numbers of all species excluding species designated as highly tolerant, hybrids, or exotics

B = Relative weights of all species excluding species designated as highly tolerant, hybrids, or exotics

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

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

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

n_i = Relative numbers or weight of species

N = Total number or weight of the sample

Results and Discussion

As shown in Table 5, the fish community continues to be significantly in departure of attainment.

Table 5. 2010 Euclid Creek IBI and MIwb Scores

River Mile	IBI Scores				MIwb Scores			
	Pass 1	Pass 2	Pass 3	Average	Pass 1	Pass 2	Pass 3	Average
0.20	32	34	--	33	**8.7**	7.4	--	8.1
0.55	26	26	26	26	5.9	5.8	**8.1**	6.6
1.65	26	24	24	25	5.6	5.5	5.6	5.6
2.70	26	26	24	25	6.1	5.6	5.3	5.7

bold = meets WWH criterion [Boat: IBI ≥40; MIwb ≥8.7; Wading: IBI ≥38; MIwb ≥7.9]

The low scores at RM 0.55 may be attributable to the low proportion of insectivores, the large proportion of tolerant species, and lack of darter species and intolerant species. In addition, it was noted that in all three sampling events at least one fish individual had a DELT recorded.

At both RM 2.70 and 1.65, the scores were very similar. The proportion of omnivores, simple lithophils and the presence of DELTs scored in the highest scoring category. However, almost all of the other metrics scored in the lowest category. In fact, the only score that differed was the metric for the number of individuals.

Upon comparing the diversity of fish species it was noted that RMs 0.20 and 0.55 had significantly more species than that of RMs 1.65 and 2.70. This might be attributable to a spillway and tunnel located at State Route 2 between RM 0.55 and RM 1.65. The spillway and tunnel may be acting as a fish migration barrier and not allowing fish to access the upstream areas of the watershed.

Macroinvertebrate Sampling

Methods

Macroinvertebrates were sampled for a six-week period in 2010, using modified multiplate Hester-Dendy (HD) samplers. Five artificial substrate sampler replicates were affixed to a concrete block and deployed at each location. The HD sampler was used to conduct a quantitative assessment. A qualitative assessment was also conducted. Sampling was conducted in accordance with Ohio EPA (1987b) protocols. The qualitative assessment was completed during retrieval of the HD, at which time all available habitats were sampled. A Marsh-McBirney FloMate Model 2000 Portable Flow Meter, which measures velocity in feet per second (fps), was used during deployment and retrieval of the HD to measure stream current.

The overall aquatic macroinvertebrate community was evaluated using Ohio EPA's Invertebrate Community Index (ICI). The ICI consists of ten structural community metrics based on drainage area, each with four scoring categories. Metrics 1-9 are based on the quantitative sample, while Metric 10 is based on the number of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) in the qualitative sample. Metric 10 is often referred to as the "EPT taxa". The total of the individual metric categories determine the ICI score; where the higher the ICI score, the less of a deviation from relatively unimpacted reference sites utilized by the Ohio EPA for each eco-region.

If a quantitative sample was not able to be collected, then a qualitative sample was collected and compared to a Qualitative Community Tolerance Value (QCTV) score to help determine attainment status. The scoring applies only to the qualitative sampling.

The QCTV score is based on the median pollution tolerance values of all organisms from a sample collected at a site. An explanation on species tolerance values is specified by DeShon (1995). The QCTV score is used as a tool for assisting with the determination of attainment status.

Higher QCTV scores are related to the presence of taxa associated with higher ICI scores. According to the Ohio EPA (1999), if the QCTV score, in the Erie/Ontario Lake Plain (EOLP) ecoregion, is greater than 37.15, it is associated with better water quality. A score between 37.15 (the 25th percentile) and 34.30 (the 75th percentile) implies that the attainment status cannot be determined from the QCTV score and instead, best professional judgment should be used to help determine attainment. A score less than 34.30 indicates the presence of taxa seen in waters that are typically associated with poorer water quality.

