Level 3 Project Study Plan

2012 Chagrin River Environmental Monitoring

(1) Objectives

It is expected that, by April 2012, the Jackson Valley Wastewater Treatment Plant (WWTP), Quail Hollow WWTP, Creekside WWTP, and Woodland Glen WWTP in the Chagrin River watershed will be decommissioned. Following decommissioning, the flows from these facilities will be redirected to the Northeast Ohio Regional Sewer District's (NEORSD) Easterly WWTP via the SOM Relief Sewer (SOMRS). These facilities did not consistently meet their National Pollutant Discharge Elimination System (NPDES) permit limits, and by removing these discharges and conveying them to NEORSD, the water quality in the streams downstream of these WWTPs is expected to improve. The purpose of this study is to evaluate fish and macroinvertebrate communities, stream habitat, and water chemistry downstream of each decommissioned WWTP, as well as two sites on the Chagrin River mainstem at river mile (RM) 26.70, upstream of Wiley Creek, and RM 22.00, downstream of Pepper-Luce Creek. Results from this study will be compared to data collected during the *2009 Pepper Pike/Moreland Hills Baseline Assessment Study* to illustrate spatial and temporal trends.

The results obtained from sampling will be evaluated using the Ohio Environmental Protection Agency's (EPA) Qualitative Habitat Evaluation Index (QHEI), Index of Biotic Integrity (IBI), Modified Index of Well Being (MIwb), and coldwater habitat taxa lists after decommissioning has taken place. An examination of the individual metrics that comprise these indices will be used in conjunction with water quality data to identify correlations between WWTP decommissioning and impacts to the biotic communities. Water chemistry data will also be compared to the Ohio Water Quality Standards to determine attainment of applicable uses (Ohio EPA, 2009b).

(2) Point/Nonpoint Sources

Point Sources	Nonpoint Sources
Storm Sewer Outfalls	Urban runoff
Septic Tanks	Spills
	Agriculture

(6) Sample Locations

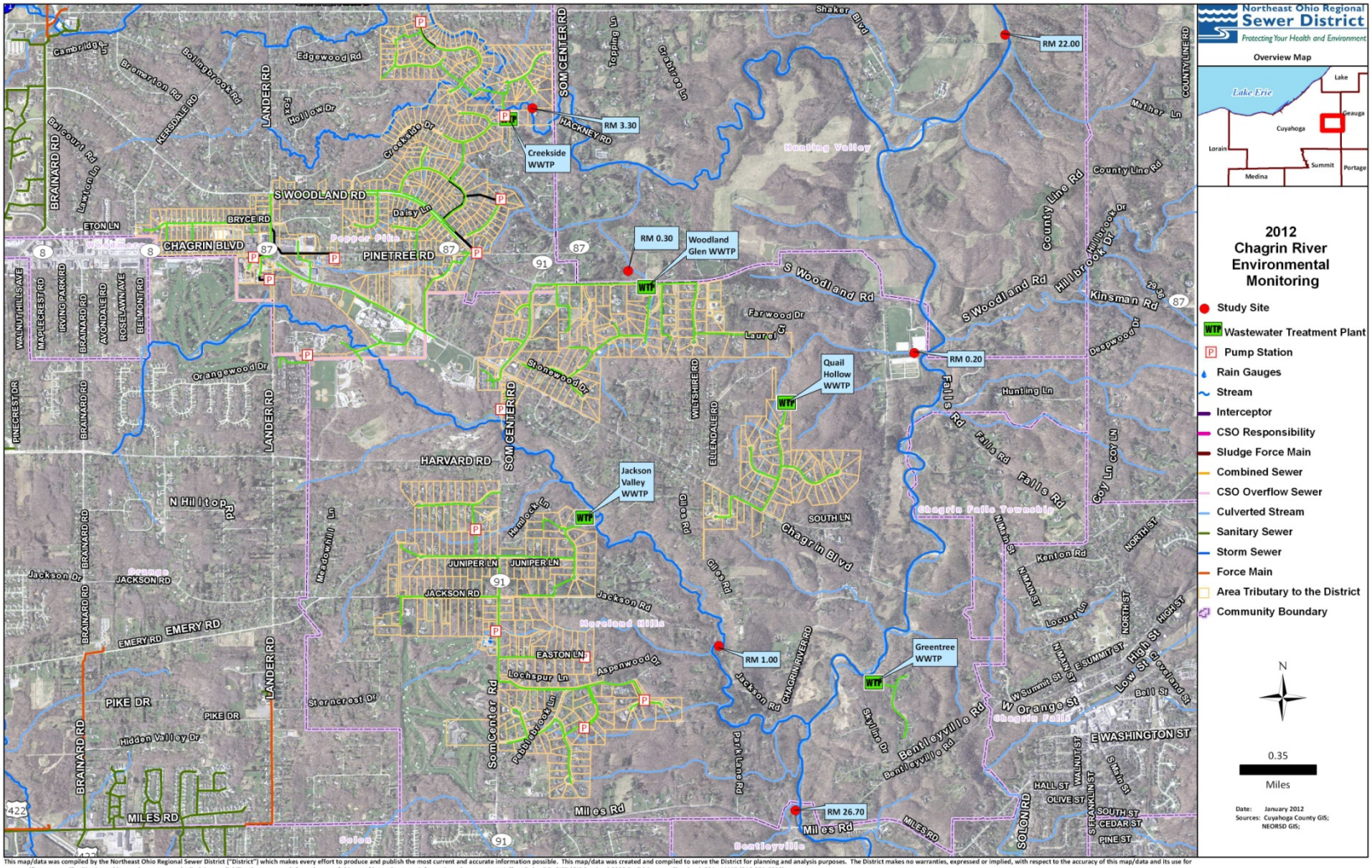
The following water chemistry, stream habitat, electrofishing and macroinvertebrate sample locations, listed from upstream to downstream, will be

