

Level 3 Project Study Plan

2008 West Creek Restoration Evaluation

(1) Objectives

Starting in the late summer of 2007, stream restoration projects were to begin at seven sites on West Creek in Cuyahoga County. The projects have been delayed and are expected to begin in the spring of 2008. The schedule for the restoration work has not been finalized, however, the Northeast Ohio Regional Sewer District intends to conduct biological and water chemistry sampling and habitat assessments until the restoration work begins.

The goals of these restoration projects are to improve existing in-stream habitat, construct additional in-stream habitat, remove or alter existing fish migration barriers, and re-stabilize eroding stream banks by utilizing bioengineered technology and natural channel design techniques. The purpose of this study is to assess habitat conditions and fish and macroinvertebrate community health in West Creek prior to restoration activities in order to establish a baseline for future monitoring. The results obtained from this assessment will be evaluated using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI), Index of Biotic Integrity (IBI), and Invertebrate Community Index (ICI). An examination of the individual metrics that comprise these indices, along with water quality data and the Ohio EPA Macroinvertebrate Field Sheet, will also be used in subsequent years to determine the degree of improvement resulting from restoration of the creek. Water quality sampling will also be conducted during assessment activities. The results of water quality sample analyses will be compared to Ohio Water Quality Standards.

(2) Nonpoint/Point Sources

Point Sources	Nonpoint Sources
Combined Sewer Overflows	Urban runoff
Sanitary Sewer Overflows	Landfills
Storm Sewer Outfalls	Spills

A map has been provided in Appendix A to show point sources that may be influencing the water quality at each sample location. These sources of pollution, along with the nonpoint sources listed in the table above, may be impacting the health of the fish and benthic macroinvertebrate communities in West Creek and will need to be taken into account when evaluating changes to these communities following restoration activities.

(3) Parameters Covered

Fish specimens will be identified to species level, weighed, counted and examined for the presence of external anomalies including DELTs (deformities, eroded fins, lesions and tumors).

Macroinvertebrate specimens will be identified to the lowest practical taxonomic level and whenever possible, to the level of taxonomy recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989 and November 8, 2006).

Water quality samples will be collected at each electrofishing/macroinvertebrate site. Appendix B lists the parameters to be tested. Field measurements for dissolved oxygen, pH, temperature, specific conductance and flow velocity will also be performed. A water quality observation checklist will be completed at each site during each sample collection (Appendix B).

The Ohio EPA Macroinvertebrate Field Sheet will be completed at each site during sampler retrieval. In addition, stream habitat will be measured by scoring components of the QHEI at all locations including substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality and gradient.

(4) Field Collection and Data Assessment Techniques

Field collections for fish will be conducted at sites 1, 8, 9b, 11, and 14 (see table in section 5). These sites were chosen because they are located upstream and downstream of fish barriers that will be removed during the restoration project. Sampling will be conducted using longline electrofishing techniques and will consist of shocking all habitat types within a sampling zone, which is 0.15 kilometers in length, while moving from downstream to upstream. The stunned fish will be collected and placed into a live well for later identification.

Fish will be identified to species level, counted, and examined for the presence of external anomalies including DELTs. Fish easily identified (commonly collected from year to year) will be returned to the site from which they are collected. Subsamples of difficult to identify species will be brought back to the laboratory for verification by NEORSD personnel and, if necessary, sent to The Ohio State University College Museum of Biological Diversity for verification by the Curator and/or Associate Curator of Fish. Voucher specimens will be collected as described in section (14). Endangered species and those too large for preservation

will not be collected as voucher specimens, but will instead be photographed. Photographed vouchers will include features that permit definitive identification of the particular species.

Fish will be preserved in 10 percent formalin in the field, soaked in tap water for 24 to 48 hours after 5 to 7 days, then transferred to solutions of 30 and 50 percent ethanol for 5 to 7 days each and, finally, to 70 percent ethanol for long-term storage. Specimens larger than six inches will be slit along the right side and then soaked in formalin for approximately 10 to 14 days before being transferred to water and solutions of 30, 50 and 70 percent ethanol. Label information will include location (description and coordinates), date, time, collectors' names and sample identification code for each specimen collected.

