

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2013 Green Creek Biological, Habitat, and Water Chemistry Assessment Study



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

Introduction

In 2013, the Northeast Ohio Regional Sewer District (NEORS) conducted water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate surveys on Green Creek, a tributary to Lake Erie, at river mile (RM) 0.01 and Site 7, located upstream of the culverted section of the creek. The data collected were evaluated to determine the extent to which the biological communities may be impacted by combined sewer overflow (CSO) discharge points and other environmental impairments. Sampling was conducted by NEORS Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORS study plan, *2013 Green Creek Environmental Monitoring*, approved by Ohio EPA on July 10, 2013. Green Creek was evaluated at Site 7 using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) and Index of Biotic Integrity (IBI).

Green Creek has not been assigned an aquatic life use designation. As of October 2013, the *Ohio Administrative Code* 3745-1-07 (2011) indicated that the Class B primary contact recreation designated use, as well as the Outside Mixing Zone Maximum (OMZM) and Outside Mixing Zone Average (OMZA) water quality criteria identified for warmwater habitat use designation, apply to water bodies not assigned an aquatic life use designation. In 2013, chemical water quality criteria identified for the warmwater habitat (WWH) use designation were applied to Green Creek RM 0.01 and Site 7. Class B primary contact recreational use criteria for *Escherichia coli* (*E. coli*) were also applied to both sites.

Table 1 provides site descriptions, hydrological unit codes (HUC), the types of surveys conducted, and GPS coordinates recorded at RM 0.01 and at the downstream end

Table 1. Site Description						
Location	Latitude	Longitude	River Mile	Description	HUC 8	Purpose
Green Creek	41.5799	-81.5737	RM 0.01	Culvert opening at Lake Erie	04110003 Ashtabula-Chagrin	Evaluate impacts to water chemistry
Green Creek	41.5578	-81.5470	Site 7	Upstream of culvert opening, on Upper Valley Drive, south of Euclid Avenue	04110003 Ashtabula-Chagrin	Evaluate impacts to fish, macroinvertebrates, water chemistry, and habitat

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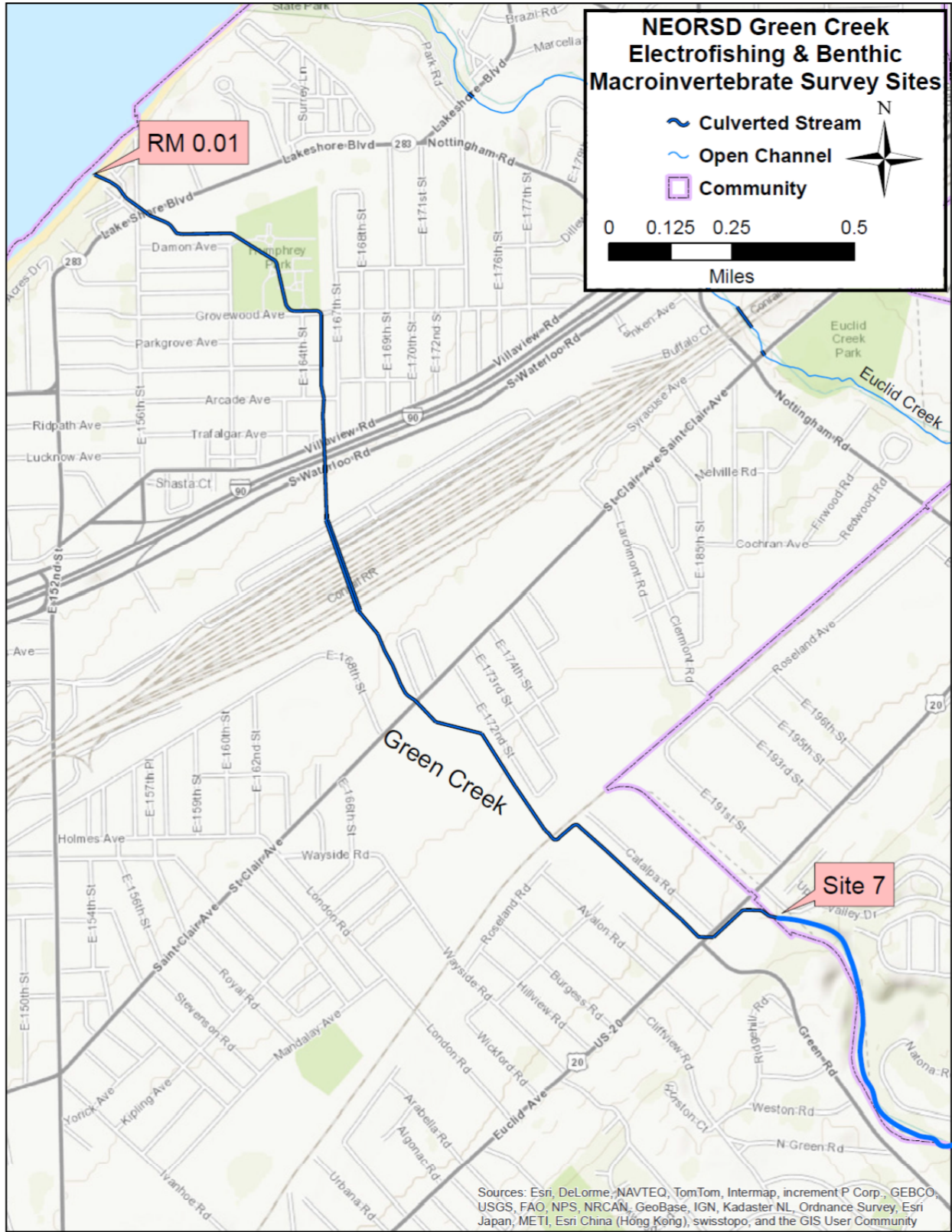