surveyed during the 2012 field season. Benthic macroinvertebrate and water chemistry samples are collected near the midpoint of each electrofishing zone, indicated by RM, unless otherwise noted. GPS coordinates are recorded at the downstream end of each electrofishing zone.

Location	Latitude	Longitude	River Mile	Location Information	USGS HUC 8 Number-Name	Purpose
Chagrin River	41.4250	-81.4176	26.70	Chagrin River Upstream of Willey Creek	04110003-Ashtabula-Chagrin	Background data for fish, macroinvertebrates, habitat, and water chemistry
37855 Jackson Road	41.4360	-81.4242	1.00	Wiley Creek Downstream of Jackson Valley WWTP	04110003-Ashtabula-Chagrin	Evaluate Willey Creek fish, macroinvertebrates, habitat, and water chemistry post decommissioning of Jackson Valley WWTP
3780 Chagrin River Road	41.4553	-81.066	0.20	Un-named tributary to Chagrin River Downstream of Quail Hollow WWTP	04110003-Ashtabula-Chagrin	Evaluate Un-named Creek fish, macroinvertebrates, habitat, and water chemistry post decommissioning of Quail Hollow WWTP
South Woodland Road, West of Windrush Drive	41.4610	-81.4318	0.30	Un-named tributary to Chagrin River Downstream of Woodland Glen WWTP	04110003-Ashtabula-Chagrin	Evaluate Un-named Creek fish, macroinvertebrates, habitat, and water chemistry post decommissioning of Woodland Glen WWTP
3226 S.O.M. Center Road	41.4719	-81.4401	3.30	Pepper-Luce Creek Downstream of Creekside WWTP	04110003-Ashtabula-Chagrin	Evaluate Pepper-Luce Creek fish, ,macroinvertebrates, habitat, and water chemistry post decommissioning of Creekside WWTP
Chagrin River	41.4764	-81.3982	22.00	Chagrin River Downstream of Pepper-Luce Creek	04110003-Ashtabula-Chagrin	Evaluate WWTP decommissioning on fish, macroinvertebrates, habitat, and water chemistry on the Chagrin River.

The map below shows point sources that may be influencing the water quality at each sample location.

2012 Chagrin River Environmental Monitoring
March 16, 2012



The following sections are applicable to all NEORSD 2012 Project Study Plans

(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). An Ohio EPA Fish Data Sheet (Appendix G) will be completed during each assessment. Quantitative fish sampling is expected to be conducted at all locations.

