NORTHEAST OHIO REGIONAL SEWER DISTRICT

2014 Nine-Mile Creek Environmental Monitoring

Prepared by
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Introduction

During 2014, the Northeast Ohio Regional Sewer District (NEORSD) conducted water chemistry sampling, stream habitat assessments, and fish and benthic macroinvertebrate community surveys on Nine-Mile Creek at one location. Nine-Mile Creek is an intensely urbanized stream in Cuyahoga County which flows through the cities of University Heights, South Euclid, Cleveland Heights, Cleveland and Bratenahl before emptying into Lake Erie. The majority of Nine-Mile Creek is culverted; sampling was conducted in one of the open sections of the creek.

The purpose of this study was to collect baseline data in order to assess the biological health of Nine-Mile Creek prior to construction of the relief sewer at East 140th Street and Hayden Avenue, a capital improvement project which should eliminate or reduce sanitary sewage to Combined Sewer Overflows (CSO) 211 and 212. These flow reductions should benefit the District's long-term CSO Control Plan's goal of four or fewer overflows per year.

Sampling was conducted by NEORSD Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community and Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat Assessments as explained in the NEORSD's Project Study Plan, *2014 Nine-Mile Creek Environmental Monitoring,* approved by Ohio EPA on April 14, 2014.

Refer to Figure 1 for a map of the sampling location. Table 1 indicates the sampling location with respect to river mile (RM), latitude/longitude, description and surveys conducted. River mile 0.40 on Nine-Mile Creek is designated by Ohio EPA as Warmwater Habitat (WWH), agricultural water supply, industrial water supply and Class B Primary Contact Recreation. A digital photo catalog of the sampling location is available upon request from NEORSD's Water Quality and Industrial Surveillance (WQIS) Division.

Figure 1. Map of Sampling Location

Table 1. Sample Locations					
Location	Latitude	Longitude	River Mile	Description	Purpose
Nine-Mile Creek	41.5574	-81.5991	0.40	Upstream of Lakeshore Boulevard	Evaluate water chemistry, fish, habitat and macroinvertebrates

Water Chemistry Sampling

Methods

Water chemistry and bacteriological sampling was conducted five times between July 22, 2014, to August 20, 2014, at RM 0.40. Techniques used for water chemistry sample collection and chemical analyses followed the Ohio EPA *Surface Water Field Sampling Manual* (2013). 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 a 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-µm 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 a YSI 600XL or EXO1 sonde. The sonde was calibrated weekly to measure dissolved oxygen, water temperature and conductivity, while pH was calibrated on a daily basis. 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).

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

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).

Formula 2: 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.

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

Results and Discussion

During the sampling period, one field blank and one duplicate sample were collected as part of the study. For the field blank collected on August 13, 2014, there were no parameters that showed possible contamination. This indicates that the field blank was not contaminated.

Each sample and sample duplicate was compared for each of the forty-three individual parameters reported on the Certificate of Analysis. After an RPD was calculated, any result greater than the acceptable difference was investigated to determine the reason for the discrepancy. A total of one potential discrepancy was found from the duplicate samples. Once the rejected data points were culled from the data set, the remaining Level 3 data was compared to the applicable Ohio EPA Water Quality Standards (OAC 3745-1) for each site. Table 2 lists the water quality parameter that was, because it did not meet Ohio EPA's requirements for Level 3 data, rejected from the data set.

Table 2. Rejected Data Based on Duplicate Comparison

Site	Date	Parameter	Action
RM 0.40	8/06/14	COD	Rejected

Paired parameters are evaluated in tandem using %RPD because they are interlinked and can be used for QA/QC purposes. The paired parameters evaluated for these samples were total solids and total dissolved solids, as well as, total phosphorus and dissolved reactive phosphorus. There were no instances in which a set of parameters had to be qualified as estimated or rejected.

The bacteriological criteria for *E. coli* consist of two components: a seasonal geometric mean and a value not to be exceeded in more than 10% of the samples collected during a 30-day period (single sample maximum). For those streams designated Class B primary contact recreation, these criteria are 161 colony-forming units

(CFU)/100mL and 523 CFU/100mL, respectively. The seasonal geometric mean criterion was exceeded at RM 0.40 in 2014 (Table 3). In addition to the seasonal geometric mean, the recreational single sample maximum value was also exceeded during the sampling period. All of the samples exceeded the single sample maximum of 523 CFU/100mL. Three of the sampling dates occurred during wet weather[1], which could account for the exceedances. Potential sources of bacteria to the creek could include stormwater runoff, CSOs, sanitary sewer overflows and illicit discharges.

