

Level 3 Project Study Plan

2011 Nine-Mile Creek Environmental Monitoring

(1) Objectives

Nine-Mile Creek is an intensely urbanized creek in Cuyahoga County that runs through the cities of University Heights, South Euclid, Cleveland Heights, Cleveland and Bratenahl before emptying into Lake Erie. The creek is also culverted for large sections during its length.

Future construction projects in the Nine-Mile watershed are anticipated to improve to its water quality, therefore, the Northeast Ohio Regional Sewer District (NEORS D) intends to conduct assessments prior to the beginning of these projects.

The purpose of this study is to collect baseline data in order to assess the biological health of Nine-Mile Creek prior to the completion of construction activities (anticipated in 2014). Flows will either be eliminated or reduced from two CSOs. NEORS D will assess water chemistry and habitat, along with the fish and benthic macroinvertebrate communities. The results obtained from the water chemistry sampling will be evaluated against the Ohio EPA's water quality standards (Ohio EPA, 2009b)¹. An examination of the fish and benthic macroinvertebrate communities will be compared as stated by Ohio EPA (1987b).

(2) Point/Nonpoint Sources

Point Sources	Nonpoint Sources
Storm Sewer Outfalls	Urban Runoff
Home Sewage Treatment Systems	Spills
NEORS D-owned CSOs	Agriculture
Sanitary Sewer Overflows	

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. Other factors that may influence ecological conditions during the study include periods of drought and periods of precipitation.

(3) Parameters Covered

Fish specimens will be identified to species level, counted and examined for the presence of external anomalies including deformities, eroded fins, lesions and tumors (DELTs). Quantitative fish sampling is expected to be conducted at all

¹ See Appendix I for a list of all references.

locations. In addition, stream habitat will be measured by scoring components of the QHEI at all locations, including the substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality and gradient.

Macroinvertebrate community assemblages will be collected from each location and sent to a Benthic Macroinvertebrate Level 3 Qualified Data Collector (QDC) for identification and enumeration. The QDC, described in section (11), will identify the specimens to the lowest practical taxonomic level as recommended by the Ohio EPA (1987b). The NEORSD Macroinvertebrate Field Sheet (Appendix B) will be completed at each site during sample collection.

Water chemistry samples will be collected at all sites. Appendix C lists the parameters to be tested along with the detection limits and practical quantitation limits. Field measurements for dissolved oxygen, pH, temperature, and conductivity will be performed. Turbidity will either be completed in the field or at NEORSD's laboratory. A NEORSD Surface Water Condition Sampling Field Data Form will be completed at each site during each sample collection (Appendix D).

(4) Field Collection and Data Assessment Techniques

Field collections for fish will be conducted at all sites, where appropriate. 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 DELTs. Fish easily identified (commonly collected from year to year) will be returned to the site from which they are collected, excluding any vouchers. Subsamples of difficult-to-identify species will be brought back to the laboratory for verification by NEORSD Level 3 Fish Qualified Data Collectors (QDC) and, if necessary, sent to The Ohio State University 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 using qualitative, and at the most downstream site quantitative, sampling techniques. Quantitative sampling will include installation of a Hester-Dendy multi-plate artificial substrate sampler (HD) that is colonized for a six-week period. Qualitative sampling will be conducted using a D-frame dip net when HD samplers are retrieved or at a time to be determined later. The NEORSD Macroinvertebrate Field Sheet will be completed during sampling. Midwest Biodiversity Institute (Columbus, Ohio) will identify the specimens to the lowest practical taxonomic level as recommended in Ohio EPA's (1987b). Voucher specimens will be collected as described in section (14). Stream flow will be measured with a Marsh-McBirney FloMate Model 2000 Portable Flow Meter or an Aquaflo Probe Model 6900 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, is described by Ohio EPA (1987a, 1987b).

Water chemistry sampling will be completed at all locations. Techniques used for water chemistry sampling and chemical analyses will follow the methods described by the Ohio EPA (2009). Chemical water quality samples from each site will be collected with two 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles in addition a 500 milliliter bottle. All water quality samples will be collected as grab samples in-stream. One duplicate sample and one field blank will be collected at a randomly selected site, at a frequency not less than 10% of the total samples collected for this study plan. The acceptable relative percent difference (RPD) for field duplicate samples will be ≤ 30 percent; results outside this range will trigger further evaluation along with an investigation into causes for disparities. RPD values above 30 percent, with results less than ten times the practical quantitation limit, will be reviewed on a case-by-case base to determine if there is any merit for further investigation. Acid preservation of the samples, as specified in the NEORSD laboratory's standard operating procedure for each parameter, will occur in the field. Appendix C lists the analytical method, detection limit and practical quantitation limit for each parameter analyzed. Field analyses include the use of either a Yellow Springs Incorporated (YSI) 556 MPS Multi-Parameter Water Quality Meter or YSI 600XL sonde to measure dissolved oxygen, water temperature, conductivity and pH; and when necessary, a Hanna HI 98129 meter

to measure pH. Turbidity will be completed either in the field or at NEORSD's laboratory. Meter specifications have been included in Appendix E.

Benthic and water column chlorophyll *a* samples will be collected at least one time under low-flow conditions between June 15th and October 15th, 2011. Sampling methods will follow those detailed in the NEORSD *Chlorophyll a Sampling and Field Filtering Standard Operating Procedure* (SOP-EA001-00). A Chlorophyll *a* Sampling Field Sheet will be completed for each site (Appendix J). Water chemistry grab samples will be collected at the same time using the methods discussed previously and will be analyzed for nutrients, turbidity, alkalinity and suspended solids.

The QHEI, as described in Ohio EPA (2006), will be used to assess aquatic habitat conditions at each sample location by Level 3 QDCs.

Species assemblages and individual metrics will be analyzed. Graphs that show current IBI and ICI scores and how these scores compare to attainment status of biocriteria may be prepared. Water chemistry data collected will be compared to Ohio water quality standards to determine whether any excursions from the applicable water quality criteria have occurred. Comparisons between water quality and biological community health will only be made if at least three water quality samples have been collected from a particular site.

(5) Sampling Locations

The following electrofishing and macroinvertebrate sample locations will be surveyed on Nine-Mile Creek during the 2010 field season. Benthic macroinvertebrate and water chemistry collection sites are located near the mid point of each electrofishing zone, indicated by river mile, unless otherwise noted. GPS coordinates are recorded at the downstream end of each electrofishing zone.

Site Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Nine-Mile Creek	41.5574565	81.59912283	0.40	Upstream of Lakeshore Boulevard	East Cleveland	Evaluate water chemistry, fish, habitat and macroinvertebrates
Nine-Mile Creek, Nela Park Branch (Site 9)	41.54290983	81.55521750	N/A	South of Belvoir Boulevard on Nela Park Branch	East Cleveland	Evaluate water chemistry, fish, habitat and macroinvertebrates
Nine-Mile Creek (Site 10)	41.54572967	81.55228433	N/A	South of Belvoir Boulevard	East Cleveland	Evaluate water chemistry, fish, habitat and macroinvertebrates

(6) Schedule

At least one electrofishing survey per site will be conducted between June 15 and October 15th, 2011. If more than one survey will be conducted, then at least four to five weeks will separate assessments. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when each electrofishing pass will be conducted.

QHEI habitat evaluations will be conducted one time at each site between June 15th and October 15th, 2011. These evaluations will be conducted around the same time as one of the electrofishing surveys.

Artificial substrate samplers will be installed once, between June 15th and August 19th, 2011, at river mile 0.40 and retrieved six weeks later. Only qualitative samples will be collected at Sites 9 and 10. Specific dates have not been scheduled for the qualitative sampling. River flow and weather conditions will be assessed weekly to determine when the sampling will be conducted.

Beginning at an undetermined date during the biological field season, June 15th to October 15th, water quality samples will be collected a minimum of three times at all of the sampling locations.

(7) QA/QC

Quality assurance and quality control of sampling and analysis methods for habitat, fish, and macroinvertebrate evaluations will follow the steps outlined by Ohio EPA (2006, 1987a, 1987b).

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 collect data. Proper steps will be taken to correct the problem as soon as possible, whether by repairing in the field, 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 NEORD Level 3 Fish Qualified Data Collectors (QDC), and if necessary, sent to The Ohio State University 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 that particular species.

