NORTHEAST OHIO REGIONAL SEWER DISTRICT

2010 West Creek Environmental Monitoring

Prepared by:
Water Quality and Industrial Surveillance Division

Introduction

In 2010, the Northeast Ohio Regional Sewer District (NEORSD) conducted water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys at two locations on West Creek. 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 study plan *2010 West Creek Environmental Monitoring* approved by Ohio EPA on June 18, 2010.

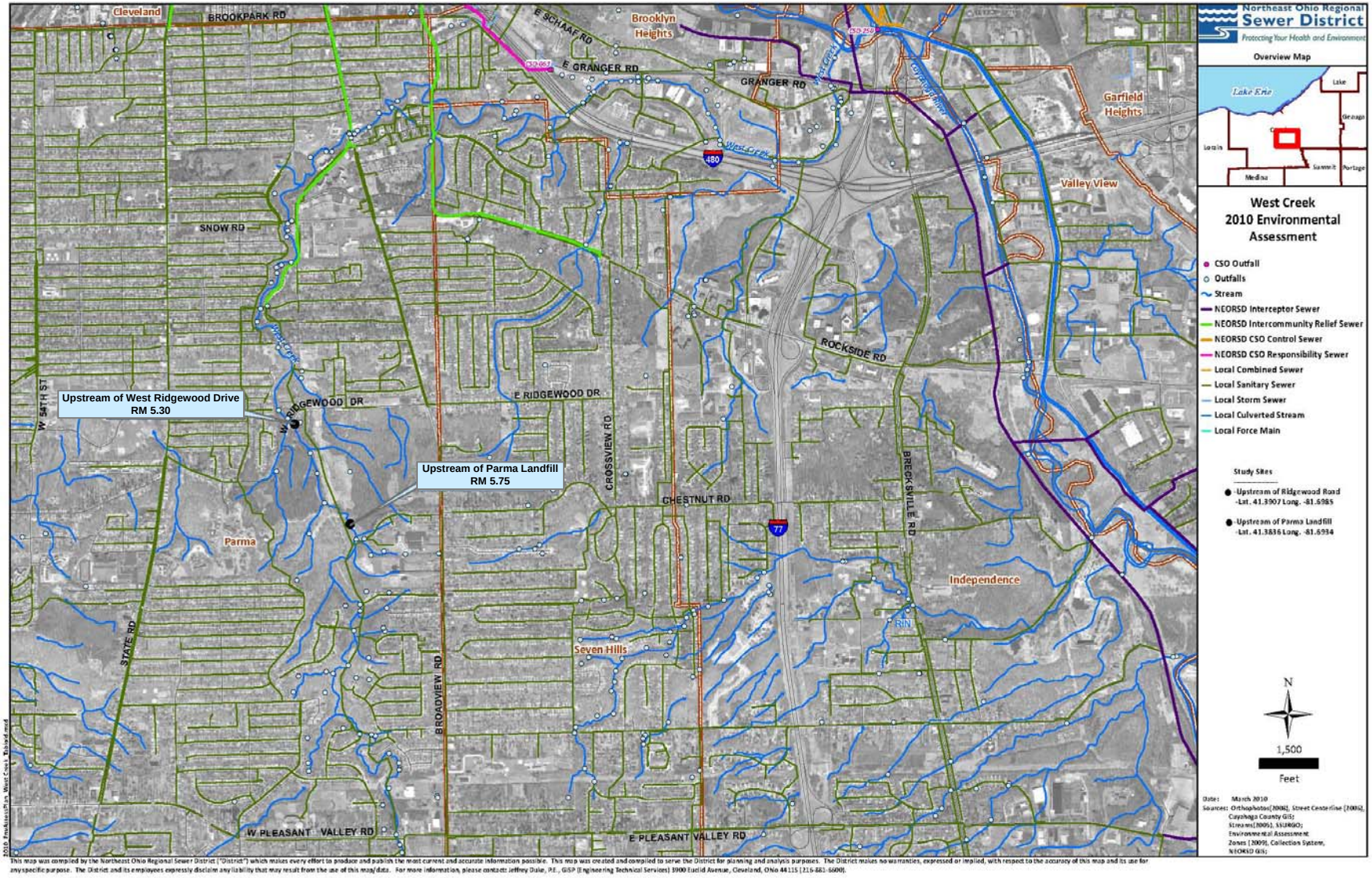
Sampling was conducted in collaboration with the Cleveland Metroparks, as they will use the data to monitor the conditions of the West Creek watershed. The purpose of the sampling was to collect baseline data upstream and downstream of the closed Parma Landfill to determine the effect, if any, the landfill has on downstream stream biota.