Table 3. 2014 Nine-Mile Creek *E. coli* Densities (colony-forming units/100mL)

Date	RM 0.40
7/22/2014	5,990
7/30/2014*	23,055
8/06/2014	1,747
8/13/2014*	13,820
8/20/2014*	23,960
Seasonal Geomean	9,560

*Wet-weather event
Exceeds single sample maximum criteria for 30-day period starting on that date

Mercury analyses for all of the sampling events were completed using EPA Method 245.1. The detection limit for this method is above the criteria for the Human Health Nondrinking and Protection of Wildlife Outside Mixing Zone Averages (OMZA), so it generally cannot be determined if the sites were in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine whether contamination was present above the detection limit. Mercury exceedances of the human health nondrinking OMZA and the protection of wildlife OMZA criterion occurred on Nine-Mile Creek at RM 0.40 for all 30-day periods (Table 4). Sources of mercury contamination may be attributable to stormwater runoff, CSOs, sanitary sewer overflows, illicit discharges and atmospheric deposition.

[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. 2014 Nine-Mile Creek Mercury Concentrations (ug/L)	
	RM 0.40
7/22/2014	< 0.01
7/30/2014	< 0.01
8/06/2014	< 0.01
8/13/2014	j0.021
8/20/2014	j0.025

Exceedance of Wildlife (0.0013 ug/L) and Human Health (0.0031 ug/L) OMZAs for 30-day period

Ohio EPA's Trophic Index Criterion assigns designations for quality of surface waters based on many factors including nutrients, periphyton, dissolved oxygen, and biological assemblages. This criterion was published in 2011 as a draft, and in March 2013, some aspects of the paper were published in a document called, "Trophic Index Criterion- Rationale and Scoring" (Ohio EPA, Division of Surface Water). The scoring places the streams into one of three categories: impaired, threatened, or acceptable. NEORSD does not assess periphyton; however, nutrients were assessed. The scoring for the nutrient component is based on levels of total phosphorus and dissolved inorganic nitrogen (DIN). The nutrient concentrations for the Nine-Mile Creek site in 2014 are shown in Table 6.

Table 6. 2014 Nine-Mile Creek Nutrient Concentrations		
River Mile/Site	Average Total Phosphorus (mg/L)	Average Dissolved Inorganic Nitrogen (mg/L)
0.40	0.165	1.202

Nine-Mile Creek, RM 0.40, received a narrative rating of "Threatened" and was described as having, "Concentrations observed with high-intensity land use and WWTP loadings." River mile 0.40 received the same "Threatened" rating in 2013, indicating that the site is still impacted by various forms of nutrient contamination. Lawn care companies frequent the area surrounding Nine-Mile Creek throughout the summer months. It is possible that contamination from local fertilizer applications and upstream CSOs could be sources of nutrient loading in Nine-Mile Creek.

Any parameters not mentioned above did not have any exceedances during the 2014 sampling of Nine-Mile Creek.

Habitat Assessment

Methods

Instream habitat assessments were conducted at RM 0.40 on Nine-Mile Creek in 2014 using the QHEI. The QHEI was developed by the Ohio EPA to assess aquatic habitat conditions that may influence the presence or absence of fish species by evaluating the physical attributes of a stream. The index is based on six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank condition, pool and riffle quality, and stream gradient. The QHEI has a maximum score of 100, and a score of 55 or more suggests that sufficient habitat exists to support a fish community that attains the headwater 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). The QHEI field sheet for RM 0.40 is available upon request from the NEORSD WQIS Division.

Results and Discussion

Nine-Mile Creek RM 0.40, which is located upstream of Lakeshore Boulevard, received a QHEI score of 77.5 (*Excellent*). The best substrate types were gravel and sand with moderate instream cover consisting of undercut banks, shallows, deep pools (>70 cm), rootwads, and woody debris. Channel development was fair with deep runs and unstable riffles consisting of gravel and sand. Bank erosion was moderate, and riparian width was wide, consisting of forest/swamp and residential/park/new field. This site exceeded the Ohio EPA target score of 55 for headwater WWH streams.

Fish Assessment

Methods

One quantitative electrofishing pass was conducted at RM 0.40 in 2014. 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. 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 for each pass were compiled and utilized to evaluate fish community health through the application of the 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 7. 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.