Figure 1. Sampling Locations

of the electrofishing zone of Site 7. Figure 1 is a map of the sampling locations on Green Creek.

Water Chemistry and Bacteriological Sampling

Water chemistry and bacteriological sampling was conducted five times between July 23, 2013 and August 20, 2013, at Green Creek Site 7 and RM 0.01. Techniques used for sampling and analyses followed the Ohio EPA *Surface Water Field Sampling Manual* (2013a). 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 was filtered using a 0.45- μ m 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 sonde. Duplicate samples and field blanks were collected at randomly selected sites, at a frequency not less than 10% of the total samples collected. Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

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

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

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

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

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

X = sample/detection limit ratio

Those RPDs that are higher than acceptable may indicate potential problems with sample collection and, as a result, the data was not used for comparison to the water quality standards.

Mercury analysis for all of the sampling events was done using EPA Method 245.1. Because the detection limit for this method is above the criteria for the Human Health Nondrinking and Protection of Wildlife Outside Mixing Zone Averages (OMZA),

it generally cannot be determined if Green Creek was in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine whether contamination was present above those levels typically found in the creek.

Results and Discussion

Green Creek is not assigned an aquatic life use designation. However, the OMZM and OMZA water quality criteria identified for warmwater habitat use designation apply to water bodies not assigned an aquatic life use designation (Ohio Administrative Code 3745-1-07). Therefore, the warmwater habitat designated use was applied to both sites. The Lake Erie Drainage Basin (LEDB) human health non-drinking water criteria and the wildlife criteria also apply. 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).

Based on Ohio EPA data validation protocol, three parameters were rejected for comparison to water quality standards due to unacceptable RPDs between duplicate samples collected on July 30th, 2013, at Green Creek Site 7. Table 2 gives results of the duplicate samples from those parameters rejected due to high RPD, which include aluminum, iron, and total suspended solids (TSS). It is unclear why the RPD was found to be unacceptable for these three parameters alone. Potential reasons for this discrepancy include lack of precision and consistency in sample collection and/or analytical procedures, environmental heterogeneity and/or improper handling of samples.

Table 2. RPD Rejected Parameters (Green Creek Site 7)					
Date	Parameter	Result	Acceptable RPD	Actual RPD	Qualifier
7/30/2013	Al	88.86	32.3	36.5	Rejected
7/30/2013	Al	128.6			
7/30/2013	Fe	183.7	24.1	34.3	Rejected
7/30/2013	Fe	259.8			
7/30/2013	TSS	20.7	31.3	160.0	Rejected
7/30/2013	TSS	2.3			

Due to possible contamination in the field blank performed on August 6th, 2013, an additional three parameters were estimated, rejected, or downgraded from Level 3 to Level 2 data based on Ohio EPA data validation protocol. It is unclear how the field blanks became contaminated and may be due to inappropriate sample collection,

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handling, contaminated blank water, and/or interference during analysis. Data validation for field blanks was calculated according to the methods described in the Ohio EPA *Surface Water Field Sampling Manual* (2013a). Data were qualified using the Sample/Field Blank Signal Ratio, which is the ratio of the concentration of the analyte measured in the sample to the concentration of the analyte measured in the field blank on the day in which the field blank was collected. Ammonia, chromium, and dissolved reactive phosphorus were found to be present in the field blank at levels in between the method detection limit (MDL) and the practical quantitation limit (PQL) with low to moderate Sample/Field Blank Signal Ratios resulting in the data being estimated, rejected, or downgraded from Level 3 to Level 2 data based on Ohio EPA data validation protocol (Table 3).