West Creek drains the eastern section of Parma and portions of Seven Hills, Brooklyn Heights, and Independence before emptying into the Cuyahoga River. Table 1 lists the sampling sites with respect to river mile (RM), latitude/longitude, description, and types of surveys conducted, and Figure 1 is a map of the sampling locations on the creek.

Table 1. 2010 Sampling Sites

River Mile	Latitude	Longitude	Description	Quadrangle	Purpose
5.75	41.3836°N	81.6934°W	Upstream of closed Parma Landfill	Cleveland South	Evaluate habitat, fish, & macroinvertebrates upstream of landfill
5.30	41.3899°N	81.6982°W	Upstream of West Ridgewood Drive Bridge	Cleveland South	Evaluate habitat, fish, & macroinvertebrates downstream of landfill

Figure 1. 2010 Sampling Locations on West Creek



Water Chemistry & Bacteriological Sampling

Methods

Water chemistry and bacteriological samples were collected over five sampling events beginning June 23, 2010 and ending on July 21, 2010. Samples collected during the June 23rd and June 30th sampling events were associated with wet weather[1]. All techniques used during water sampling and chemical analyses followed the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009) to ensure consistency throughout the study. Water chemistry samples were collected in two 4-liter disposable polyethylene cubitainers with a disposable polypropylene lid and two 473-milliliter (mL) plastic bottles. The plastic bottles were preserved with either trace sulfuric acid or trace nitric acid. The bacteriological samples were collected in a sterile 500 mL plastic bottle that was preserved with sodium thiosulfate. All samples were stored on ice in a cooler in the locked vehicle until they were relinquished to NEORSD's Analytical Services with a chain of custody.

Field analyses were conducted using either a YSI 600XL sonde meter or a YSI-556 MPS Multi-Parameter Water Quality Meter to measure dissolved oxygen, water temperature, conductivity and pH. During the June 23rd sampling event, a Hanna HI 98129 meter was used because the pH sensor calibration on the YSI 600XL sonde and YSI-556 MPS failed to meet quality assurance and quality control (QA/QC) requirements. All field notes and field measurements were recorded on a Surface Water Condition Sampling Field Data Form.

Over the course of the five sampling events, one sample duplicate and one sample field blank were obtained for QA/QC purposes. The sample duplicate was collected at RM 5.30 during the July 14th sampling event and the sample field blank was collected during the July 21st sampling event. The field blank results appeared to be normal and did not show any signs of contamination through handling or transportation. The results from the sample duplicate were compared to the primary sample using calculation of relative percent differences (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 42 individual chemical parameters reported on the Certificates of Analysis. The acceptable RPD between duplicate and

[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. Rainfall data taken from NEORSD Parma (RPM) Rain Gauge from June 20, 2010 to July 21, 2010.

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, four potential disparities were found: beryllium (66.7%), titanium (70.3%), total suspended solids (134.9%), and ammonia (67.5%). The reported concentrations of beryllium, titanium and total suspended solids were less than 10 times their practical quantitation limit (PQL). Therefore, the increased RPD values were most likely due to the low concentrations measured for those parameters. Conversely, the reported concentration of ammonia was greater than 10 times its PQL, but wet weather measured at nearby NEORSD Rain Gauges[2] within in the watershed may have impacted the samples collected on that day. The increased flow may have resulted in less homogenization of the river due to runoff and therefore could have resulted in the differences observed between the two samples. All Certificates of Analysis, Chain of Custodies, and Surface Water Condition Sampling Field Data Forms are available upon request from the NEORSD Water Quality & Industrial Surveillance (WQIS) Division.

Results and Discussion

Both sites on West Creek are designated as Warmwater Habitat (WWH), Agricultural Water Supply, Industrial Water Supply, and Class B Primary Contact Recreation (Ohio EPA, 2010). The results of the water chemistry and bacteriological samples were compared to the applicable water quality standards to determine attainment status for these designated uses. At RM 5.30, the concentration of iron exceeded the Protection of Agricultural Uses Outside Mixing Zone Average (OMZA) criterion for one thirty-day period. This exceedance may be attributed to a water main break in the City of Parma that was discovered by NEORSD WQIS Investigators on July 7th during water chemistry sampling. The water main break caused the creek to become turbid just upstream of RM 5.30 and the samples collected that day were turbid-brown. Chemical analyses of the samples revealed an elevated concentration of iron. Based on the average concentration for the thirty-day period, iron exceeded the statewide numeric criterion (Table 2).