All macroinvertebrate community assemblages will be collected and sent to MBI for identification and enumeration. MBI will identify specimens to the lowest practical taxonomic level as recommended by Ohio EPA (1987b). The MBI QA/QC manual is attached (Appendix F). All macroinvertebrate specimens will be returned to NEORSD. Voucher specimens for each site will be separated into individual vials and collected as described in section (14). The remaining specimens for each site will be returned in a single container labeled with the site number, collection method and date. All specimens and accompanying chain-of-custody documentation will be retained by NEORSD and stored at the Environmental & Maintenance Services Center for a period not less than ten years.

Water samples obtained for chemical analyses will be collected, preserved (see Section 4), labeled and then placed on ice inside the field truck. The field truck will remain locked at all times when not occupied/visible. Sampling activities, including sample time and condition of surface water sampled, will be entered in a field log book and on the Surface Water Condition Sampling Field Data Form. 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 are on file with Ohio EPA. The Quality Assurance Officer at Analytical Services will send updates, revisions and any information on document control to Ohio EPA as needed.

Three filtrations will be completed for each benthic and water column chlorophyll a sample. In addition, a field filtration blank will be submitted for every 20 samples.

(8) Work Products

Within one year of completion of the project, fish data (species, numbers, pollution tolerances, the incidence of DELT anomalies, IBI and scores), macroinvertebrate data (types and numbers of macroinvertebrates collected and assessments), 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, ICI and QHEI scores and any excursions from water quality standards may be prepared for internal use.

(9) Qualified Data Collectors

The following Level 3 QDCs may be involved with these studies:

Name	Address	Email Address	Phone Number	QDC Specialty(s)
Kathryn Crestani	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	crestanik@neorsd.org	216-641-6000	QDC - 011 CWQA/SHA
Kristina Granlund	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	granlundk@neorsd.org	216-641-6000	QDC - 511 CWQA/SHA
Seth Hothem	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 010 CWQA/FCB/SHA
Ron Maichle ⁴	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 145 CWQA/SHA/BMB
Jill Novak ^{3,6}	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	novakj@neorsd.org	216-641-6000	QDC - 512 CWQA/SHA
Francisco Rivera	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 262 CWQA/SHA
John Rhoades ¹	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 008 CWQA/FCB/SHA/ BMB
Tom Zablontny ²	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	zablontnyt@neorsd.org	216-641-6000	QDC - 018 CWQA/FCB/SHA
Cathy Zamborsky	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 009 CWQA/SHA
Martin Knapp ⁵	Midwest Biodiversity Institute P.O. Box 21561 Columbus, Ohio 43221	martygator@hotmail.com	614-457-6000	QDC - 300 BMB
¹ Lead Project Manager		⁴ Benthic Macroinvertebrate Biology (BMB) Project Manager		
² Fish Community Biology (FCB) Project Manager		⁵ Benthic Macroinvertebrate Identification		
³ Stream Habitat Assessment (SHA) Project Manager		⁶ Chemical Water Quality Assessment (CWQA) Project Manager		

The following is a list of persons not qualified as QDCs who may be involved in the project. Prior to the start of sampling, the project managers will explain to each individual the proper methods for sampling. 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
Nick Barille	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	barillen@neorsd.org	216-641-6000
Scott Broski	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	broskis@neorsd.org	216-641-6000
Joseph Broz	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	brozj@neorsd.org	216-641-6000
Joseph Carbonaro	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	carbonaro@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	dobrianskyt@neorsd.org	216-641-6000
Kyle Frantz	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	frantzk@neorsd.org	216-641-6000

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Name	Address	Email Address	Phone Number
Rae Grant	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Eric Hinton	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hintone@neorsd.org	216-641-6000
Mark Matteson	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	mattesonm@neorsd.org	216-641-6001
Denise Phillips	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	phillipsd@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
Wolfram von Kiparski	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Amy Erzen Summer Co-op	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	erzena@neorsd.org	216-641-6000
Summer Co-op	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
Summer Co-op	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
Summer Co-op	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000

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

See attached (Appendix G).

- (11) Contract laboratory contact information

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

The Ohio State University Museum of Biological Diversity
 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

Identification of macroinvertebrates will be completed by MBI (Columbus, Ohio). Benthic macroinvertebrates will be identified to the lowest practical level as recommended by Ohio EPA (1987b). MBI contact information:

Mr. Chris Yoder
Midwest Biodiversity Institute
P.O. Box 21561
Columbus, Ohio 43221
yoder@rrohio.com
614-457-6000

(12) Copy of Ohio Division of Natural Resources (ODNR) collector's permit
To be submitted electronically when issued by ODNR (Appendix H).

(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

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. When benthic macroinvertebrates 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: Kathryn Crestani / Date: _____

Print/Signature: Kristina Granlund / Date: _____

Print/Signature: Seth Hothem / Date: _____

Print/Signature: Ron Maichle / Date: _____

Print/Signature: Jill Novak / Date: _____

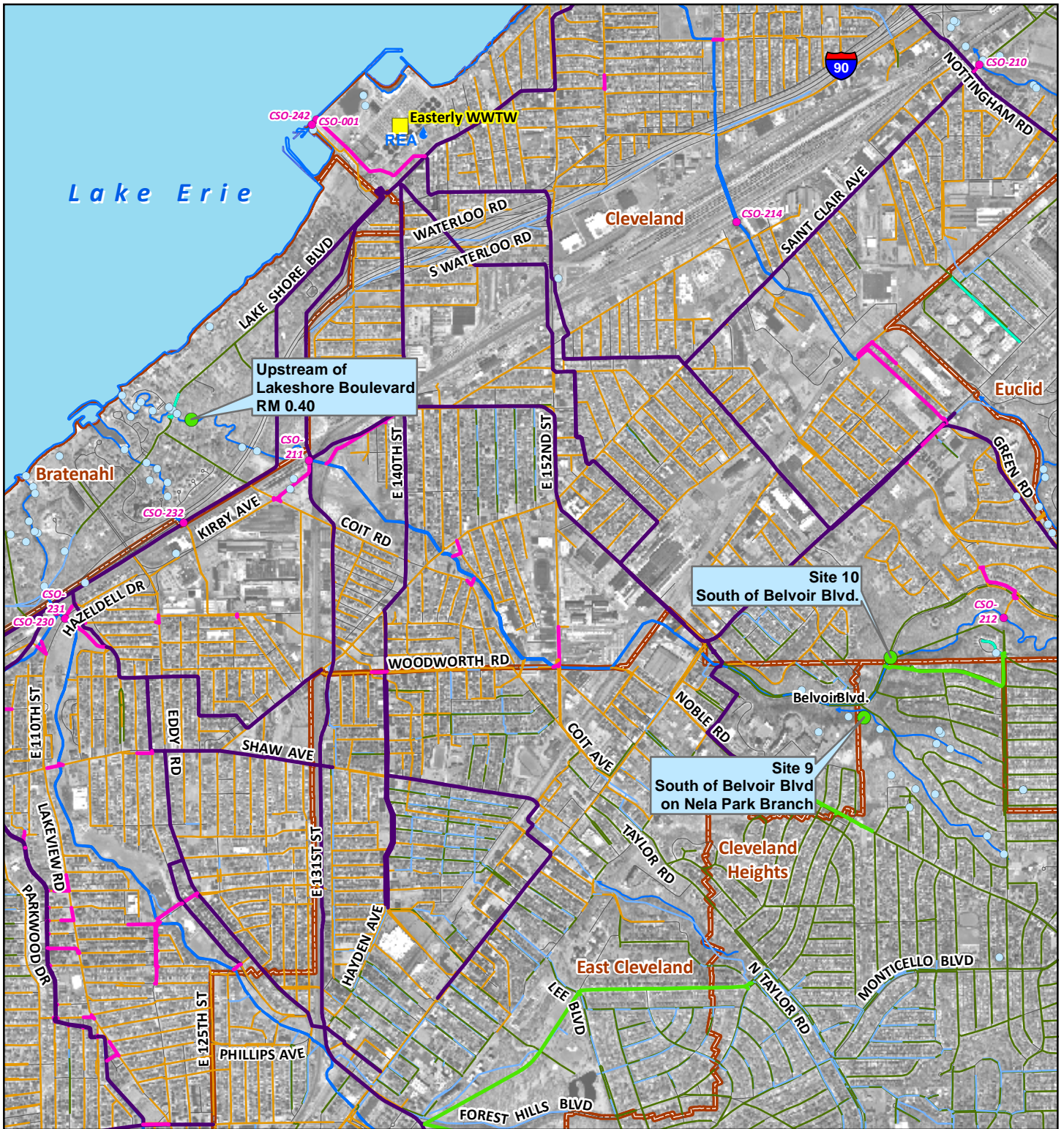
Print/Signature: John Rhoades / Date: _____