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

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

One electrofishing pass was conducted at RM 0.40 on August 14, 2014. This sampling event yielded six species of fish totaling 337 individuals and an IBI score of 16 (*Poor*). The fish collected during this pass consisted primarily of highly pollution-tolerant species. These species included the creek chub (64%), white sucker (32%), and fathead minnow (0.5%). The remaining three fish species collected were the largemouth bass (intermediate), striped shiner (intermediate), and the pumpkinseed sunfish (moderately pollution-tolerant). Compared to 2013, there was an increase in the number of species collected at RM 0.40 in 2014. There was, however, a decrease in IBI score compared to 2013. CSO 211 (east of Coit Road), which is located a little over half a mile upstream of RM 0.40, averages an estimated 77 overflows annually. Overflows from this CSO combined with overground runoff may contain pollutants that may be negatively impacting the fish community at this site. In addition, historical sampling of the Nela-Park branch of Nine-Mile Creek has consistently resulted in water quality exceedances for bacteria, cadmium, and mercury over the years. These exceedances may have a negative effect on the downstream fish population as well. The 2014 IBI score is listed in Table 8.

Table 8. 2014 Nine-Mile Creek IBI Score

River Mile/Site	Score	Narrative Rating
RM 0.40	16	*Poor*

Macroinvertebrate Sampling

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 Nine-Mile Creek, RM 0.40. 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 NEORSD WQIS Division.

The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI) (OEPA 1987a). 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

At RM 0.40, no HD was collected, as it was missing during the planned retrieval. A total of 23 taxa were collected during the qualitative sample collection. The sample consisted of one mayfly (*Baetis flavistriga)* and two caddisfly (*Cheumatopsyche sp* and *Hydropsyche depravata* group), while the remainder of the sample was composed of pollution-tolerant organisms. Based on the following information and using best professional judgment, RM 0.40 was assigned a *Poor* rating: three EPT taxa, tolerant taxa (total 8), field narrative rating (fair), predominant organism (black fly), density (low for all habitats except riffle, which was moderate), and diversity (low for all habitats). Poor riffle and margin habitat created by shifting substrates and a heavier than normal silt load may have contributed to the relatively poor macroinvertebrate community at RM 0.40.

Conclusions

The purpose of this study was to collect baseline data on Nine-Mile Creek before construction of the relief sewer at East 140th Street and Hayden Avenue and to identify point and non-point source pollution affecting Nine-Mile Creek. The data collected in 2014, along with previous years, will be compared to data collected post-construction.

The number of overflows per year to Nine-Mile Creek is expected to be reduced due to the construction of the relief sewer.

Water chemistry results revealed that *E. coli* densities are elevated on Nine-Mile Creek at RM 0.40. Mercury exceedances were also noted at RM 0.40 as well.

RM 0.40 obtained a QHEI score of 77.5 (*Excellent*) and exceeded the WWH target score of 55. Although the habitat score suggests Nine-Mile Creek could support a healthier fish community, water quality exceedances combined with the unstable nature of the substrate at RM 0.40 has led to non-attainment for fish and macroinvertebrates (Table 10).

It is anticipated that the water quality and biological scores on Nine-Mile Creek will improve once construction of the relief sewer is complete. Wet-weather flow relief in the collection system, as well as a reduction of overflows as a result of these projects, may help to improve the biological community and water quality of Nine-Mile Creek. Further sampling will determine the effectiveness of the projects and any improvement in water quality, habitat and biological communities.

Table 10. 2014 Nine-Mile Creek Survey Results.

River Mile	Aquatic Life Use Attainment Status	IBI Score (Narrative Rating)	ICI Score (Narrative Rating)	Habitat (Narrative Rating)	Water Quality Exceedances
0.40	NON	20 *Poor*	-- *Poor**	77.5 *Excellent*	*E. coli*, Mercury
Warmwater Habitat Criteria		40	34		
Nonsignificant Departure from Criterion		≤4	≤4		
Target				55	

*Based on best professional judgment

Acknowledgments

Field activities and report review completed by the following, except where otherwise noted:

Kelsey Amidon
Jonathan Brauer
Donna Friedman
Seth Hothem
Ron Maichle
Mark Matteson, Author

Mario Meany
Jill Knittle
John Rhoades
Francisco Rivera
Eric Soenhlen
Tom Zablotny
Cathy Zamborsky

WQIS Co-Ops: Julia Klepach, Sean Giblin, and Kyle Connelly

Analytical Services Division – Completed analysis for all water chemistry sampling

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