Macroinvertebrate community assemblages will be collected from each location. The Midwest Biodiversity Insitute (MBI)[1] will identify and enumerate the specimens collected from each site. All specimens will be identified to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b)[2]. The NEORSD Macroinvertebrate Field Sheet (Appendix A) will be completed at each site during HD sample retrieval or when qualitative sampling is conducted.

Stream habitat will be measured by scoring components of the QHEI at all locations, including the substrate, instream cover, channel morphology, riparian zone, bank erosion, pool/glide and riffle/run quality and gradient. See Appendix H for an example of the QHEI Field Sheet.

Water chemistry samples will be collected at each electrofishing and macroinvertebrate sampling site included in the study. Water chemistry samples will be analyzed by NEORSD's Analytical Services Division. Appendix B lists the parameters to be tested along with the detection limits and practical quantitation limits. Field measurements for dissolved oxygen, pH, temperature, conductivity and turbidity will also be performed. A Surface Water Condition Sampling Field Data Form will be completed at each site during each sampling event (Appendix C).

Benthic and water column chlorophyll *a* samples may be collected from stream locations. Chemical and physical water quality parameters to be measured in conjunction with the chlorophyll *a* samples include total phosphorus, dissolved reactive phosphorus, nitrate+nitrite, alkalinity, turbidity and suspended solids.

[1] The bid submitted by MBI has not yet been approved by The Northeast Ohio Regional Sewer District Board of Trustees at the time of this writing. An amended study plan will be submitted if the District is unable to enter into a contract with MBI and must contract this service with another vendor.

[2] See Appendix K for a list of all references.

(4) Field Collection and Data Assessment Techniques

Field collections for fish will be conducted at all stream locations. Sampling will be conducted using longline or boat electrofishing techniques and will consist of shocking all habitat types within a sampling zone, which are 0.15, 0.20 and 0.50 kilometers in length for headwater, wading, and boat sites, respectively. Headwater and wading sites will be sampled while moving from downstream to upstream. Boating sites will be sampled moving from upstream to downstream. The stunned fish will be collected and placed into a live well for later identification. The longline and boat electrofishing zones will be conducted between one to three times during the field season (June 15 - October 15).

Fish will be identified to the species level, weighed (wading and boat sites only), 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, except for required vouchers. All species not identified in the field will be brought back to the laboratory for verification by NEORSD Level 3 Qualified Data Collectors (QDC's). If necessary, vouchers will be 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 10 percent formalin for approximately 10 to 14 days before being transferred to water and solutions of 30, 50 and 70 percent ethanol, respectively. 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 quantitative and qualitative sampling techniques. Quantitative sampling will be done using a modified Hester-Dendy multi-plate artificial substrate sampler (HD) that is colonized for a six-week period. Multiple HD samplers will be installed at one or all sampling locations in case samplers are lost due to vandalism, burial, etc. and for the purposes of providing a replicate sample. Qualitative sampling will be conducted using a D-frame dip net when HD samplers are retrieved. The NEORSD Macroinvertebrate Field Sheet will be completed during sampling. NEORSD may

complete replicates as needed for additional information, training and identification purposes.

Macroinvertebrate voucher specimens for both quantitative and qualitative sampling will be collected as described in section (13). Macroinvertebrate community assemblages collected will be shipped to MBI for identification and enumeration. MBI will identify specimens to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b).

A detailed description of the sampling and analysis methods utilized in the fish community and macroinvertebrate community surveys, including calculations of the IBI, MIwb and ICI, can be found in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b).

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

Techniques used for water chemistry sampling and chemical analyses will follow the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009a). 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. Bacteriological samples will be collected in a disposable sterile plastic bottle; if required, sodium thiosulfate may be used for preservation. All water quality samples will be collected as grab samples. One duplicate sample and one field blank will be collected at randomly selected sites at a frequency of 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 ≤40 percent; results outside this range will trigger further evaluation and investigation into causes for disparities. RPD values above 40 percent, with results less than ten times the practical quantitation limit, will be reviewed on a case-by-case basis 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 B lists the analytical method, method detection limit and practical quantitation limit for each parameter analyzed. Field analyses include the use of either a YSI-556 MPS Multi-Parameter Water Quality Meter or YSI 600XL sonde to measure dissolved oxygen (DO), water temperature, conductivity and pH; and when necessary, a Hanna HI 98129 meter to measure pH and a Hach LDO meter to measured DO. Turbidity will be measured using either a Hach 2100P IS Portable Turbidimeter, or Hach 2100Q Portable Turbidimeter. Specifications for these meters have been included in Appendix D.