Print/Signature: Francisco Rivera / Date: _____

Print/Signature: Tom Zabloutny / Date: _____

Print/Signature: Cathy Zamborsky / Date: _____

Appendix A



**Nine Mile Creek
2010 Environmental Assessment**



Study Sites

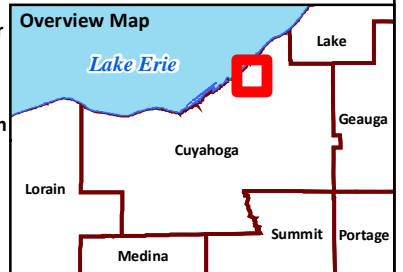
- Upstream of Lakeshore Boulevard
-Lat.41.5575 Long.-81.5991
- South of Belvoir Blvd.
-Lat.41.5429 Long.-81.5552
- 1/2 mile south of Belvoir Blvd. on Nela Park Branch
-Lat.41.5457 Long.-81.5523

- CSO Outfall
- Outfalls
- NEORS D Interceptor Sewer
- NEORS D Intercommunity Relief Sewer
- NEORS D CSO Control Sewer
- NEORS D CSO Responsibility Sewer
- Stream
- Local Combined Sewer
- Local Sanitary Sewer
- Local Storm Sewer
- Local Culverted Stream
- Local Force Main

Date: March 2010
Sources: Orthophotos(2008), Street Centerline (2006), Cuyahoga County GIS; Streams(2005), SURGO; Environmental Assessment Zones (2009), Collection System, NEORS D GIS;



1,700
Feet



2010_EnvAssesPlan_NineMileCreek_Letter.mxd

This map was compiled by the Northeast Ohio Regional Sewer District ("District") which makes every effort to produce and publish the most current and accurate information possible. This map was created and compiled to serve the District for planning and analysis purposes. The District makes no warranties, expressed or implied, with respect to the accuracy of this map and its use for any specific purpose. The District and its employees expressly disclaim any liability that may result from the use of this map. For more information, please contact: Jeffrey Duke, P.E., GISP (Engineering Technical Services) 3900 Euclid Avenue, Cleveland, Ohio 44115 (216-881-6600).

Appendix B

NEORS Macroinvertebrate Field Sheet

Stream: _____ River Mile: _____ Year: _____

Location: _____ Project: _____

Drainage Area (mi²): _____ Latitude (°N)/Longitude (°W): _____

Hester-Dendy Deployment Information

Install Date: _____ Crew Initials (QDC Circled): _____

Current at HD (fps): _____ Depth (cm): _____ Pictures Obtained: Yes No

Reinstall Date: _____ Crew Initials (QDC Circled): _____

Current (fps): _____ Depth (cm): _____ Reason: _____

Reinstall Date: _____ Crew Initials (QDC Circled): _____

Current (fps): _____ Depth (cm): _____ Reason: _____

Sampling/Retrieval Information

Sampling Method: Hester-Dendy Dipnet Surber Grab Other: _____

Sampling ID: HD: _____ Qualitative: _____ Other: _____

Sampling Date: _____ Crew Initials (QDC Circled): _____

HD Condition- Current (fps): _____ Depth (cm): _____ Water Temp: _____ °F / °C

Number of HD Blocks Obtained: _____ Remarks: _____

Disturbed: Yes No Comments: _____

Debris: Yes No Comments: _____

Silt/Solids: None Slight Moderate Heavy

Dipnet- Time Sampled (min): _____ X Number of Crew: _____ = Total (min): _____

Habitats Sampled: Pool Riffle Run Margin Backwater

Samples Analyzed By: _____ QDC #: _____ Date: _____

River Sampling Conditions

Flow Condition: Flood Above Normal Normal Low Interstitial Intermittent Dry

Current Velocity: Fast Moderate Slow Non-detect

Channel Morphology: Natural Channelized Channelized (Recovered) Impounded

Bank Erosion: Extensive Moderate Slight None

Riffle Development: Extensive Moderate Sparse Absent

Riffle Quality: Good Fair Poor *Embedded:* Yes No

Water Clarity: Clear Murky Turbid Other: _____

Water Color: None Green Brown Grey Other: _____

Canopy: Open 75 % 50 % 25 % Closed

Comment Section: _____

Physical Characteristics

Substrate Characteristics

	Pool Units	Riffle Units	Run Units
Bedrock			
Boulder			
Rubble			
Coarse Gravel			
Fine Gravel			
Sand			
Silt			
Clay/Hardpan			
Detritus			
Peat			
Muck			
Other			
Macrophytes			
Algae			
Artifacts			
Compaction (F,M,S)			
Depth (Avg)			
Width (Avg)			

Predominant Land Use (Left, Right or Both)

Forest	Urban	Open Pasture
Shrub	Residential/Park	Closed Pasture
Old Field	Mining/Construction	
Rowcrop	Wetland	
Industrial	Other	

Predominant Riparian Vegetation

Left	Right	Type
_____	_____	Large Trees
_____	_____	Small Trees
_____	_____	Shrubs
_____	_____	Grass/Weeds
_____	_____	None

Margin Habitat

Margin Quality:	Good	Fair	Poor
Undercut Banks		Root Mats	
Grass		Water Willow	
Shallows		Clay/Hardpan	
Rip Rap		Bulkhead	
Other			

Biological Characteristics

Riffle:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Run:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Pool:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Margin:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Other Notable Collections:

V= Very Abundant; A= Abundant; C= Common; R= Rare

Overall Amount (V=>151; A= 150-101; C= 100-11; R= 10-1)

/	Porifera, Bryozoa
/ /	Turbellaria, Oligochaeta, Hirudinea
/	Isopoda, Amphipoda
/	Decapoda, Hydracarina
	Ephemeroptera
	Baetidae
	Other _____
/	Zygoptera, Anisoptera
	Plecoptera
	Hemiptera
/	Megaloptera, Neuroptera
	Trichoptera
	Hydropsychidae
	Other _____
	Coleoptera
	Elimidae
	Other _____
	Diptera
	Chironomidae
	Other _____
/	Gastropoda, Bivalvia
	Other _____
	Other _____
	Other _____