Table 3. Field Blank Qualifiers				
Date	Site	Parameter	Sample/Field Blank Signal Ratio	Interpretation
8/6/2013	RM 0.01	Chromium	3.8	Downgraded to Level 2
8/6/2013	RM 0.01	Dissolved Reactive Phosphorus	9.6	Estimated
8/6/2013	Site 7	Chromium	4.4	Downgraded to Level 2
8/6/2013	Site 7	Ammonia	2.7	Rejected
8/6/2013	Site 7	Dissolved Reactive Phosphorus	7.8	Estimated
Data Qualification Ranges for Sample/Field Blank Signal Ratios Ratio \leq 3 Rejected 3 < Ratio \leq 5 Downgraded 5 < Ratio \leq 10 Estimated				

All results for mercury at Green Creek were below the MDL for mercury. Mercury was not found to be in exceedance of the OMZM and OMZA criteria for warmwater habitat aquatic life. Mercury may have been in exceedance of human health nondrinking OMZA and Wildlife OMZA criteria as these values are lower than the MDL for mercury according to the EPA Method 245.1. No other chemical parameters were found to be in exceedance of the applicable water quality standards at both RM 0.01 and Site 7.

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Class B primary contact recreational use criteria for *E. coli* were applied to Green Creek at RM 0.01 and Site 7 in 2013. The bacteriological criteria for *E. coli* consist of two components, a single sample maximum not to be exceeded in more than 10% of the

Table 4. <i>E. coli</i> levels		
Green Creek RM 0.01		
Date	<i>E. coli</i> CFU/100mL	Single Sample Maximum Criterion Exceedance
7/23/2013	2900*	Yes
7/30/2013	7200	Yes
8/6/2013	740	Yes
8/13/2013	2300*	Yes
8/20/2013	4100	Yes
Seasonal Geometric Mean		Criterion
2708.3		161
Green Creek Site 7		
Date	<i>E. coli</i> CFU/100mL	Single Sample Maximum Criterion Exceedance
7/23/2013	860*	Yes
7/30/2013	265	No
7/30/2013	210	No
8/6/2013	160	No
8/13/2013	245*	No
8/20/2013	155	No
Seasonal Geometric Mean		Criterion
262.3		161
		Exceedance
		Yes
* Samples were collected during a wet weather event. ¹		

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.

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samples collected during a 30-day period and a seasonal geometric mean. These criteria for class B primary contact water are 161 colony-forming units per 100 milliliters (CFU/100mL) and 523 CFU/100mL, respectively. Table 4 lists all of the *E. coli* results from Green Creek measured during the 2013 field season. At RM 0.01, both the seasonal geometric mean and the single sample maximum criteria were exceeded for all 30 day periods, beginning on each sampling date, in which sampling was performed during the 2013 field season. *E. coli* results at Site 7 were significantly lower than those observed at RM 0.01. The single sample maximum criterion was exceeded in only the first 30 day period beginning on July 23rd, 2013, during which 20% of the collected samples were above the criterion value of 523 CFU/100mL. The moderately high *E. coli* levels present at Site 7 can most likely be attributed to the presence of combined sewer overflow CSO-256. The seasonal geometric mean for Site 7 exceeded the criterion value by 167% in comparison to RM 0.01, which exceeded the criterion value by 1,680%. This data indicates that the input of the majority of sanitary sewage contamination in Green Creek increases downstream of Site 7 and upstream of RM 0.01. This contamination can most likely be attributed to the presence of CSO-214 located upstream of RM 0.01, but downstream of Site 7.

Ohio EPA's Trophic Index Criterion assigns designations for quality of surface waters based on multiple 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, 2013b). 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 average concentrations of dissolved inorganic nitrogen including ammonia, nitrate, and nitrite at Green Creek RM 0.01 and Site 7 were 0.927 mg/L and 0.475 mg/L, respectively. The average concentrations of total phosphorus at RM 0.01 and Site 7 were 0.071 mg/L and 0.051 mg/L, respectively. At both sites, these nutrient levels were considered to be "concentrations typical of healthy streams in working landscapes" (Ohio EPA, 2013b).

Habitat Assessment

Methods

Instream habitat assessments were conducted once on Green Creek Site 7 in 2013 using the Qualitative Habitat Evaluation Index (QHEI). The QHEI was developed by the Ohio EPA to assess aquatic habitat conditions that may influence the presence or absence of fish species by evaluating the physical attributes of a stream. The index is based on six

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metrics: stream substrate, instream cover, channel morphology, riparian zone and bank condition, pool and riffle quality, and stream gradient. The QHEI has a maximum score of 100, and a score of 60 or more suggests that sufficient habitat exists to support a fish community that attains the warmwater habitat criterion (Ohio EPA, 2003). A more detailed description of the QHEI can be found in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006). QHEI field sheets for each site are available upon request from the NEORSD WQIS Division.