Benthic and water column chlorophyll *a* samples may be collected if time and resources allow. Sampling methods will follow those detailed in the NEORSD *Chlorophyll a Sampling and Field Filtering Standard Operating Procedure* (SOP-EA001-00 (Appendix F). A Chlorophyll *a* Sampling Field Sheet will be completed for each site (Appendix E), when applicable. 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.

Where possible, data assessment will include an analysis of temporal and spatial trends in the collected data. Species assemblages and individual metrics will be analyzed. Graphs that show current and historic QHEI, IBI, MIwb and ICI scores and how these scores compare to attainment status of biocriteria will be prepared. Water chemistry data collected will be compared to Ohio water quality standards as described in Ohio EPA's *State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1* (2009b) to determine whether any excursions from the applicable water quality criteria have occurred. It will also be used to determine any relationships among individual parameters and chlorophyll *a* concentrations. 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.

(5) Stream Flow Measurement

Stream flow will be recorded for all locations during each electrofishing pass utilizing data from the United States Geological Survey (USGS) gauge station nearest the stream location, if applicable.

Stream flow will be measured with a Marsh-McBirney FloMate Model 2000 Portable Flow Meter or Global Water FP111 Flow Probe, which measure flow in feet per second, when HD samplers are installed and retrieved. See Appendix D for technical specifications for each flow meter.

(7) Schedule

One to three electrofishing surveys will be conducted at headwater, wading and boat sites, between June 15 and October 15, 2012. Surveys will be conducted at least three weeks apart. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when each electrofishing pass will be conducted.

Artificial substrate samplers will be installed at stream locations once between June 15 and August 17, 2012, and retrieved six weeks later. Qualitative macroinvertebrate sampling will be conducted one time at all sites. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when the HD sampler installations and retrievals and qualitative sampling will be conducted.

QHEI habitat evaluations will be conducted one time between June 15 and October 15, 2012. These evaluations will be conducted around the same time as one of the electrofishing surveys.

Water chemistry samples will be collected a minimum of three times from stream locations between June 15 and October 15, 2012.

Benthic and water column chlorophyll *a* samples may be collected at least one time from stream locations between June 15 and October 15, 2012. These samples will be collected under low-flow conditions.

(8) 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* (1987a) and *III* (1987b) and *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006a).

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 any problems as soon as possible, whether by repairing in the field, at the NEORSD Environmental and Maintenance Services Center, or by contacting the supplier or an appropriate service company.

All unidentifiable fish species will be brought back to the laboratory for verification by Level 3 QDC's 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 (13). 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.

All macroinvertebrate community assemblages from stream locations, except for any replicate samples, will be collected and shipped to MBI for identification and

enumeration. All specimens will be identified to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b). All macroinvertebrate specimens will be returned to NEORSD. At least two voucher specimens of each species, when available, will be separated into individual vials and kept as described in section (13). The remaining specimens for each site will be returned in a single container labeled with the site number and collection method and date. All specimens and accompanying chain-of-custody documentation will be retained by NEORSD and stored at the Environmental and 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 (Appendix C). 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 most current NEORSD Analytical Services Quality Manual (effective date November 18, 2011) 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.

For benthic and water column chlorophyll *a* sampling, three filtrations will be performed for each sample. A field filtration blank will be submitted for every 20 samples.

(9) 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 scores, chlorophyll *a* results, and any excursions from water quality standards may be prepared for internal use.