Appendix C

Parameter	Additional Name	Test	Minimum Detection Limit	Practical Quantitation Limit
Alkalinity		EPA 310.2	1.5 mg/L	10 mg/L
Chemical Oxygen Demand	COD	EPA 410.4	5 mg/L	10 mg/L
Hexavalent Chromium	Hex Chrome	SM 3500 Cr D. ¹	1 µg/L	5 µg/L
Mercury	Hg	EPA 245.1	0.005 µg/L	0.050 µg/L
Ammonia *	NH ₃	EPA 350.1	0.002 mg/L	0.010 mg/L
Nitrite + Nitrate	NO ₂ + NO ₃	EPA 353.2	0.001 mg/L	0.010 mg/L
Nitrite	NO ₂	SM 4500-NO ₂ ⁻ B. ¹	0.002 mg/L	0.010 mg/L
Nitrate	NO ₃	EPA 353.2	0.001 mg/L	0.010 mg/L
Soluble Phosphorus	Soluble-P	EPA 365.1	0.004 mg/L	0.010 mg/L
Total Phosphorus	Total-P	EPA 365.1	0.002 mg/L	0.010 mg/L
Chlorophyll <i>a</i>	Chlorophyll <i>a</i>	EPA 445.0	To be determined	2.0 µg/L
Chloride	Chloride by IC	EPA 300.0	0.057 mg/L	5.000 mg/L
Sulfate	Sulfate by IC	EPA 300.0	0.046 mg/L	5.000 mg/L
Biological Oxygen Demand	BOD	SM 5210 ¹	2 mg/L	5 mg/L
Silver	Ag	EPA 200.7	0.12 µg/L	1.00 µg/L
Aluminum	Al	EPA 200.7	3.7 µg/L	10.0 µg/L
Arsenic	As	EPA 200.7	0.31 µg/L	2.00 µg/L
Barium	Ba	EPA 200.7	0.12 µg/L	2.00 µg/L
Beryllium	Be	EPA 200.7	0.12 µg/L	1.00 µg/L
Calcium	Ca	EPA 200.7	11.2 µg/L	275.0 µg/L
Cadmium	Cd	EPA 200.7	0.022 µg/L	1.00 µg/L
Cobalt	Co	EPA 200.7	0.15 µg/L	1.00 µg/L
Chromium	Cr	EPA 200.7	0.25 µg/L	2.00 µg/L
Copper	Cu	EPA 200.7	0.17 µg/L	1.00 µg/L
Iron	Fe	EPA 200.7	1.5 µg/L	10.00 µg/L
Potassium	K	EPA 200.7	31.4 µg/L	275.0 µg/L
Magnesium	Mg	EPA 200.7	40.9 µg/L	100.0 µg/L
Manganese	Mn	EPA 200.7	0.038 µg/L	1.00 µg/L
Molybdenum	Mo	EPA 200.7	0.31 µg/L	1.00 µg/L
Sodium	Na	EPA 200.7	59.5 µg/L	500.0 µg/L
Nickel	Ni	EPA 200.7	0.17 µg/L	2.00 µg/L
Lead	Pb	EPA 200.7	0.39 µg/L	3.00 µg/L
Antimony	Sb	EPA 200.7	0.61 µg/L	5.00 µg/L
Selenium	Se	EPA 200.7	0.63 µg/L	5.00 µg/L
Tin	Sn	EPA 200.7	13.4 µg/L	50.00 µg/L
Titanium	Ti	EPA 200.7	0.22 µg/L	2.00 µg/L
Thallium	Tl	EPA 200.7	1.10 µg/L	5.00 µg/L
Vanadium	V	EPA 200.7	0.15 µg/L	1.00 µg/L
Zinc	Zn	EPA 200.7	1.6 µg/L	10.00 µg/L
Total Metals	Total Metals (calc.)	EPA 200.7	µg/L =(Cr µg/L)+(Cu µg/L)+(Ni µg/L)+(Zn µg/L)	
Hardness	Hardness (calc.)	SM 2340 B ¹	CaCO ₃ mg/L =(2.497*Ca mg/L)+(4.118*Mg mg/L)	
Total Solids	TS	SM 2540 B ¹	0.5 mg/L	1.0 mg/L
Total Suspended Solids	TSS	SM 2540 D ¹	0.5 mg/L	1.0 mg/L
Total Dissolved Solids	TDS	SM 2540 C ¹	0.5 mg/L	1.0 mg/L
Turbidity **		EPA 180.1	0.1 NTU	0.2 NTU
<i>Escherichia coli</i>	<i>E. coli</i>	EPA 1603 D	1 colony	--
Field Parameter		Test	(Value Reported in)	
pH		SM 4500H-B ¹	s.u.	
Conductivity		SM 2510A ¹	µs/cm	
Dissolved Oxygen	DO	SM 4500-0 G ¹	mg/L	
Temperature	Temp	SM 2550B ¹	°C	
Turbidity **		EPA 180.1	NTU	

*NOTE: Listed MDL/PQL is for undistilled samples. Any samples that are required to be distilled will have a MDL = 0.044 mg/L, PQL = 0.100 mg/L

** Turbidity will either be completed in the field or at the laboratory.

¹ Standard Methods for the Examination of Water and Wastewater, 19th Edition

Appendix D

NEORSD Surface Water Condition Sampling Field Data Form

Stream: _____ Date: _____ Collectors: _____

Gage Station and ID: _____ Daily Mean Discharge: _____ ft³/sec

Was this sample taken during or following a wet weather event? YES / NO

Water Quality Meters Used: _____

Time (hrs): _____ River Mile (Site): _____

Weather: Clear Partly Cloudy Overcast Light Rain/Showers Heavy Rain
Steady Rain Heavy Snow Melt Other: _____

Flow: Dry Intermittent Minimal Baseline/Normal Elevated Flood

HD Status: OK Buried Out of Water H-D was Reset
Unknown (river too high) Missing Not Installed Flow: _____ fps

Color: Clear Muddy Tea Milky Other: _____

Odor: Normal Petroleum Anaerobic Sewage Chemical Other: _____

Surface Coating: None Foam Oily Scum Other: _____

Field Parameters: Conductivity (µmhos/cm): _____ Temperature (°C): _____

Dissolved Oxygen (mg/L): _____ pH (s.u.): _____

Turbidity (NTU): _____

General Comments: _____

Time (hrs): _____ River Mile (Site): _____

Weather: Clear Partly Cloudy Overcast Light Rain/Showers Heavy Rain
Steady Rain Heavy Snow Melt Other: _____

Flow: Dry Intermittent Minimal Baseline/Normal Elevated Flood

HD Status: OK Buried Out of Water H-D was Reset
Unknown (river too high) Missing Not Installed Flow: _____ fps

Color: Clear Muddy Tea Milky Other: _____

Odor: Normal Petroleum Anaerobic Sewage Chemical Other: _____

Surface Coating: None Foam Oily Scum Other: _____

Field Parameters: Conductivity (µmhos/cm): _____ Temperature (°C): _____

Dissolved Oxygen (mg/L): _____ pH (s.u.): _____

Turbidity (NTU): _____

General Comments: _____

Sample ID: _____

Sample ID: _____

Appendix E



Hach₂O Your formula for water analysis.

View Order 0 item(s), **Total:** \$0

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2100P IS Portable Turbidimeter

Specifications

2100P Portable Turbidimeter Specifications:

- Ranges:** 0-1000 NTU with automatic decimal point placement or manual range selection of 0-9.99, 0-99.9 and 0-1000 NTU selection.
- Accuracy:** ± 2% of reading plus stray light from 0 to 1000 NTU (stray light: <0.02 NTU)
- Repeatability:** ± 1% of reading or ± 0.01 NTU, whichever is greater
- Resolution:** 0.01 NTU on lowest range
- Sample Required:** 15 mL
- Power Requirement:** Four AA alkaline batteries or optional 120 or 230 Vac battery eliminator.
- Construction:** High-impact ABS plastic shell
- Dimensions:** 22.2 x 9.5 x 8.9 cm (8.75 x 3.75 x 3.5")
- Shipping Weight:** 3.6 kg (8 lb)
- Warranty:** Two years

Specifications subject to change.

MAIN PRODUCT PAGE

- » [2100P IS Portable Turbidimeter](#)

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2020we & 2020wi Portable Turbidity Meters

The Clear Choice for Turbidity Measurement!

Industry-leading precision, sensitivity, and dependability in one of the most innovative **handheld meters** available on the market!

- **Waterproof** to IP67
- Lithium rechargeable battery
- USB port
- 7 languages
- Backlit display
- EPA and ISO versions

- 2020we** Complies with USEPA 180.1 Standard
- 2020wi** Complies with ISO 7027 Standard



Kit supplied with 0, 1, and 10 NTU standard, sample bottle, 4 sample tubes, USB cable, USB computer/wall adapter, and waterproof carrying case.

Order Codes	
1970-EPA	2020we Kit: Portable turbidity meter complies with USEPA 180.1 Standard
1970-ISO	2020wi Kit: Portable turbidity meter complies with ISO 7027 Standard

Turbidity Specifications

Meter Features

Order Codes

Turbidity Specifications:	
Unit of Measure:	2020we: NTU, AU, ASBC, EBC 2020wi: FNU, FAU, ASBC, EBC
Range:*	0-4000 NTU/FNU, 0-10,500 ASBC, 0-150 EBC
Resolution:*	0.01 NTU/FNU 10.00-10.99 0.1 NTU/FNU 11.00-109.9 1 NTU/FNU 110-4000
Accuracy:*	From 0-2.5 NTU the accuracy is ±0.05 NTU From 2.5-100 NTU the accuracy is ±2% From 100 NTU the accuracy is ±3%
Detection Limit:	0.05 NTU/FNU
Range Selection:	Automatic
Reproducibility:*	0.02 NTU/FNU or 1%
Light Source:	Tungsten (EPA) complies with EPA 180.1 Standard 860 LED (ISO) complies with ISO 7027

*Over 600 NTU/FNU units expressed as AU/FAU

Water Quality Turbidity Meter

Orion AQUAfast AQ4500 Turbidimeter

Thermo Electron introduces the Orion AQ4500 Turbidimeter which offers advanced features not available on any other benchtop or portable turbidimeter. The AQ4500 offers a dual source LED which allows readings that comply with both EPA 180.1 and ISO 7027. Turbidity can be read in the range of 0 - 1000 NTU with a choice of units: NTU, FTU, FNU, ASBC, and EBC. In the range of 0 - 40 NTU the AQ4500 offers a ratiometric range which will give EPA, GLI method 2 equivalent numbers. This portable field unit is truly IP67 waterproof with typical battery life of over 1000 hours on one set of batteries and datalog capacity of 100 points which can later be downloaded to a printer or computer. The AQ4500 accepts 24 mm cuvettes and comes with a two year warranty.