Table 2. Iron Results from West Creek RM 5.30

Sample Date	Form[1]	Units	Concentration	Thirty-day Period	Average Concentration	OMZA Criterion
6/23/2010	TR	µg/L	108.00	6/23 - 7/22	3,924.25	5,000.00
6/30/2010	TR	µg/L	90.36	6/30 - 7/29	4,878.32	
7/7/2010	TR	µg/L	19,070.00	7/7 - 8/5	6,474.30	
7/14/2010	TR	µg/L	132.00	7/14 - 8/12	176.45	
7/21/2010	TR	µg/L	220.90	-	-	

[1]TR = Total Recoverable

[2] Rainfall data taken from NEORSD Southerly WWTP (RSY) and Independence (RIN) Rain Gauges from July 11, 2010 to July 14, 2010.

At RMs 5.75 and 5.30, the concentrations of mercury potentially exceeded the Protection of Human Health Nondrinking OMZA criterion for three thirty-day periods and the Protection of Wildlife OMZA criterion for all thirty-day periods. These are considered potential exceedances because all mercury concentrations were either below the minimum detection limit (MDL) or estimated to be between the MDL and PQL. Since the criteria themselves are below the MDL, a clear determination of actual exceedances could not be made.

The Class B Primary Contact Recreation criteria for West Creek is an *Escherichia coli* criterion not to exceed a single sample maximum 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 criterion of 161 CFU/100mL (Ohio EPA, 2010). The *E. coli* densities at both sites exceeded the single sample maximum of 523 CFU/100mL in more than ten percent of the samples taken during all thirty-day periods. Additionally, both sites exceeded the seasonal geometric mean criterion of 161 CFU/100mL (Table 3).

Table 3. West Creek *E. coli* Densities

Sample Date	Units	RM 5.75	RM 5.30	Wet Weather Sampling Event (NEORSD RPM Rain Gauge)
6/23/2010	CFU/100mL	1,700	810	Yes
6/30/2010	CFU/100mL	6,400	17,546	Yes
7/7/2010	CFU/100mL	12,100	4,300	No
7/14/2010	CFU/100mL	48,000	38,750	No
7/21/2010	CFU/100mL	27,000	13,000	No
Seasonal Geometric Mean	CFU/100mL	11,128	7,901	---

The cause of the exceedances is unclear, as elevated *E. coli* densities were seen during wet and dry weather conditions. Potential sources of bacteriological contamination to West Creek include sanitary sewer overflows, storm sewer outfalls, failing septic systems, and stormwater and urban runoff. Any of the above mentioned sources may have contributed to the elevated *E. coli* densities seen during sampling.

Habitat Assessment

Methods

Aquatic habitat conditions were assessed at RMs 5.75 and 5.30 using the Qualitative Habitat Evaluation Index (QHEI). The QHEI, as described in the Ohio EPA document *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006), is an index used to assess the physical components of a stream that are important to fish communities. The index is comprised

of six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle-run quality, and map gradient. Each metric is given a score, and the sum of all metric scores is the QHEI score for that site. A QHEI score ≥ 60 indicates that the stream has adequate habitat diversity and should be able to attain a WWH fish community as long as no other aquatic life use impairments exist (Rankin, 1989). The QHEI field sheets for each site are available upon request from the WQIS Division.

Results and Discussion

A QHEI score of 74.5 was obtained upstream of the landfill at RM 5.75 (Table 4). The site had a predominately cobble and gravel substrate with sparse-to-moderate instream cover consisting of undercut banks, overhanging vegetation, shallows, rootmats, deep pools (>1m), rootwads, boulders, backwaters, and woody debris. The site also had a well developed riffle with moderately stable substrate and low-to-moderate embeddedness. This site met the Ohio EPA's target score of 60 for WWH streams.