(10) 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)
John W. Rhoades	4747 East 49th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 00008 CWQA/FCB/SHA/ BMB
Cathy Zamborsky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 00009 CWQA/SHA
Seth Hothem	4747 East 49th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 00010 CWQA/FCB/SHA/ BMB
Kathryn Crestani	4747 East 49th Street Cuyahoga Hts., Ohio 44125	crestanik@neorsd.org	216-641-6000	QDC - 00011 CWQA/SHA
Tom Zablotny	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zablotnyt@neorsd.org	216-641-6000	QDC - 00018 CWQA/FCB/SHA
Ron Maichle	4747 East 49th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 00145 CWQA/SHA/BMB
Francisco Rivera	4747 East 49th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 00262 CWQA/SHA
Kristina Granlund	4747 East 49th Street Cuyahoga Hts., Ohio 44125	granlundk@neorsd.org	216-641-6000	QDC - 00511 CWQA/SHA
Jillian Novak	4747 East 49th Street Cuyahoga Hts., Ohio 44125	novakj@neorsd.org	216-641-6000	QDC - 00512 CWQA/SHA/BMB
Jonathan Brauer	4747 East 49th Street Cuyahoga Heights, Ohio 44125	brauerj@neorsd.org	216-641-6000	QDC - 00663 SHA
Martin Knapp	Midwest Biodiversity Institute P.O. Box 2156 Columbus, Ohio 43221	martygator@hotmail.com	614-457-6000	QDC - 300 BMB

The following is a list of persons not qualified as Level 3 QDC's 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 49th Street Cuyahoga Hts., Ohio 44125	barillen@neorsd.org	216-641-6000
Joseph Carbonaro	4747 East 49th Street Cuyahoga Hts., Ohio 44125	carbonaroj@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	dobrianskyt@neorsd.org	216-641-6000
Kyle Frantz	4747 East 49th Street Cuyahoga Hts., Ohio 44125	frantzk@neorsd.org	216-641-6000
Rae Grant	4747 East 49th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Mark Matteson	4747 East 49th Street	mattesonm@neorsd.org	216-641-6000

Name	Address	Email Address	Phone Number
	Cuyahoga Hts., Ohio 44125		
Denise Phillips	4747 East 49th Street Cuyahoga Hts., Ohio 44125	phillipsd@neorsd.org	216-641-6000
Brandy Reischman	4747 East 49th Street Cuyahoga Hts., Ohio 44125	reischmanb@neorsd.org	216-641-6000
Kevin Roff	4747 East 49th Street Cuyahoga Hts., Ohio 44125	roffk@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 East 49th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Kelly Boreman Summer Co-Op	4747 East 49th Street Cuyahoga Hts., Ohio 44125	boremank@neorsd.org	216-641-6000
NEORSD Summer Co-op #2	4747 East 49th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
NEORSD Summer Co-op #3	4747 East 49th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
NEORSD Summer Co-op #4	4747 East 49th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000

(11) Contract laboratory contact information

Analysis of chemical and bacteriological samples will be completed by NEORSD Analytical Services Division. See Appendix J for NEORSD Analytical Services Division Certificate of Accreditation.

NEORSD Analytical Services
Mr. Mark Citriglia
4747 East 49th Street
Cuyahoga Heights, OH 44125
citrigliam@neorsd.org
216-641-6000

Any fish that is not positively identified in the field or at NEORSD 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.

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 for stream locations 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 ODNR collector's permit

See Appendix I for Ohio Department of Natural Resources Division of Wildlife Wild Animal Scientific Collection Permit.

(13) Digital 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 within the NEORSD's service area. 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's Environmental and Maintenance Services Center.

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

(15) Sample Location Statement

I attest that I will make available any and all sampling location information, including but not limited to; the name of the water body sampled, sampling location latitude and longitude, sampling location river mile where possible, general location information, the U.S. geological survey HUC 8 number and name, and the purpose for data collection at each sampling location.

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

(16) Additional L3 Data Collector Statement

It is anticipated that the Midwest Biodiversity Institute will be contracted to complete macroinvertebrate identification and to create the macroinvertebrate voucher collection. However, awarding of the contract is dependent upon approval by the Northeast Ohio Regional Sewer District Board of Trustees, which, to date, has not occurred. Once the contract is awarded, the person responsible to complete the identification and create the voucher collection will provide a letter stating their role. The letter will be submitted electronically when finalized. An amendment to the study plan will be submitted if an alternative party is awarded the contract.

The Lead Project Manager for all NEORSD project study plans is approved for all other project data types.