FEATURES

- Nephelometric and Ratiometric measurements with Autoranging
- Data log capacity of up to 100 data points
- Readings in the range of 0 - 1000 NTU with a choice of units: NTU, FTU, FNU, ASBC, or EBC
- Includes Turbidity Standards kit, rugged carrying case, and replacement cuvettes
- Orion AQ4500 is truly IP67 waterproof to a depth of 3 meters



SPECIFICATIONS

Type	Turbidity Meter	Repeatability	± 1% of reading or 0.01 NTU
Principle of Operation	Nephelometric	Response Time	< 8 seconds
Operating Modes	Automatic	Calibration	1, 10, 100, 1000 NTU
Measurement Modes	Automatic	Signal Averaging	Yes
Ranges		Sample Cell Size	24 mm
	NTU 0 - 2000	Sample Size	-12 mL
	Nephelometric 0 - 4000	Display	Custom LED
	EPA 0 - 4000 NTU	RTC	Yes
ISO - NEPH (7027)	0 - 150 FNU	Input/Output	RS-232 Serial Port
ISO - ABSB	40 - 4000 FAU	Power	Battery - four AA's (2,500 hours Alkaline, 10, 000 lithium)
IR RATIO	0 - 4000 NTU	Environmental Conditions	
EBC	0 - 24.5	Operating Temperature	-40° to 140°F (-40° to -60°C)
ASBC	0 - 236	Humidity	90% RH at 30.0C max
Accuracy	± 2% of reading plus 0.01 NTU (0 - 500 NTU)	Light Source	White, IR
	± 3% of reading (500 - 1000 NTU)	Warranty	2 years
	± 5% of reading (1000 - 2000 NTU)	Weight	8 lbs (3.63 kg)
Resolution	0.01 NTU (0 - 9.99)	Safety Rating	UL, CSA, CE, FCC
	0.1 NTU (10 - 99.9)		
	1 NTU (100 - 1000)		

CALL GEOTECH TODAY (800) 833-7958

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6600EDS Extended Deployment System

Measure over 10 parameters in severe fouling environments
Featuring Patented Clean Sweep® Anti-fouling Technology



Profile of the 6600EDS depicting (clockwise from bottom) temperature/conductivity, turbidity, Rapid Pulse™ dissolved oxygen, chlorophyll and pH/ORP—all of which (except conductivity) are kept free of fouling by the patented Clean Sweep® universal wiper assembly, as well as individual optical wipers.

Building upon the unprecedented accuracy and reliability of YSI's stirring-independent Rapid Pulse™ dissolved oxygen system, as well as on the improved and proven wiped optical sensors, YSI offers the YSI 6600EDS (Extended Deployment System).

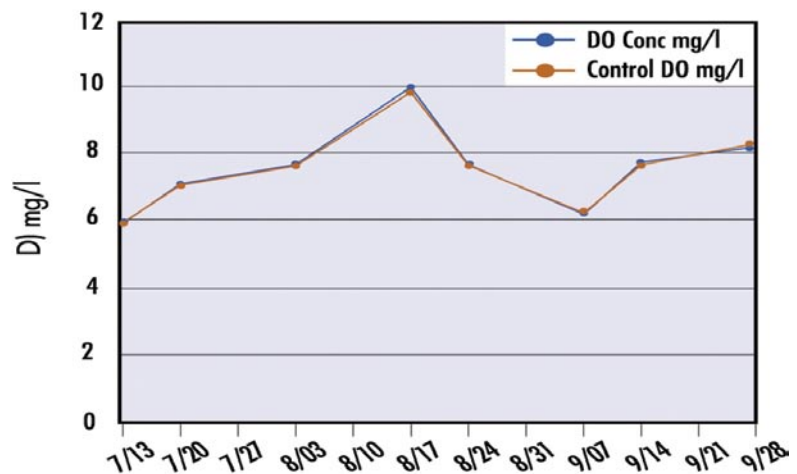
- Provides unprecedented DO accuracy and longevity in aggressive fouling environments
- Patented wiped fouling protection for turbidity, chlorophyll, DO, BGA, pH, and ORP sensors
- Ideal for extended, long-term deployments
- Virtually maintenance free
- Sensors are field-replaceable
- Integrates with DCPs (via RS-232 or SDI-12)



A prototype 6600EDS after continuous deployment for 80 days in Buzzards Bay, MA. The sensor in the foreground is the active DO sensor. The sensor at top-right was used as a non-wiped fouling reference. Note extensive fouling by plant and animal species on the non-wiped sensor.

Initial field studies of the YSI 6600EDS show that the system provides unprecedented DO accuracy and longevity in aggressive fouling environments. The 6600EDS was inspected after 80 days of an ongoing deployment performance evaluation. The Rapid Pulse™ DO sensor performed within specifications throughout this deployment without the need for recalibration or cleaning. During this deployment, the instrument was removed once for battery replacement; none of the sensors was cleaned or recalibrated.

6600 EDS 80-Day DO Performance Evaluation



Remarkably close agreement (mean error 0.16mg/l) between the continuously deployed sonde and the control measurements was observed throughout an 80-day deployment.

Pure
Data for a
Healthy
Planet.®

Sensor Performance verified
by the EPA Environmental
Technology Verification
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YSI Gulf Coast
+1 225 753 2650
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YSI Hydodata (UK)
+44 1462 673 581
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+973 39771055
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*Sensors with listed with the ETV logo were submitted to the ETV program on the YSI 6600EDS. Information on the performance characteristics of YSI water quality sensors can be found at www.epa.gov/etv, or call YSI at 800.897.4151 for the ETV verification report. Use of the ETV name or logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

Sensor performance verified*

The 6600EDS uses sensor technology that was performance-verified through the US EPA's Environmental Technology Verification Program (ETV). For information on which sensors were performance-verified, look for the ETV logo.



YSI 6600EDS Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen* % Saturation 6562 Rapid Pulse™ Sensor* ETV	0 to 500%	0.1%	0 to 200%: ±2% of reading or 2% air saturation, whichever is greater; 200 to 500%: ±6% of reading
Dissolved Oxygen* mg/L 6562 Rapid Pulse™ Sensor* ETV	0 to 50 mg/L	0.01 mg/L	0 to 20 mg/L: ± 0.2 mg/L or 2% of reading, whichever is greater; 20 to 50 mg/L: ±6% of reading
Conductivity** 6560 Sensor* ETV	0 to 100 mS/cm	0.001 to 0.1 mS/cm (range dependent)	±0.5% of reading + 0.001 mS/cm
Salinity	0 to 70 ppt	0.01 ppt	±1% of reading or 0.1 ppt, whichever is greater
Temperature 6560 Sensor* ETV	-5 to +50°C	0.01°C	±0.15°C
pH 6561 Sensor* ETV	0 to 14 units	0.01 unit	±0.2 unit
ORP	-999 to +999 mV	0.1 mV	±20 mV
Depth Deep Medium Shallow Vented Level	0 to 656 ft, 200 m 0 to 200 ft, 61 m 0 to 30 ft, 9.1 m 0 to 30 ft, 9.1 m	0.001 ft, 0.001 m 0.001 ft, 0.001 m 0.001 ft, 0.001 m 0.001 ft, 0.001 m	±1 ft, ±0.3 m ±0.4 ft, ±0.12 m ±0.06 ft, ±0.02 m ±0.01 ft, 0.003 m
Turbidity* 6136 Sensor* ETV	0 to 1,000 NTU	0.1 NTU	±2% of reading or 0.3 NTU, whichever is greater**
Rhodamine* 6025 Sensor* ETV	0-200 µg/L	0.1 µg/L	±5% reading or 1 µg/L, whichever is greater

* Maximum depth rating for all standard optical sensors is 200 feet, 61 m. Also available in Deep Depth option: 656 feet, 200 m.

** Report outputs of specific conductance (conductivity corrected to 25° C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed 1989).

** In YSI AMCO-AEPA Polymer Standards.

	Range	Detection Limit	Resolution	Linearity
BGA - Phycocyanin* 6025 Sensor* ETV	~0 to 280,000 cells/mL† 0 to 100 RFU	~220 cells/mL§	1 cell/mL 0.1 RFU	R ² > 0.9999**
BGA - Phycoerythrin* 6025 Sensor* ETV	~0 to 200,000 cells/mL† 0 to 100 RFU	~450 cells/mL§§	1 cell/mL 0.1 RFU	R ² > 0.9999***
Chlorophyll* 6025 Sensor* ETV	~0 to 400 µg/L 0 to 100 RFU	~0.1 µg/L§§§	0.1 µg/L Chl 0.1% RFU	R ² > 0.9999****

* Maximum depth rating for all standard optical probes is 200 feet, 61 m. Also available in Deep Depth option 656 ft 200 m.
BGA = Blue-Green Algae
RFU = Relative Fluorescence Units
~ = Approximately

† Explanation of Ranges can be found in the 'Principles of Operation' section of the 6-Series Manual.