A score of 59.5, just below the target score, was obtained downstream of the landfill at RM 5.30 (Table 4). The site had a predominately bedrock and gravel substrate with sparse instream cover consisting of shallows, rootmats, boulders and woody debris. This site had one fairly developed riffle with moderately stable-to-unstable substrate and low-to-moderate embeddedness. The channel morphology at both sites exhibited low sinuosity, moderate stability and no channelization.

Table 4. 2010 West Creek Qualitative Habitat Evaluation Index Scores

River Mile	Location	Score	Narrative Rating
5.75	Upstream of Landfill	74.5	*Excellent*
5.30	Downstream of Landfill	59.5	*Good*

Electrofishing Surveys

Methods

Electrofishing surveys were conducted two times at RMs 5.75 and 5.30. Both sampling sites are considered headwater sites because they each have a tributary drainage area of less than 20 square miles (mi²). Sampling was conducted using longline electrofishing techniques and consisted of shocking all habitat types within a sampling zone of 0.15 kilometers in length, while moving from downstream to upstream. The methods that were used followed Ohio EPA's protocols in the document *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987) and *III* (1987b). Fish collected during the surveys were identified to species level, counted, and examined for the presence of external anomalies including deformities, erosions, lesions, and tumors (DELTs). All fish were then released to the waters from which they were collected, except for voucher specimens and those that could not be easily identified in the field.

The results from this sampling were used to calculate Ohio EPA's Index of Biotic Integrity (IBI) scores for each site. The IBI is a measure of the overall fish community health and is comprised of 12 metrics that represent the structural and functional attributes of the community. For headwater sites, the 12 metrics are:

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 with DELT anomalies

Each metric can receive a score of five (highest possible), three, or one (lowest possible). The sum of all metric scores is the IBI score for that site. An IBI score ≥ 40 (*Good*) meets the WWH biocriterion for headwater sites in the *Erie Ontario Lake Plain* (EOLP) ecoregion of Ohio and is in attainment of the WWH use designation. An IBI score of 36 (*Marginally Good*) is also in attainment, as it is considered nonsignificant departure (≤ 4 IBI units) from the criterion. A list of the species, numbers, pollution tolerances and incidence of DELT anomalies for fish collected during the electrofishing surveys at each site is available upon request from the WQIS Division.

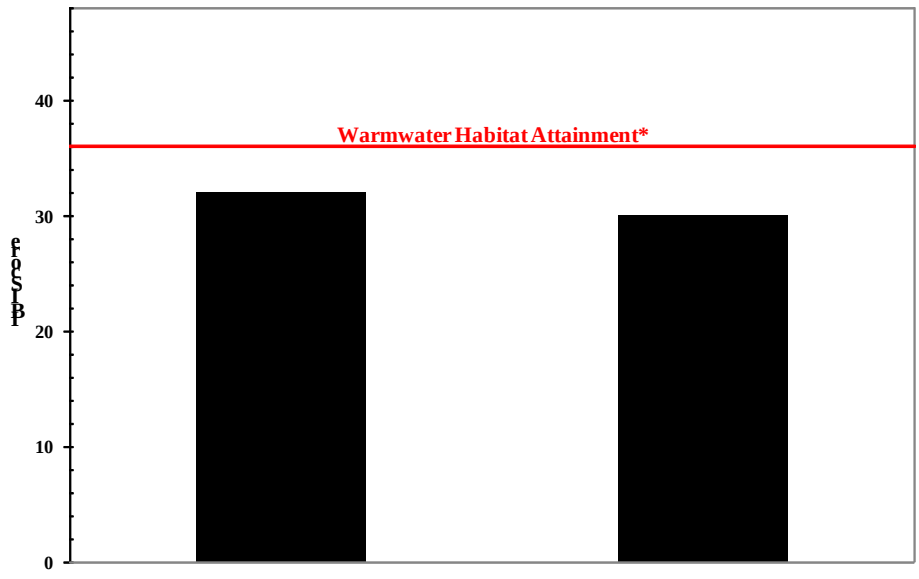
Results and Discussion

The IBI scores for both sites fell into the narrative range of *Fair* (Table 5). The average IBI scores for each site did not meet the WWH biocriterion for headwater sites in the EOLP ecoregion of Ohio and therefore did not attain the WWH use designation (Figure 2).