Results and Discussion

The stream segment at Site 7 obtained a QHEI score of 53 (*Fair*). This value falls below the Ohio EPA's target score of 60 for the support of healthy fish and benthic macroinvertebrate communities. The most prominent substrate types present were sand and gravel. Other substrate types present included boulder, cobble, and artificial substrates. Sparse instream cover included undercut banks, overhanging vegetation, shallows, boulders, and woody debris. The downstream section of the stream was channelized with walls of wooden beams on both sides of the stream. The remainder of the stream had low sinuosity, with little riparian zone on river left and no riparian zone on river right, all of which detracted from the overall QHEI score.

Electrofishing

Methods

One quantitative electrofishing pass was conducted at Green Creek Site 7 in 2013. Sampling was conducted using the backpack electrofishing technique and consisted of shocking all habitat types within a sampling zone while moving from downstream to upstream. The sampling zone was 0.15 kilometers. The methods that were used followed Ohio EPA protocol methods as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Fish collected during the surveys were identified and examined for the presence of anomalies including DELTs (deformities, eroded fins, lesions, and tumors). All fish were then released to the waters from which they were collected, except for vouchers and those that could not be easily identified in the field.

The electrofishing results were compiled and utilized to evaluate fish community health through the application of the Ohio EPA 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 5.

Table 5. IBI Metrics (Headwater)
Total number of Native Species
Number of Darters & Sculpins
Number of Headwater Species
Number of Minnow Species
Number of Sensitive Species
Percent Tolerant Species
Percent Pioneering Species
Percent Omnivores
Percent Insectivores
Number of Simple Lithophils
Percent DELT Anomalies
Number of Fish

Results and Discussion

In 2013, Green Creek Site 7 obtained an IBI score of 20 (*Poor*) and failed to meet the warmwater habitat IBI criterion of 40. The single species found to be present, Creek Chubs, was highly pollution tolerant. No DELT anomalies were found to be present on the fish collected. Degraded water quality indicated by *E. coli* exceedances at Site 7 may be contributing to the abundance of pollution-tolerant fish species and lack of pollution-intolerant species. Additionally, Green Creek is extensively culverted from Lake Erie, to immediately downstream of the electrofishing zone at Site 7, decreasing the accessibility of Site 7 to fish populations. The culvert opening at Lake Erie is also higher than the water level of the lake, acting as a fish barrier between the lake and Green Creek. A QHEI score of 53 (*Fair*) at Site 7 also indicates that the necessary instream habitat is not present to support a robust fish community.

Macroinvertebrate Sampling

Methods

Hester Dendy (HD) samplers were not installed at Green Creek Site 7 in 2013 due to the inability of the site to meet the required minimal current velocity of 0.3 feet per second over the HD. However, a single round of qualitative sampling was performed at

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this site in 2013 in order to assess the macroinvertebrate community. Macroinvertebrate qualitative samples were sent to Third Rock Consulting 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* (1987b). The taxa lists are available upon request.

Results

Qualitative sampling at Green Creek Site 7 was performed on September 4th, 2013. A total of eleven taxa were identified in the qualitative sample including four EPT, three non-insect, three dipteran, and one odonatan taxa. The pollution tolerance of the identified taxa ranged from moderately intolerant to tolerant with the majority of the taxa being categorized as facultative. EPT taxa identified included specimens from *Baetis flavistrigia*, *Polycentropus* sp, *Cheumatopsyche* sp, and *Hydropsyche depravata* group. By best professional judgment, due to the low number of total taxa and low number of sensitive taxa in the qualitative sample, the macroinvertebrate community at this site in 2013 has been categorized as *Poor*. Low stream gradient, stream channelization, sparse instream cover, poor marginal habitat, and sanitary sewage contamination indicated by high levels of *E. coli* may together contribute to the lack of a healthy macroinvertebrate community at Green Creek Site 7.

Conclusions

Green Creek RM 0.01 and Site 7 were found to be in attainment for all applicable chemical water quality standards. Elevated densities of *E. coli* were measured at both sites, with particularly elevated *E. coli* densities present at RM 0.01. Elevated *E. coli* densities can most likely be attributed to the presence of CSO-214 and CSO-256, which may discharge to Green Creek during wet weather events. The QHEI score for Green Creek Site 7 (53, *Fair*) was found to be below the Ohio EPA's target score of 60. The IBI score for Green Creek Site 7 was found to be below the WWH biological criterion. The health of the macroinvertebrate community was also categorized as *Poor*. The low drainage area of Green Creek and the presence of extended culverted and channelized sections of stream present a challenge to the development of healthy fish and macroinvertebrate communities at Green Creek Site 7.

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