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

(17) 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: Jonathan Brauer / Date: _____

Print/Signature: Kathryn Crestani / Date: _____

Print/Signature: Kristina Granlund/ Date: _____

Print/Signature: Seth Hothem/ Date: _____

Print/Signature: Ron Maichle / Date: _____

Print/Signature: Jillian Novak/ Date: _____

Print/Signature: Francisco Rivera/ Date: _____

Print/Signature: Thomas Zablotny/ Date: _____

Print/Signature: Cathy Zamborsky/ Date: _____

Appendix A

NEORSD Macroinvertebrate Field Sheet

Stream: _____ River Mile: _____ Year: _____

Location: _____ Project: _____

Drainage Area (mi^2): _____ Latitude (ºN)/Longitude (ºW): _____

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 Core Other: _____

Sample ID: HD: _____ Qualitative: _____ Other: _____

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

HD Condition- Current (fps): _____ Depth (cm): _____ Water Temp: _____ ºF / ºC

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 _____

Field Narrative Rating: E VG G MG F P VP

Appendix B

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-$N0_2^-$ 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	0.001 mg/L	0.010 mg/L
Chlorophyll *a*	Chlorophyll *a*	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.)	EPA 200.7 [1]	CaCO3 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
Escherichia coli	*E. coli*	EPA 1603 D	1 colony	--
Field Parameter		**Test**	**(Value Reported in)**	
pH		EPA 150.1 [1]	s.u.	
Conductivity		SM 2510A [1]	µs/cm	
Dissolved Oxygen	DO	SM 4500-0 G [1]	mg/L	
Temperature	Temp	EPA 1701.1 [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

Laboratory Scope of Accreditation

Attachment to Certificate of Accreditation 005, expiration date November 30, 2012. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

State Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **(216) 641-6000**

Northeast Ohio Regional Sewer District Analytical Services
4747 East 49th Street
Cuyahoga Heights, OH 44125

Program Non-Potable Water

Method	Analyte	Accreditation Type	Primary	Effective Date
ASTM D4839-03	Total organic carbon (TOC)	NELAP	PA	11/17/2010
Colilert QT (SM 9223 B 20th Ed)	E. coli (Enumeration)	NELAP	PA	11/29/2007
Colilert QT (SM 9223 B 20th Ed)	Total coliform (Enumeration)	NELAP	PA	11/22/2010
EPA 1000.0	Pimephales promelas	NELAP	PA	1/8/2009
EPA 1002.0	Ceriodaphnia dubia	NELAP	PA	1/8/2009
EPA 160.4	Residue, volatile	NELAP	PA	10/22/2008
EPA 1600	Enterococci	NELAP	PA	11/22/2010
EPA 1603	E. coli (Enumeration)	NELAP	PA	11/29/2007
EPA 1631	Mercury	NELAP	PA	3/31/2008
EPA 1664 Rev A	Oil and grease	NELAP	PA	11/29/2007
EPA 180.1	Turbidity	NELAP	PA	12/31/2007
EPA 200.7	Aluminum	NELAP	PA	11/29/2007
EPA 200.7	Antimony	NELAP	PA	11/29/2007
EPA 200.7	Arsenic	NELAP	PA	11/29/2007
EPA 200.7	Barium	NELAP	PA	11/29/2007
EPA 200.7	Beryllium	NELAP	PA	11/29/2007
EPA 200.7	Cadmium	NELAP	PA	11/29/2007
EPA 200.7	Calcium	NELAP	PA	11/29/2007
EPA 200.7	Chromium	NELAP	PA	11/29/2007
EPA 200.7	Cobalt	NELAP	PA	11/29/2007
EPA 200.7	Copper	NELAP	PA	12/31/2007
EPA 200.7	Iron	NELAP	PA	11/29/2007
EPA 200.7	Lead	NELAP	PA	11/29/2007
EPA 200.7	Magnesium	NELAP	PA	11/17/2010
EPA 200.7	Manganese	NELAP	PA	11/29/2007
EPA 200.7	Molybdenum	NELAP	PA	11/29/2007
EPA 200.7	Nickel	NELAP	PA	11/29/2007
EPA 200.7	Potassium	NELAP	PA	12/31/2007
EPA 200.7	Selenium	NELAP	PA	11/29/2007
EPA 200.7	Silver	NELAP	PA	11/29/2007
EPA 200.7	Sodium	NELAP	PA	12/31/2007
EPA 200.7	Thallium	NELAP	PA	11/29/2007
EPA 200.7	Tin	NELAP	PA	11/29/2007
EPA 200.7	Titanium	NELAP	PA	11/29/2007
EPA 200.7	Vanadium	NELAP	PA	11/29/2007
EPA 200.7	Zinc	NELAP	PA	12/31/2007