§ Estimated from cultures of *Microcystis aeruginosa*.
§§ Estimated from cultures *Synechococcus sp.*
§§§ Determined from cultures of *Isochrysis sp.* and chlorophyll *a* concentration determined via extractions.

**Relative to serial dilution of Rhodamine WT (0-400 µg/L).
***Relative to serial dilution of Rhodamine WT (0-8 µg/L).
****Relative to serial dilution of Rhodamine WT (0-500 µg/L).

YSI 6600EDS Sonde Specifications

Medium	Fresh, sea or polluted water	Software	EcoWatch®
Temperature	Operating Storage -5 to +50°C -10 to +60°C	Dimensions	Diameter 3.5 in, 8.9 cm Length, no depth 19.6 in, 34.3 cm Length, depth 21.6 in, 54.9 cm Weight, depth and batteries 7 lbs, 3.18 kg
Communications	RS-232, SDI-12	Power	External 12 V DC Internal 8 C-size alkaline batteries

YSI 556 Meter Specifications

14.1 Sensor Specifications

<i>Dissolved Oxygen</i>	
Sensor Type:	Steady state polarographic
Range: % air sat'n mg/L	<ul style="list-style-type: none"> ▪ 0 to 500% air saturation ▪ 0 to 50 mg/L
Accuracy: % air sat'n mg/L	<ul style="list-style-type: none"> ▪ 0 to 200% air saturation: ±2% of the reading or 2% air saturation; whichever is greater ▪ 200 to 500% air saturation: ±6% of the reading ▪ 0 to 20 mg/L: ±2% of the reading or 0.2 mg/L; whichever is greater ▪ 20 to 50 mg/L: ±6% of the reading
Resolution: % air sat'n mg/L	<ul style="list-style-type: none"> ▪ 0.1% air saturation ▪ 0.01 mg/L
<i>Temperature</i>	
Sensor Type:	YSI Precision™ thermistor
Range:	-5 to 45°C
Accuracy:	±0.15°C
Resolution:	0.01°C
<i>Conductivity</i>	
Sensor Type:	4-electrode cell with auto-ranging
Range:	0 to 200 mS/cm
Accuracy:	±0.5% of reading or ±0.001 mS/cm; whichever is greater—4 meter cable ±1.0% of reading or ±0.001 mS/cm; whichever is greater—20 meter cable
Resolution:	0.001 mS/cm to 0.1 mS/cm (range-dependent)
<i>Salinity</i>	
Sensor Type:	Calculated from conductivity and temperature
Range:	0 to 70 ppt
Accuracy:	±1.0% of reading or 0.1 ppt; whichever is greater
Resolution:	0.01 ppt



YSI 650 Multiparameter Display System

Rugged and Reliable Display and Data Logging System



The YSI 650 Multiparameter Display System

Easily log real-time data, calibrate YSI 6-Series sondes, set up sondes for deployment, and upload data to a PC with the feature-packed YSI 650MDS (Multiparameter Display System). Designed for reliable field use, this versatile display and data logger features a waterproof IP-67, impact-resistant case.

- Compatible with EcoWatch® for Windows® data analysis software
- User-upgradable software from YSI's website
- Menu-driven, easy-to-use interface
- Multiple language capabilities
- Graphing feature
- Three-year warranty

Feature-Packed Performance

Battery Life

With the standard alkaline battery configuration of 4 C-cells, the YSI 650 will power itself and a YSI 6600 sonde continuously for approximately 30 hours. Or, choose the rechargeable battery pack option with quick-charge feature.

Optional Barometer

Temperature-compensated barometer readings are displayed and can be used in dissolved oxygen calibration. Measurements can be logged to memory for tracking changes in barometric pressure.

Optional GPS Interface

Designed to NMEA protocol, the YSI 650 MDS will display and log real-time GPS readings with a user supplied GPS interfaced with YSI 6-Series sondes.

Memory Options

Standard memory with 150 data sets, or a high-memory option (1.5 MB) with more than 50,000 data sets; both options with time and date stamp.

Pure
Data for a
Healthy
Planet.®

*A powerful logging
display for your data
collection processes*

*The 650MDS can be
used with YSI sondes
for spot sampling as
well as short-term data
logging.*

*Supply a GPS with
NMEA 0183 protocol,
connect with the YSI
6115 kit, and collect
GPS data along with
water quality data.*

*Upload data from the
650 to EcoWatch® for
instant data viewing.*





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environmental@ysi.com

YSI Integrated Systems & Services
+1 508 748 0366
Fax +1 508 748 2543
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SonTek/YSI
+1 858 546 8327
Fax +1 858 546 8150
inquiry@sontek.com

YSI Gulf Coast
+1 225 753 2650
Fax +1 225 753 8669
environmental@ysi.com

YSI Hydrodata (UK)
+44 1462 673 581
Fax +44 1462 673 582
europe@ysi.com

YSI Middle East (Bahrain)
+973 1753 6222
Fax +973 1753 6333
halsalem@ysi.com

YSI (Hong Kong) Limited
+852 2891 8154
Fax +852 2834 0034
hongkong@ysi.com

YSI (China) Limited
+86 10 5203 9675
Fax +86 10 5203 9679
beijing@ysi-china.com

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+81 44 222 0009
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YSI 650MDS Specifications

Temperature	Operating Storage	-10 to +60°C for visible display -20 to +70°C
Waterproof Rating		IP-67 for both the standard alkaline battery configuration and for the rechargeable battery pack option
Connector		MS-8; meets IP-67 specification
Dimensions	Width Length Weight with batteries	4.7 in, 11.9 cm 9 in, 22.9 cm 2.1 lbs, 0.91 kg
Display		VGA; LCD with 320 by 240 pixels with backlight
Power	Standard Optional	4 alkaline C-cells with detachable battery cover Ni metal hydride battery pack with attached battery cover and 110/220 volt charging system
Communications		RS-232 to all sondes, for data transfer to PC, and for software updates
Optional GPS		NMEA 0183; requires user-supplied GPS and YSI 6115 Y-cable
Backlight		4 LEDs illuminating LCD; user-selectable
Keypad		20 keys, including instrument on/off, backlight on/off, enter, esc, 10 number/letter entry keys, 2 vertical arrow keys, 2 horizontal arrow keys, period key, and minus key
Warranty		3 years

Ordering Information

650-01	Instrument, standard memory
650-02	Instrument, high memory
650-03	Instrument, standard memory, barometer
650-04	Instrument, high memory, barometer
6113	Rechargeable battery pack kit with 110 volt charger and adapter cable
616	Charger, cigarette lighter
4654	Tripod
614	Ultra clamp, C-clamp mount
5081	Carrying case, hard-sided
5085	Hands-free harness
5065	Form-fitted carrying case
6115	Y-cable for interface with user-supplied GPS system



The 650MDS can interface with any YSI sonde for

- spot sampling
- short-term studies
- surface and ground water monitoring
- water level monitoring

Packaged together, the 600QS system includes a 600R conductivity sonde, 650MDS, field cable, and additional sensor options such as pH, dissolved oxygen, ORP, and vented level.



YSI 600XL and 600XLM Sondes

Measure multiple parameters simultaneously

The YSI 600XL and YSI 600XLM compact sondes measure eleven parameters simultaneously:

Temperature	TDS
Conductivity	pH
Specific Conductance	ORP
Salinity	Depth or Level
Resistivity	Rapid Pulse™ DO (% and mg/L)



The YSI 600XL and 600XLM

Connect with Data Collection Platforms

Either sonde can easily connect to the YSI 6200 DAS (Data Acquisition System), YSI EcoNet™ or your own data collection platform, via SDI-12 for remote and real-time data acquisition applications.

Economical Logging System

The YSI 600XLM is an economical logging system for long-term, *in situ* monitoring and profiling. It will log all parameters at programmable intervals and store 150,000 readings. At one-hour intervals, the instrument will log data for about 75 days utilizing its own power source. The 600XL can also be utilized in the same manner with user-supplied external power.