Table 5. 2010 West Creek Index of Biotic Integrity Scores

River Mile	Location	Survey 1	Survey 2	Average	Narrative Rating
5.75	Upstream of Landfill	32	32	32	*Fair*
5.30	Downstream of Landfill	32	28	30	*Fair*

Figure 2. Average IBI scores for West Creek



*Non-significant departure (=4 IBI units) from criterion

Surveys conducted upstream of the landfill, at RM 5.75, yielded an average catch of 427 fish consisting of central stoneroller minnows, creek chubs, western blacknose dace and goldfish. All of these species are considered to be highly tolerant to pollution, except for the central stoneroller minnow, which has intermediate tolerance to pollution (Ohio EPA, 1987). The only IBI metrics that received a score of five at this site were: Proportion of omnivores, Proportion of Pioneering species, Number of individuals, and Proportion with DELT anomalies. The majority of the other metrics received a score of one. Although this site showed adequate habitat diversity, the fish population was not indicative of a WWH community. In the past, fish migration barriers located at RMs 3.65, 2.10, and 1.10 may have prevented a healthy fish community from inhabiting this site. In January 2010, these barriers were removed as part of the West Creek Restoration Initiative. Once the habitat at these sites is fully recovered from the restoration work, a more diverse fish community may migrate upstream and populate this site.

Surveys conducted downstream of the landfill, at RM 5.30, yielded an average catch of 481 fish consisting of central stoneroller minnows, creek chubs, western blacknose dace and northern fathead minnows. All of these species are highly tolerant to pollution, except for the central stoneroller minnow. Again, the Proportion of omnivores, Proportion of Pioneering species, Number of individuals, and Proportion with DELT anomalies received a score of five; while the majority of the other IBI metrics received a score of one. Just like the upstream site, this site was not indicative of a WWH fish community. Habitat limitations at this site, such as inadequate in-stream cover and a predominately bedrock substrate, may make it less likely that a healthy fish community

will be present. Also, this site is upstream of the fish migration barriers that were removed in 2010. Once the habitat at these sites is fully recovered from the restoration work, a more diverse fish community may migrate upstream and populate this site.

When comparing the electrofishing results from RM 5.75 to RM 5.30, few differences were found. With the exception of the goldfish and northern fathead minnow, the abundance and diversity of the two fish communities was nearly identical as the majority of the species were highly tolerant to pollution. Also, similar IBI metric scoring was seen between the two sites, as the overall scores fell into the narrative range of *Fair*. Due to these similar findings, it does not appear that the landfill is having an effect on the downstream fish community.

Macroinvertebrate Sampling

Methods

Macroinvertebrates were sampled quantitatively for a six-week period at RMs 5.75 and 5.30 using a modified Hester-Dendy artificial substrate sampler (HD). The modified HD consists of five replicates of artificial substrate samplers affixed to a cinder block and deployed at each location. A qualitative assessment was also completed during retrieval of the HD, at which time all available habitats were actively sampled with a dip net. A Marsh-McBirney FloMate Model 2000 Portable Flow Meter was used to measure stream velocity in feet per second (fps) during deployment and retrieval of the HD. The HDs at both sites were re-installed during the colonization period due to wash outs during wet weather. The HD at RM 5.75 was retrieved on August 4, 2010. It is important to note that the HD was mostly buried when retrieved. The HD at RM 5.30 was not recovered after re-installation due to another wash out and instead a qualitative sample was collected on August 4, 2010.

Quantitative and qualitative macroinvertebrate samples were shipped to AMT (Ravenna, OH), for identification and enumeration. Specimens were identified to the lowest practical taxonomic level, as defined by Ohio EPA (1987b), when life stage and condition allowed. The taxa lists and enumerations are available upon request from WQIS.

Ohio EPA's Invertebrate Community Index (ICI) is used to evaluate the overall aquatic macroinvertebrate community. The ICI consists of ten community metrics based on drainage area, each with four different scoring categories of 6, 4, 2, and 0 points. 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. These three groups are commonly referred to as the "EPT" taxa. The total of the 10 individual metric categories determines the ICI score. The higher the ICI score, the less of a deviation from relatively unimpacted reference sites utilized by the Ohio EPA for each eco-region. An ICI score ≥ 34 (*Good*) meets the WWH biocriterion

for headwater sites in the EOLP ecoregion of Ohio and is in attainment of the WWH use designation. An ICI score of 30 (*Marginally Good*) is considered to be in nonsignificant departure (≤ 4 ICI units) from the criterion.