Quantitative and qualitative macroinvertebrate samples were picked up by AMT (Ravenna, Ohio) for processing, identification and enumeration. Specimens were identified to the lowest practical taxonomic level, as defined by Ohio EPA (1987a). The taxa lists and enumerations are available upon request to WQIS.

To obtain comparable ICI results, some deployment recommendations should be adhered to. Most notably is that during deployment, the current over the HD needs to be greater than or equal to 0.3 feet per second. This is because the stream flow over the HD has been determined to have one of the greatest influences on the macroinvertebrate community represented (DeShon, 1995). Also, similar habitats should be selected when deploying the HDs for greater comparability (United States Environmental Protection Agency, 1990). NEORSD follows these guidelines so that the ICI scoring and trend analysis are comparable.

Results and Discussion

The results from the 2010 macroinvertebrate sampling can be found in Table 6. It should be noted that the flow during deployment and retrieval at RM 0.55 was less than 0.3 fps. At RM 0.55, a QCTV score of 33.8 was achieved; coupled with best professional judgment, evaluation of the community and the EPT taxa, NEORSD staff believe that this site is not in attainment of the WWH criterion for macroinvertebrates. Instead of using the ICI value of 18 for RM 0.55, NEORSD recommends assigning a narrative rating of *Fair* to the macroinvertebrate community at this site. The narrative rating was assigned because of the low velocity which may be attributable to the seiche effect from Lake Erie at this site.

The evaluation of RM 0.20 showed a QCTV score of 32.4. Even though the site had the most qualitative taxa of any of the sites on Euclid Creek, it lacked EPT taxa. The majority of the taxa collected were from the family Chironomidae (midges); other

common organisms collected were Hydracarina (water mites) and Oligochaeta (aquatic worms). Based on best professional judgment, a narrative rating of *Poor* should be assigned to the site.

Table 6. Summary of 2010 Euclid Creek Macroinvertebrate Collections.

River Mile	Retrieval Date	ICI Score[1]	Total Quantitative Taxa	Total Qualitative Taxa	Total EPT Taxa
0.20	08/23/10	--	--	30	0
0.55	08/23/10	18	19	27	2
1.65	07/28/10	42	35	24	6
2.70	08/02/10	42	30	28	5

[1] The ICI Criterion for WWH is ≥ 34 units.

Conclusions

Table 7 lists the attainment status of each site, as indicated by NEORSD sampling results. Also listed are some of the potential causes for impairments, according to the TMDL (Ohio EPA, 2005).

Table 7. Attainment Status of the Euclid Creek Sites in 2010, as indicated by NEORSD sampling results.

River Mile	**Attainment Status**	**Average IBI Score**	**Average MIwb Score**	**ICI Score**	**Potential Impairments**
0.20	(NON)	[33]	[8.1]	*Poor*	Organic Enrichment and Habitat
0.55	(NON)	26	8.1	*Fair*	Organic Enrichment and Habitat
1.65	PARTIAL	24.7	5.6	42	Organic Enrichment and Fish Barrier at Route 2
2.70	PARTIAL	25.3	5.3	42	Organic Enrichment, Habitat and Fish Barrier at Route 2
Warmwater Habitat Criteria [boat]/wading		[40]/38	[8.7]/7.9	34	
Nonsignificant Departure from Criteria		≤4	≤0.5	≤4	

( ) – Attainment status based on a qualitative benthic macroinvertebrate sample

The 2010 sampling results indicate that bacteriological, habitat and fish barriers are more than likely the significant contributors to the stream's not meeting attainment status. Organic enrichment, which is evident from the bacteriological samples, appeared even at the upmost sampling station during the 2010 study. The elevated bacteriological counts at all the sites could be the result of malfunctioning household sewage treatment systems and/or urbanization effects (which includes improper connections, CSOs and urban runoff). The Route 2 tunnel and spillway also appears to limit the fish passage

since both sites upstream of the barrier received low fish scores. As indicated by the 2010 phosphorus and chlorophyll *a* sampling, it is believed that nutrients are mostly likely not a leading factor to the current attainment status of the stream.

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