Macroinvertebrate sampling will be conducted at sites 1, 8, 9b, 11 and 14 using quantitative and qualitative sampling techniques. Quantitative sampling will include installation of a five Hester-Dendy multi-plate artificial substrate sampler assemblage (HD) that is colonized for a six-week period. Multiple HD samplers may be installed at some or all of the locations to reduce the loss of samplers due to vandalism, burial, etc. Five Surber square-foot samples may be used in place of a HD sampler where deemed uncollectible due to the HD sampler having been vandalized, buried, etc. Surber samples, if substituted for a HD sampler, will be used for informational purposes only, and will not be used to calculate an ICI score. Qualitative sampling will be conducted using a D-frame dip net when HDs are retrieved. The Ohio EPA Macroinvertebrate Field Sheet will be completed during each HD retrieval. Tiffany Moore of NEORSD and Marty Sneen of EA Engineering, Sciences, and Technology, both Level 3 QDCs for Benthic Macroinvertebrate Biology, will identify the specimens to the lowest practical taxonomic level and when the condition of the specimen allows, to the level of taxonomy recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989 and November 8, 2006). Voucher specimens will be collected as described in section (14). Difficult to identify species will be sent to EA Engineering, Science and Technology for verification. Stream flow will be measured with a Marsh-McBirney FloMate Model 2000 Portable Flow Meter when the HD samplers are installed and retrieved.

A detailed description of the sampling and analysis methods utilized in the fish community and macroinvertebrate surveys, including calculations of the IBI and ICI, can be found in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987, updated January 1, 1988 and November 8, 2006) and *III* (1987, updated September 30, 1989 and November 8, 2006).

Water chemistry sampling will be completed at sites 1, 8, 9b, 11, and 14. Techniques used for water quality sampling and chemical analyses will follow the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2006). Chemical water quality samples from each site will be collected with one 4-liter disposable polyethylene cubitainer with disposable polypropylene lid and two 473-mL plastic bottles. All water quality samples will be collected as grab samples. One duplicate sample and one field blank will be collected at a randomly selected site for each round of sampling. The acceptable relative percent difference for field duplicate samples will be ≤ 30 percent; results outside this range will trigger further evaluation and investigation into causes for disparities. Acid preservation of the samples, as specified in the NEORS laboratory's standard operating procedure for each parameter, will occur in the field. Appendix B lists the analytical method and detection limit for each parameter analyzed. Field analyses include the use of a Marsh-McBirney FloMate Model 2000 Portable Flow Meter, which measures flow in feet per second, and a YSI-556 MPS Multi-Parameter Water Quality Meter to measure dissolved oxygen, water temperature, specific conductivity and pH at the time of sampling. Meter specifications have been included in Appendix B.

The QHEI, as described in Ohio EPA's, *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006) will be used to assess aquatic habitat conditions at each sample location.

Where possible, data assessment will include an analysis of spatial trends in the collected data, especially changes in fish and macroinvertebrate communities immediately upstream and downstream of existing migration barriers. Graphs that show QHEI, IBI, and ICI scores will be prepared. These graphs, along with an examination of individual metrics that comprise these indices and water quality data collected during sampling will be used to evaluate the degree of success resulting from specific restoration activities. Comparisons between water quality and biological community health will only be made if at least three water quality samples have been collected from that site.

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(5) Sampling Locations

The following electrofishing and macroinvertebrate sample locations, listed from upstream to downstream on West Creek, will be surveyed during the 2008 field season.

Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Site #14	41.3618°N	81.6892°W	7.90	Downstream from West Pleasant Valley Road	Broadview Heights	Evaluate habitat, fish, & macroinvertebrates prior to restoration
Site #11	41.4103°N	81.6943°W	3.65	Upstream of Broadview Road	Cleveland South	Evaluate habitat, fish, & macroinvertebrates prior to restoration and removal of fish barrier
Site #9B	41.4122°N	81.6754°W	2.40	Brooklyn Heights Park, upstream from I-480	Cleveland South	Evaluate habitat, fish, & macroinvertebrates prior to restoration and removal of fish barrier
Site #9A	41.4134°N	81.7606°W	2.10	Downstream from I-480	Cleveland South	Evaluate habitat prior to restoration and removal of fish barrier
Site #8	41.4144°N	81.6618°W	1.60	Downstream from Lancaster Drive Bridge	Cleveland South	Evaluate habitat, fish, & macroinvertebrates prior to restoration and removal of fish barrier
Site #6	41.4097°N	81.6570°W	1.10	ODOT Concrete Flume	Cleveland South	Evaluate habitat prior to restoration and removal of fish barrier
Site #5	41.4093°N	81.6556°W	1.00	Adjacent to Mercomp Landfill	Cleveland South	Evaluate habitat prior to restoration
Site #1	41.4145°N	81.6477°W	0.20	Between Granger & Schaaf Roads	Cleveland South	Evaluate habitat, fish, & macroinvertebrates changes prior to restoration

(6) Schedule

Initial biological, habitat, and water chemistry data collection occurred in the 2007 sampling season, to establish baseline conditions.

One to Two electrofishing surveys will be conducted in 2008 between June 15 and October 15. Each survey will be conducted at least four to five weeks apart. Specific dates have not been scheduled. Stream flow and weather conditions will be assessed weekly to determine when each electrofishing pass will be conducted.

Artificial substrate samplers will be installed on West Creek once, between June 15 and July 15, 2008, at all of the sites and retrieved six weeks later. Specific dates have not been scheduled. Stream flow and weather conditions will be assessed weekly to determine when the HD installations and retrievals will be conducted.

Ohio EPA Macroinvertebrate Field Sheets will be completed during the retrieval of each HD sampler.

Water quality samples will be collected a minimum of three times between June 15 and October 15, 2008.

Habitat evaluations will be conducted one time in 2008 between June 15 and October 15. These evaluations will be conducted around the same time as one of the electrofishing passes.

(7) QA/QC

Quality assurance and quality control of sampling and analysis methods for habitat, fish, and macroinvertebrate evaluations will follow Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987, updated January 1, 1988 and November 8, 2006) and *III* (1987, updated September 30, 1989 and November 8, 2006) and *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006).

Electrofishing equipment will be used according to the guidelines listed in the operation and maintenance manual provided by Smith-Root, Inc. Malfunctioning equipment will not be used to conduct surveys. Proper steps will be taken to correct the problem as soon as possible, whether by repairing in the field or at the NEORSD Environmental & Maintenance Services Center or by contacting the supplier or an appropriate service company.

Subsamples of difficult to identify fish species will be brought back to the laboratory for verification by NEORSD personnel, and if necessary sent to The Ohio State University College Museum of Biological Diversity for verification by the Curator and/or Associate Curator of Fish. Voucher specimens will be collected as described in section (14). Endangered species and those too large for preservation will not be collected as voucher specimens, but will instead be photographed. Photographed vouchers will include features that will permit definitive identification of the particular species.

Macroinvertebrate community assemblages will be identified to the lowest practical taxonomic level and when the condition of the specimen allows, to the level of taxonomy recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989 and November 8, 2006). The EA Engineering, Science and Technology QA/QC manual is attached in Appendix C. All macroinvertebrate specimens collected and identified by EA Engineering, Science and Technology will be returned to NEORSD. Voucher specimens will be separated into individual vials and collected as described in section (14). The remaining specimens for each site will be placed in a single container labeled with the site number and method and date of collection. All specimens and accompanying chain-of-custody documentation will be retained by NEORSD and stored at the Environmental & Maintenance Services Center (EMSC) for a period not less than ten years.

Water samples obtained for chemical analyses will be collected, labeled and then placed on ice inside the field truck. The field truck will remain locked when not occupied/visible. Sampling activities, including sample time and condition of surface water sampled, will be entered in a QDC log book and on the water quality observation checklist. The samples will then be delivered immediately to the NEORSD Analytical Services cooler, after which the door to the cooler will be locked and the samples will be transferred to the custody of Analytical Services. The NEORSD Analytical Services Quality Manual and associated Standard Operating Procedures is on file with Ohio EPA. The Quality Assurance Officer at Analytical Service will send updates, revisions and any information on document control to Ohio EPA as needed.