In the event that a quantitative sample cannot be retrieved, the qualitative samples are utilized to help determine attainment status. Some of the methods that can be used to help determine attainment from the qualitative samples are total taxa richness, EPT richness, number of sensitive taxa, number of tolerant taxa, field sheets and the Qualitative Community Tolerance Value (QCTV) scores. The QCTV score is the median pollution tolerance value calculated from the collected species that have an associated tolerance value recorded from a weighted ICI scoring. For an explanation on species tolerance values, refer to "Development and Application of the Invertebrate Community Index (ICI)" (DeShon, 1995). The QCTV score is one tool used to assist with the determination of attainment status. The QCTV score was obtained through hand calculation by AMT.

Higher QCTV scores are related to the presence of taxa associated with higher ICI scores. If the QCTV score in the 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 determine attainment status. A score less than 34.30 indicates the presence of taxa seen in waters that are typically associated with poorer water quality (Ohio EPA, 1999).

Results and Discussion

The results of the quantitative and qualitative samples for both sites are shown on Table 6.

Table 6. 2010 West Creek Results

River Mile	ICI Score	QCTV Score	Narrative Rating	EPT Taxa	Quantitative Taxa	Pollution-Sensitive Quantitative Taxa	Qualitative Taxa	Pollution-Sensitive Qualitative Taxa
5.75	**36**	--	*Good*	6	35	4	31	7
5.30	--	40.5	*(Good)**	7	--	--	21	4

Bold indicates attainment of WWH biocriterion
*Best professional judgment

RM 5.75 obtained an ICI score of 36, which meets the WWH biocriterion in the EOLP ecoregion of Ohio. The ICI metrics that received the highest possible score of 6 were: the Number of Caddisfly Taxa, Number of Dipteran Taxa and Percent Caddisflies. The overall community composition of the sample revealed: 5% mayflies, 14% tribe Tanytarsini midges, 18% caddisflies, and 63% other diptera and non-insects.

Additionally, 11 pollution-sensitive taxa were found at this site, four in the quantitative sample and seven in the qualitative sample (Table 6).

RM 5.30 obtained a QCTV score of 40.5, which indicates that this site is associated with better water quality in the EOLP ecoregion of Ohio. The qualitative sample yielded a total of 21 taxa, with a majority of the taxa consisting of caddisflies and midges. There were a total of seven EPT taxa in the sample, which was comparable to the number of EPT taxa in the upstream site (Table 6). There were also four pollution-sensitive taxa in the sample: *Ceratopsyche morose* grp., *Ceratopsyche sparna*, *Hydropsyche dicantha*, and *Parametriocnemus* sp. Examining the qualitative sample, the QCTV score, number of EPT taxa, number of pollution-sensitive qualitative taxa, and best professional judgment suggests that the WWH biocriterion for macroinvertebrates is being attained at the downstream location.

Overall, the macroinvertebrate results indicate a healthy macroinvertebrate community inhabiting the upstream and downstream sites. Since both sites are considered to be attaining the WWH use designation, it would appear that the landfill is not having an impact on the downstream macroinvertebrate community.

Conclusions

The purpose of this study was to collect baseline data to determine if the Parma Landfill was having an impact on the downstream biota in West Creek. The results from this study indicate no overall impact from the landfill, as the biological results upstream of the landfill were comparable to the results downstream of the landfill. Both the upstream and downstream sites were in partial attainment of the aquatic life use criterion and the QHEI scores were in the *Good* to *Excellent* range (Table 7).

Table 7. 2010 West Creek Aquatic Life Use Attainment

River Mile	Location	IBI Score	ICI Score	QHEI Score	Attainment Status
5.75	Upstream of Landfill	32	36	74.5 *(Excellent)*	PARTIAL
5.30	Downstream of Landfill	30	**	59.5 *(Good)*	PARTIAL

WWH biocriterion attainment - IBI score of 40, ICI score of 34
Nonsignificant Departure ≤4 IBI units, ≤4 ICI units
** QCTV Score of 40.5 considered to be in attainment of WWH biocriterion

Additionally, both sites exhibited some of the same water quality impairments, indicating no significant change in water quality upstream of the landfill as compared to downstream of the landfill. Because of these contributing factors, the Parma Landfill does not appear to be negatively affecting West Creek.

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Analytical Services Division – Completed analysis for all water chemistry sampling

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