- Either sonde fits down 2-inch wells
- Horizontal measurements in very shallow waters
- Stirring-independent Rapid Pulse® dissolved oxygen sensor
- Field-replaceable sensors
- Easily connects to data collection platforms
- Available with detachable cables to measure depth up to 200 feet
- Compatible with YSI 650 Multiparameter Display System
- Use with the YSI 5083 flow cell for groundwater applications

Pure
Data for a
Healthy
Planet.®
Economical, multiparameter
sampling or logging in a
compact sonde

Sensor performance verified*

The 6820 VZ and 6920 VZ sondes use sensor technology that was verified through the US EPA's Environmental Technology Verification Program (ETV). For information on which sensors were performance-verified, turn this sheet over and look for the ETV logo.





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YSI Environmental
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+1 508 748 0366
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inquiry@sontek.com

YSI Gulf Coast
+1 225 753 2650
Fax +1 225 753 8669
environmental@ysi.com

YSI Hydrodata (UK)
+44 1462 673 581
Fax +44 1462 673 582
europe@ysi.com

YSI Middle East (Bahrain)
+973 1753 6222
Fax +973 1753 6333
halsalem@ysi.com

YSI (Hong Kong) Limited
+852 2891 8154
Fax +852 2834 0034
hongkong@ysi.com

YSI (China) Limited
+86 10 5203 9675
Fax +86 10 5203 9679
beijing@ysi-china.com

YSI Nanotech (Japan)
+81 44 222 0009
Fax +81 44 221 1102
nanotech@ysi.com

ISO 9001
ISO 14001

Yellow Springs, Ohio Facility

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*Sensors with listed with the ETV logo were submitted to the ETV program on the YSI 6600EIS. Information on the performance characteristics of YSI water quality sensors can be found at www.epa.gov/etv, or call YSI at 800.897.4151 for the ETV verification report. Use of the ETV name or logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

YSI incorporated
Who's Minding
the Planet?[®]

YSI 600XL & 600XLM Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen % Saturation 6562 Rapid Pulse™ Sensor* ET ✓	0 to 500%	0.1%	0 to 200%: ±2% of reading or 2% air saturation, whichever is greater; 200 to 500%: ±6% of reading
Dissolved Oxygen mg/L 6562 Rapid Pulse™ Sensor* ET ✓	0 to 50 mg/L	0.01 mg/L	0 to 20 mg/L: ±0.2 mg/L or 2% of reading, whichever is greater; 20 to 50 mg/L: ±6% of reading
Conductivity* 6560 Sensor* ET ✓	0 to 100 mS/cm	0.001 to 0.1 mS/cm (range dependent)	±0.5% of reading + 0.001 mS/cm
Salinity	0 to 70 ppt	0.01 ppt	±1% of reading or 0.1 ppt, whichever is greater
Temperature 6560 Sensor* ET ✓	-5 to +50°C	0.01°C	±0.15°C
pH 6561 Sensor* ET ✓	0 to 14 units	0.01 unit	±0.2 unit
ORP	-999 to +999 mV	0.1 mV	±20 mV
Depth & Level Medium Shallow Vented Level	0 to 200 ft, 61 m 0 to 30 ft, 9.1 m 0 to 30 ft, 9.1 m	0.001 ft, 0.001 m 0.001 ft, 0.001 m 0.001 ft, 0.001 m	±0.4 ft, ±0.12 m ±0.06 ft, ±0.02 m ±0.01 ft, 0.003 m

* Report outputs of specific conductance (conductivity corrected to 25° C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed 1989).

YSI 600XL & 600XLM Sonde Specifications

Medium	Fresh, sea or polluted water	
Temperature	Operating Storage	-5 to +50°C -10 to +60°C
Communications	RS-232, SDI-12	
Software	EcoWatch®	
Dimensions	Diameter Length Weight	1.65 in, 4.19 cm 1.65 in, 4.9 cm 16 in, 40.6 cm 21.3 in, 54.1 cm 1.3 lbs, 0.59 kg 1.5 lbs, 0.69 kg
Power	External Internal (600XLM only)	12 V DC 4 AA-size alkaline batteries

YSI model 5083
flow cell and
600XL. This is an
ideal combination
for groundwater
applications.



HI 98129

Combo pH/EC/TDS/Temperature Tester with Low Range EC



Description

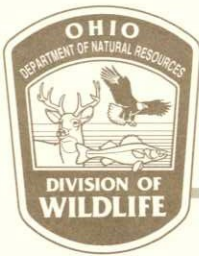
The HI 98129 Combo waterproof tester offer high accuracy pH, EC/TDS and temperature measurements in a single tester! No more switching between meters for your routine measurements. The waterproof Combo (it even floats) has a large easy-to-read, dual-level LCD and automatic shut-off. pH and EC/TDS readings are automatically compensated for the effects of temperature (ATC). This technologically advanced tester has a replaceable pH electrode cartridge with an extendable cloth junction as well as an EC/TDS graphite electrode that resists contamination by salts and other substances. This gives these meters a greatly extended life. Your tester no longer needs to be thrown away when the pH sensor is exhausted.

The EC/TDS conversion factor is user selectable as is the temperature compensation coefficient (β). Fast, efficient, accurate and portable, the Combo pH, EC/TDS and temperature tester brings you all the features you've asked for and more!

Specifications

Range	pH	0.00 to 14.00 pH
Range	EC	0 to 3999 $\mu\text{S/cm}$
Range	TDS	0 to 2000 ppm
Range T	emperature	0.0 to 60.0°C / 32 to 140.0°F
Resolution pH		0.01 pH
Resolution EC		1 $\mu\text{S/cm}$
Resolution T	DS	1 ppm
Resolution	Temperature	0.1°C / 0.1°F
Accuracy pH		± 0.05 pH
Accuracy EC/T	DS	$\pm 2\%$ F.S.
Accuracy	Temperature	$\pm 0.5^\circ\text{C}$ / $\pm 1^\circ\text{F}$
Temperature Compensation		pH: automatic; EC/TDS: automatic with β adjustable from 0.0 to 2.4% / °C
Calibration	pH	automatic, 1 or 2 points with 2 sets of memorized buffers (pH 4.01 / 7.01 / 10.01 or 4.01 / 6.86 / 9.18)
Calibration	EC/TDS	automatic, 1 point
TDS Conversion Factor		adjustable from 0.45 to 1.00
pH Electrode		HI 73127 (replaceable; included)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Battery Type / Life		4 x 1.5V / approx. 100 hours of continuous use; auto-off after 8 minutes of non-use
Dimensions		163 x 40 x 26 mm (6.4 x 1.6 x 1.0")
Weight		100 g (3.5 oz.)

Appendix H



DIVISION OF WILDLIFE

Ohio Department of Natural Resources

Division of Wildlife Headquarters
2045 Morse Road, Bldg. G
Columbus, Ohio 43229-6693
1-800-WILDLIFE

WILD ANIMAL PERMIT: 12-108
SCIENTIFIC COLLECTION

JOHN W. RHOADES
NEORS
4747 EAST 49TH ST.
CUYAHOGA HEIGHTS, OH 44125-1

Vicki J. Mountz **DATE ISSUED**
Acting Chief, Division of Wildlife 3/14/2011

Others authorized on permit

YES (SEE ATTACHMENT)

SOCIAL SECURITY NUMBER: XXX-XX-7681

is hereby granted permission to take, possess, and transport at any time and in any manner specimens of wild animals, subject to the conditions and restrictions listed below or any documents accompanying this permit.

This permit, unless revoked earlier by the Chief, Division of Wildlife, is effective
from: 3/16/2011 to: 3/15/2012

This permit must be carried while collecting wild animals and be exhibited to any person on demand.

THIS PERMIT IS RESTRICTED TO THE FOLLOWING

1. Permittee may collect fish and aquatic macro-invertebrates for survey and inventory purposes. All endangered species are to be released at site of capture.
2. Permittee must consult with Wildlife's Stream Conservation and Environmental Assessment Unit (SCEA) prior to conducting any wild animal work associated with compliance requirements of the Clean Water Act (CWA) Section 401 and/or 404. Contact the unit at 614/265-6346 (John Navarro) or 614/265-6631 (Becky Jenkins).
3. 24 hours prior to setting trap nets or gillnets, contact must be made with the local wildlife officer or nearest district office to advise location and duration of sampling. All vouchers are to be deposited at NEORS.
4. Collection is prohibited in Big Darby, Little Darby, Chagrin river and Fish Creek (Williams County) without explicit written permission from the Division of Wildlife.
5. Permittee must provide an annual report of collecting activities to the Division of Wildlife. Report shall provide species, quantity and locations of collection.

Locations of Collecting

STATEWIDE WITH NOTED EXCEPTIONS

Equipment and method used in collection:

SEINES, TRAP NETS AND ELECTROSHOCKER.