(8) Work Products

Within one year of completion of the project, fish data (species, numbers, weights, pollution tolerances, the incidence of DELT anomalies, IBI and MIwb scores), macroinvertebrate data (types and numbers of macroinvertebrates collected and ICI scores), habitat data (QHEI raw data and scores) and water chemistry results will be submitted to the Ohio EPA. Additionally, reports summarizing, interpreting, graphically presenting and discussing the IBI, MIwb, ICI and QHEI

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scores in relation to restoration activities and excursions from water quality standards will be prepared for internal use.

(9) Qualified Data Collectors

The following Level 3 Qualified Data Collectors (QDC) will be involved with this study:

Name	Address	Email Address	Phone Number	QDC Specialty(s)
¹ John W. Rhoades	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 008 CWQA/FCB/SHA
Cathy Zamborsky	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 009 CWQA/SHA
Seth Hothem	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 010 CWQA/FCB/SHA
Kathryn Crestani	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	crestanik@neorsd.org	216-641-6000	QDC - 011 CWQA/SHA
^{3,4} Tiffany Moore	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	mooret@neorsd.org	216-641-6000	QDC - 017 CWQA/BMB/SHA
^{2,5} Tom Zabloutny	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	zabloutnyt@neorsd.org	216-641-6000	QDC - 018 CWQA/FCB/SHA
⁶ Ron Maichle	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 145 CWQA
⁴ Marty Sneen	EA Engineering, Science and Technology 444 Lake Cook Road, Suite #18 Deerfield, IL 60015	msneen@eaest.com	847-945-8010	QDC - 026 BMB
¹ Lead Project Manager		⁴ Benthic Macroinvertebrate Identification		
² Stream Habitat Assessment (SHA) Project Manager		⁵ Fish Community Biology (FCB) Project Manager		
³ Benthic Macroinvertebrate Biology (BMB) Project Manager		⁶ Chemical Water Quality Assessment (CWQA) Project Manager		

The following is a list of persons not qualified as a QDC who may be involved in the project. Prior to the start of sampling, the project managers will explain to each of these and any other individuals the proper methods for electrofishing and macroinvertebrate collections, water quality sampling and QHEI evaluation. Sampling will only be completed under the direct observation of a QDC. The lead project manager will be responsible for reviewing all reports and data analysis prepared by qualified personnel prior to completion.

Name	Address	Email Address	Phone Number
Joseph Broz	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	brozj@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	dobrianskyt@neorsd.org	216-641-6000
Rae Grant	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Lateefah Hafeez	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hafeezl@neorsd.org	216-641-6000
Eric Hinton	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hintone@neorsd.org	216-641-6000

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Name	Address	Email Address	Phone Number
Mike Pavlik	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	pavlikm@neorsd.org	216-641-6000
Francisco Rivera	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000
Kevin Roff	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	roffk@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000
Elizabeth Toot-Levy	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	toot-levye@neorsd.org	216-641-6000
Wolfram vonKiparski	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Timothy Whipple	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	whipplet@neorsd.org	216-641-6000

- (10) Documentation of approval of project manager and other personnel as level 3 qualified data collectors

See attached (Appendix D).

- (11) Contract laboratory contact information

Any fish that is not positively identified in the field or NEORSD laboratory will be sent to The Ohio State University College Museum of Biological Diversity for verification by the Curator of Fish. Fish will be identified to the species level.

Dr. Ted Cavender, Curator of Fish / Mr. Marc Kibbey, Associate Curator of Fish
 1315 Kinnear Road, Columbus, Ohio 43212
cavender.1@osu.edu / kibbey.3@osu.edu
 614-292-7873

Any macroinvertebrate that is not positively identified by NEORSD will be sent to EA Engineering, Science and Technology for verification. As necessary, EA Engineering, Science and Technology may be contracted by NEORSD to do the complete identification of macroinvertebrate samples.