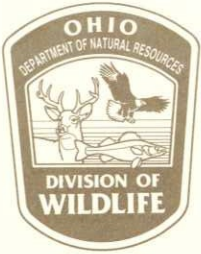
Name and number of each species to be collected:

FISH AND MACROINVERTEBRATES AS REQUIRED. ALL FISH (EXCEPT VOUCHER SPECIES) MUST BE RELEASED AT THE COLLECTION SITE.

RESTRICTIVE DOCUMENTS ACCOMPANYING THIS PERMIT? NO

This permit is not valid for collecting migratory birds, their nests, or eggs unless a current permit from the U.S. Fish and Wildlife Service has been obtained.

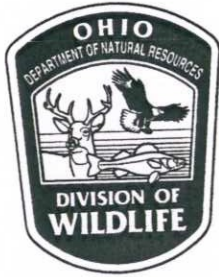
NO ENDANGERED SPECIES MAY BE TAKEN WITHOUT WRITTEN PERMISSION FROM THE CHIEF



ATTACHMENT

This attachment to Scientific Collecting Permit #12-108 authorizes the following persons to conduct the activities listed on the permit, within the conditions and restrictions set forth. Each person must carry and exhibit upon request, a copy of the permit and this attachment when conducting any of the listed activities. The person named on the permit assumes full responsibility for the actions of the persons on this list and for completing and submitting all required reports.

<u>Name</u>	<u>SSN or Driver License</u>
SETH HOTHEM	XXX-XX-6166
THOMAS ZABLOTNY	XXX-XX-6448
CATHERINE ZAMBORSKY	XXX-XX-6550
FRANCISO RIVERA	XXX-XX-5886
JILLIAN NOVAK	SA294701
KATHRYN CRESTANI	XXX-XX-1565
RON MAICHLE	XXX-XX-8924
KRISTINA GRANLUND	SJ501394
ADDITIONAL ON FILE	



STANDARD CONDITIONS FOR SCIENTIFIC COLLECTING AND EDUCATION PERMITS (ORC 1533.08 AND 1533.09)

The standard conditions listed below apply to all permit holders unless otherwise stated on an issued permit. The standard conditions below are in addition to the provisions listed on the permit. Failure to comply with the conditions of the permit may result in the suspension or termination of your permit. If you need an amendment to your permit, or have questions regarding these conditions, contact the Division of Wildlife Permit Coordinator at (614)265-6315. Please allow a minimum of two weeks for amendments.

1. When collecting or sampling you and any subpermittees must carry a copy of your permit and present to any officer upon request.
2. Only persons listed on the permit may conduct permitted activities.
3. Collection on all Department of Natural Resources properties is prohibited without authorization from the appropriate landholding division.
4. Collection is prohibited in the Little Darby Creek, Big Darby Creek, Killbuck Creek, Fish Creek (Williams County) and the upper portions of the Grand River watershed without written authorization from the Chief.
5. The collection and possession of state endangered and threatened species is prohibited without prior approval from the Chief.
6. The possession of Aquatic Nuisance Species (ANS) for educational or scientific purposes is prohibited without authorization from the Chief.
7. A migratory bird permit issued by the United States Fish and Wildlife Service may be required for all persons collecting or in possession of migratory birds.
8. Twenty-four hours prior to all stream collection, the permit holder must contact the local wildlife officer or nearest district office to advise the location and duration of sampling. Messages are acceptable.
9. All voucher specimens must be ascensioned to the Cleveland Museum of Natural History, The Ohio State University, Museum of Biological Diversity or the Cincinnati Museum of Natural History.
10. Traps and nets must be checked and all animals removed every twenty-four hours.
11. Traps and nets must bear a durable waterproof tag bearing the name and address of the user in English letters, legible at all times.
12. Unless otherwise provided, all specimens must be released at the point of capture.
13. When sampling on public properties or over water, non-toxic shot shall be used.
14. Newly discovered Aquatic Nuisance Species (ANS) must be reported to the Division of Wildlife within twenty-four hours of capture.
15. All Starlings, house sparrows and aquatic nuisance species collected for laboratory use must be euthanized upon completion of project.

Appendix I. References

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- Ohio Environmental Protection Agency. (1987b). *Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities* (Updated September 1989; March 2001; November 2006; and August 2008). Columbus, OH: Division of Water Quality Monitoring and Assessment.
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- Ohio Environmental Protection Agency. (2008). State of Ohio Draft Water Quality Standards *Ohio Administrative Code* Chapter 3745-1. Columbus, OH: Division of Surface Water, Standards and Technical Support Section.
- Ohio Environmental Protection Agency. (2009a). *Ohio EPA manual of surveillance methods and quality assurance practices*. Columbus, OH: Divisions of Surface Water and Environmental Services.
- Ohio Environmental Protection Agency. (2009b). State of Ohio Water Quality Standards *Ohio Administrative Code* Chapter 3745-1 (Revision: Adopted July 9, 2009; Effective October 9, 2009). Columbus, OH: Division of Surface Water, Standards and Technical Support Section.

Appendix J. NEORS Chlorophyll a Sampling Field Sheet

Stream: _____
 Location: _____
 RM: _____
 Lat/Long: _____

Collectors: _____
 Date: _____
 Time: _____

Number of Rocks: _____

Total Area Scraped: _____ cm²

Diameter of individual scrape

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____
- 10 _____
- 11 _____
- 12 _____
- 13 _____
- 14 _____
- 15 _____
- 16 _____
- 17 _____
- 18 _____
- 19 _____
- 20 _____
- 21 _____
- 22 _____
- 23 _____
- 24 _____
- 25 _____

Area of individual scrape

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____
- 10 _____
- 11 _____
- 12 _____
- 13 _____
- 14 _____
- 15 _____
- 16 _____
- 17 _____
- 18 _____
- 19 _____
- 20 _____
- 21 _____
- 22 _____
- 23 _____
- 24 _____
- 25 _____
- Total: _____

Diameter to Area Conversion	
Diameter (cm)	Area (cm ²)
1.6	2.011
1.7	2.27
1.8	2.545
1.9	2.835
2.0	3.142
2.1	3.464
2.2	3.801
2.3	4.155

Total Sample Volume _____ ml

Filter 1 LABLynx ID _____
 Vol _____ ml

Filter 2 LABLynx ID _____
 Vol _____ ml

Filter 3 LABLynx ID _____
 Vol _____ ml

Water Column Chlorophyll Sample	
Filter 1 LABLynx ID _____	Vol _____ ml
Filter 2 LABLynx ID _____	Vol _____ ml
Filter 3 LABLynx ID _____	Vol _____ ml

Flow: None Low Normal Elevated High

Turbidity: Clear Low Moderate* High*

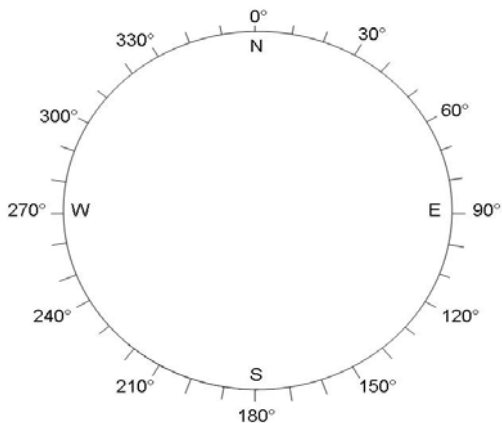
*Explain _____

Sky: Overcast Cloudy Partly Cloudy Mostly Clear Clear

Canopy: Open Mostly Open Partly Closed Closed

Riparian None Narrow L R Moderate L R Wide L R

Downstream Channel Direction



Clinometer

Left Bank _____°

Right Bank _____°

Left Bank _____°

Right Bank _____°

Left Bank _____°

Right Bank _____°

Stream Widths

_____m _____m _____m

Record two most predominate substrates with an X, and check all present.

	Riffle	Run	Reach
Boulder/Slabs	_____	_____	_____
Bedrock	_____	_____	_____
Boulder/Slabs	_____	_____	_____
Cobble	_____	_____	_____
Gravel	_____	_____	_____
Sand	_____	_____	_____
Silt _____	_____	_____	_____
Hardpan	_____	_____	_____
Detritus	_____	_____	_____
Artificial	_____	_____	_____

Substrate Origin

Limestone Tills Rip-rap
 Sandstone Shale Wetlands
 Lacustrine Hardpan Coal Fines

Silt

Heavy Moderate Normal None

Embeddedness

Extensive Moderate Normal None

Notes: _____

Length of Reach: _____m

Stream Drawing