Marty Sneen, Benthic Specialist (QDC# 026)
 EA Engineering, Science and Technology
 444 Lake Cook Road Suite #18
 Deerfield, IL 60015
msneen@eaest.com
 847-945-8010 ext. 108

(12) Copy of ODNR collector's permit

To be submitted electronically when issued to NEORSD by ODNR.

(13) Catalog Statement

A digital photo catalog of all sampling locations will be maintained for 10 years and will include photos of the specific sampling location(s), the riparian zone adjacent to the sampling location(s) and the general land use in the immediate vicinity of the sampling location(s).

Print/Signature: John W. Rhoades / Date: _____

(14) Voucher Specimen Statement

Based on Ohio EPA's Final Responsiveness Summary of the Credible Data Rules (3/24/06), NEORSD is requesting approval of an alternative vouchering protocol, as follows:

NEORSD will maintain a benthic macroinvertebrate and fish voucher collection which includes two specimens, or appropriate photo vouchers, of each species or taxa collected during the course of biological sampling from any stream within the NEORSD's service area. When benthic macroinvertebrate from multiple surface waters are collected within the same year and identified by the same QDC, one voucher collection will be created to represent the specimens collected from those streams. When fish specimens from multiple surface waters are collected within the same year, one voucher collection will be created to represent the specimens collected from those streams. A separate collection for each sampling event will not be maintained.

NEORSD will provide specimens or photo vouchers to the Director upon request. This collection will be stored at the NEORSD laboratory in the Environmental and Maintenance Services Center.

Print/Signature: John W. Rhoades / Date: _____

(15) Trespassing Statement

I have not been convicted or pleaded guilty to a Violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Print/Signature: John W. Rhoades / Date: _____

Print/Signature: Cathy Zamborsky / Date: _____

Print/Signature: Seth Hothem / Date: _____

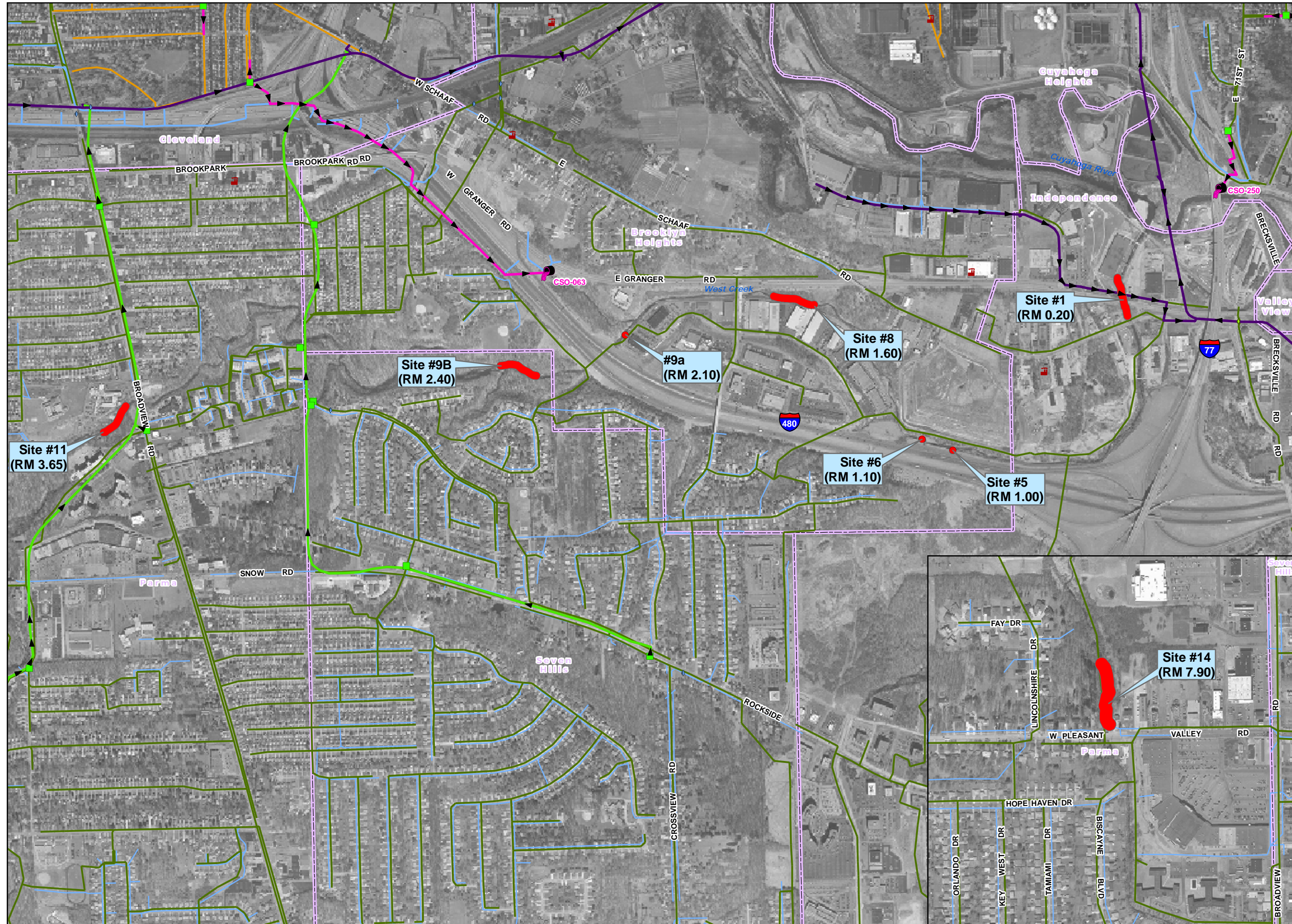
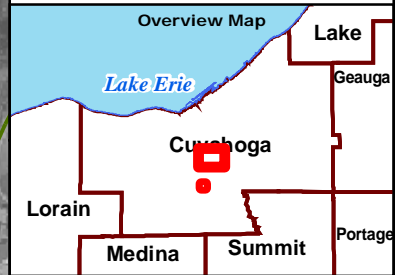
Print/Signature: Kathryn Crestani / Date: _____

Print/Signature: Tiffany Moore / Date: _____

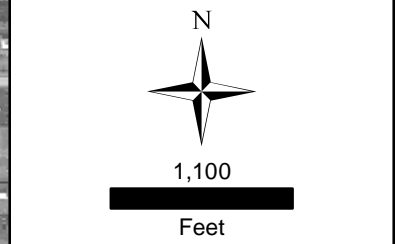
Print/Signature: Tom Zablotny / Date: _____

Print/Signature: Ron Maichle / Date: _____

Appendix A



- ### West Creek Restoration Evaluation
- CSO Outfalls
 - Habitat Only
 - Fish, Macroinvertebrate, Habitat and Water Sample Site
 - Automated Regulators
 - Manual Control Device
 - Hydro Brake
 - Regulator
 - Wastewater Treatment Facility
 - WQIS Industries
 - Flow Monitor
 - Level Monitor
 - Remote Level Monitor
 - Rain Gauges
 - Stream
 - Interceptor Sewer
 - (ICRS) Intercommunity Relief Sewer
 - CSO Control Sewer
 - CSO Responsibility Sewer
 - Local Combined Sewer
 - Local Sanitary Sewer
 - Local Storm Sewer
 - Local Culverted Stream
 - Local Force Main
 - Community Boundary



Appendix B

Parameter	Test	Detection Limit
Alkalinity	EPA 310.2	5 mg/L
COD	EPA 410.4	1 mg/L
Hex Chrome	SM 3500	10 ug/L
Mercury	EPA 245.1	0.05 ug/L
NH3	EPA 350.1	0.01 mg/L
NO2	SM 4500NO2B	0.01 mg/L
NO3	EPA 353.2	0.01 mg/L
Soluble-P	EPA 365.1	0.01 mg/L
Total-P	EPA 365.2	0.01 mg/L
BOD	SM 5210B	2 mg/L
TDS	SM 2540C	1 mg/L
Ag	EPA 200.7	1 µg/L
Al	EPA 200.7	5 µg/L
As	EPA 200.7	2 µg/L
Be	EPA 200.7	0.5 µg/L
Ca	EPA 200.7	50 µg/L
CaCO3	EPA 200.7	1 µg/L
Cd	EPA 200.7	1 µg/L
Co	EPA 200.7	1 µg/L
Cr	EPA 200.7	1 µg/L
Cu	EPA 200.7	1 µg/L
Fe	EPA 200.7	1 µg/L
K	EPA 200.7	50 µg/L
Mg	EPA 200.7	20 µg/L
Mn	EPA 200.7	1 µg/L
Mo	EPA 200.7	2 µg/L
Na	EPA 200.7	20 µg/L
Ni	EPA 200.7	1 µg/L
Pb	EPA 200.7	3 µg/L
Sb	EPA 200.7	5 µg/L
Se	EPA 200.7	5 µg/L
Sn	EPA 200.7	10 µg/L
TMET	EPA 200.7	(sum of Cr+Cu+Ni+Zn)
Ti	EPA 200.7	10 µg/L
Tl	EPA 200.7	10 µg/L
V	EPA 200.7	1 µg/L
Zn	EPA 200.7	1 µg/L
TS	SM 2540B	1 mg/L
TSS	SM 2450D	1 mg/L
Turbidity	EPA 180.1	0.1 NTU
pH	SM 4500H+B	1-14 s.u.

NEORSD Surface Water Condition Sampling Field Data Form

Date: _____ Time: _____ Site (RM): _____

Flow: Low Medium High _____fps

USGS 04208000 Cuyahoga River @ Independence, OH Flow Gage: _____ft³/sec*

HD Status: OK Buried Out of Water Missing

Clarity: Clear Murky Turbid Other: _____

Color: None Green Brown Grey Other: _____

Was this sample taken during or following a wet weather event? Yes/No

If yes, when and how much rain occurred? _____

General Comments: _____

Date: _____ Time: _____ Site (RM): _____

Flow: Low Medium High _____fps

USGS 04208000 Cuyahoga River @ Independence, OH Flow Gage: _____ft³/sec*

HD Status: OK Buried Out of Water Missing

Clarity: Clear Murky Turbid Other: _____

Color: None Green Brown Grey Other: _____

Was this sample taken during or following a wet weather event? Yes/No

If yes, when and how much rain occurred? _____

General Comments: _____

Appendix C

Standard Operating Procedures

Laboratory Processing of Benthic Samples

Upon arrival at the laboratory, the Hester-Dendy (H-D), Surber, and qualitative samples were logged in and accounted for. Prior to sorting and identification, each sample was rinsed on a No. 60 (0.250 mm openings) U.S. Standard Testing Sieve to remove the preservative and the H-D plates were scraped to remove the organisms. Sorting of each H-D and Surber sample was conducted in a white enamel pan first under a magnifier lamp and finally under a compound dissecting scope. If necessary, a Folsom sample splitter was used to subsample the H-Ds and Surbers until a more manageable number of organisms was achieved. Prior to splitting, the sample was pre-picked to remove any large and/or rare taxa. In all a minimum of 250 organisms in representative proportions were removed from the fractionated samples. Organisms were sorted to higher taxonomic levels (generally Class or Order level) and preserved separately in labeled vials containing 70% ethyl alcohol. To assure a consistent level of quality and sorting efficiency, senior EA personnel checked all samples. The qualitative samples contained very little detrital matter and therefore were simply rinsed prior to identification.

Macroinvertebrate identifications were made to the lowest practical taxonomic level using the most current literature available (see attached list of taxonomic literature). Whenever possible, the level of identifications followed those recommended by Ohio EPA (2006). Chironomidae larvae were cleared in warm 10% potassium hydroxide and mounted in CMC-10 prior to identification. Generally, 100 chironomids from any single sample were mounted for identification. For all sample types, specimens were enumerated, coded and recorded on a standard laboratory bench sheet for data processing.

Data Analyses

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 (Ohio EPA 1987). 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.

Scoring criteria for all ten metrics is dependent upon drainage area. The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by Ohio EPA (1989a). The sum of the individual metric scores resulted in the ICI score for that particular location.

Calculation of the ICI was conducted using a computer program written for the software SAS[®] by EA in 1994. This program is continuously tested and updated to ensure its accuracy. Although the ICI is most often used to analyze the combination of H-D and qualitative data from a particular location, for this study, the ICI was also calculated for the combination of Surber and qualitative data when H-D data were not available.

The only other statistical comparison used was the relative abundance (or percent composition) of individual taxa from each site and sample type. Relative abundance was calculated for both sample types as:

$$\text{Rel. Abund.(\%)} = 100 \times \frac{\text{\# Individuals of a Taxa}}{\text{Total \# of Individuals in Sample}}$$

All sample processing and data analysis were completed by permanent and full-time EA Engineering, Science, & Technology, Inc. staff working in our Deerfield, Illinois office and laboratory. Specific staff members that worked on this project and relevant experience are listed below by task:

<u>Task</u>	<u>EA Personnel</u>	<u>Years of Experience</u>
Login, Sorting, Mounting	Conrad Zack	2
Identification	Marty Sneen	19
Data Analysis	Joe Vondruska	24
	Marty Sneen	19

Selected Ohio EPA Reporting Requirements

Item 12-Taxonomic literature

Although EA's taxonomic library contains substantially more references than are listed here, the following list only includes taxonomic literature used to identify the benthos in samples from Big Creek, Doan Brook, Euclid Creek, and Mill Creek.

Bednarik, A.F. and W.P. McCafferty. 1979. Biosystematic revision of the genus Stenonema (Ephemeroptera: Heptageniidae). Canadian Bulletins of Fisheries and Aquatic Sciences 201:1-73.

Bode, R.W. 1983. Larvae of North American Eukiefferiella and Tvetenia (Diptera: Chironomidae). New York State Museum Bulletin 452:1-40.

Bolton, M.J. 2007. Ohio EPA supplemental keys to the larval Chironominae (Diptera) of Ohio and Ohio Chironomidae checklist. Ohio EPA, Division of Surface Water, Ecological Assessment Section, Columbus, Ohio.

Brown, H.P. 1976. Aquatic dryopoid beetles (Coleoptera) of the United States. Water

Pollution Control Series 18050 ELDO4/72. 2nd edition. U.S. Environmental Protection Agency, Cincinnati, OH.

Burch, J.B. 1982. Freshwater snails (Mollusca: Gastropoda) of North America. EPA-600/3-82-026. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

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Item 13-Voucher Collection

A voucher collection was developed containing two good specimens (when available) of each taxon identified from the samples. This voucher collection along with all sample specimens will be returned to NEORSD upon completion of all the sample analysis.

Outside expert specimen verification was not necessary for identification of these specimens. However, if a reference collection had been needed to verify any specimens, EA maintains a sizable macroinvertebrate voucher collection with over 1800 specimens representing over 700 taxa. If this taxonomic library proved to be insufficient, every reasonable attempt would be made to have the specimen(s) identified or verified by a noted authority.

Item 16-Chironomidae Identification

Chironomidae larvae were cleared in warm 10% potassium hydroxide and mounted in CMC-10 prior to identification. Generally, 100 chironomids from any single sample are mounted for identification. Species level identifications generally follow those suggested by Ohio EPA.

Item 17-Copies of Raw Data

Copies of the laboratory bench sheets are appended to the hard copy of this document.

Item 18-ICI Calculation

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 (Ohio EPA 1987). 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.

Scoring criteria for all ten metrics is dependent upon drainage area. The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from at least 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by Ohio EPA (1989a). The sum of the individual metric scores resulted in the ICI score for that particular location.

Calculation of the ICI was conducted using a computer program written for the software SAS® by EA in 1994. This program is continuously tested and updated to ensure its accuracy.

Item 20-Statistical Analyses

The only other statistical comparison used was the relative abundance (or percent composition) of individual taxa per site and sample type. Relative abundance was calculated for both sample types as:

$$\text{Rel. Abund.} = \frac{\# \text{ Individuals of a Taxa}}{\text{Total \# of Individuals in Sample}}$$

Item 21-Results

Complete results are appended to the hard copy of this document.

Item 25-Electronically Formatted Data

For convenience, the data and text are provided in electronic format as Word 2003® files via email and on the enclosed CD-RW.