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State Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **(216) 641-6000**

Northeast Ohio Regional Sewer District Analytical Services
4747 East 49th Street
Cuyahoga Heights, OH 44125

Program Non-Potable Water

Method	Analyte	Accreditation Type	Primary	Effective Date
EPA 245.1	Mercury	NELAP	PA	11/29/2007
EPA 300.0	Bromide	NELAP	PA	11/22/2010
EPA 300.0	Chloride	NELAP	PA	11/22/2010
EPA 300.0	Fluoride	NELAP	PA	11/22/2010
EPA 300.0	Nitrate as N	NELAP	PA	11/22/2010
EPA 300.0	Nitrite as N	NELAP	PA	11/22/2010
EPA 300.0	Orthophosphate as P	NELAP	PA	11/22/2010
EPA 300.0	Sulfate	NELAP	PA	11/22/2010
EPA 3005A	Preconcentration under acid	NELAP	PA	11/29/2007
EPA 3010A	Hot plate acid digestion (HNO3 + HCl)	NELAP	PA	11/29/2007
EPA 3015	Microwave-assisted acid digestion	NELAP	PA	11/29/2007
EPA 310.2	Alkalinity as CaCO3	NELAP	PA	11/17/2010
EPA 325.2	Chloride	NELAP	PA	11/17/2010
EPA 350.1	Ammonia as N	NELAP	PA	11/29/2007
EPA 351.2	Kjeldahl nitrogen, total (TKN)	NELAP	PA	11/17/2010
EPA 353.2	Nitrate as N	NELAP	PA	11/29/2007
EPA 353.2	Total nitrate-nitrite	NELAP	PA	11/17/2010
EPA 365.1	Orthophosphate as P	NELAP	PA	11/29/2007
EPA 365.1	Phosphorus, total	NELAP	PA	10/22/2008
EPA 410.4	Chemical oxygen demand (COD)	NELAP	PA	11/29/2007
EPA 420.4	Total phenolics	NELAP	PA	11/17/2010
EPA 445	Chlorophyll A	NELAP	PA	11/22/2010
EPA 6010B	Aluminum	NELAP	PA	11/29/2007
EPA 6010B	Antimony	NELAP	PA	11/29/2007
EPA 6010B	Arsenic	NELAP	PA	11/29/2007
EPA 6010B	Barium	NELAP	PA	11/29/2007
EPA 6010B	Beryllium	NELAP	PA	11/29/2007
EPA 6010B	Cadmium	NELAP	PA	11/29/2007
EPA 6010B	Calcium	NELAP	PA	11/29/2007
EPA 6010B	Chromium	NELAP	PA	11/29/2007
EPA 6010B	Cobalt	NELAP	PA	11/29/2007
EPA 6010B	Copper	NELAP	PA	12/31/2007
EPA 6010B	Iron	NELAP	PA	11/29/2007
EPA 6010B	Lead	NELAP	PA	11/29/2007
EPA 6010B	Magnesium	NELAP	PA	11/29/2007
EPA 6010B	Manganese	NELAP	PA	11/29/2007

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State Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **(216) 641-6000**

Northeast Ohio Regional Sewer District Analytical Services
4747 East 49th Street
Cuyahoga Heights, OH 44125

Program Non-Potable Water

Method	Analyte	Accreditation Type	Primary	Effective Date
EPA 6010B	Molybdenum	NELAP	PA	11/29/2007
EPA 6010B	Nickel	NELAP	PA	11/29/2007
EPA 6010B	Potassium	NELAP	PA	12/31/2007
EPA 6010B	Selenium	NELAP	PA	11/29/2007
EPA 6010B	Silver	NELAP	PA	11/29/2007
EPA 6010B	Sodium	NELAP	PA	12/31/2007
EPA 6010B	Thallium	NELAP	PA	11/29/2007
EPA 6010B	Tin	NELAP	PA	11/29/2007
EPA 6010B	Titanium	NELAP	PA	11/29/2007
EPA 6010B	Vanadium	NELAP	PA	11/29/2007
EPA 6010B	Zinc	NELAP	PA	12/31/2007
EPA 7470	Mercury	NELAP	PA	11/29/2007
Enterolert	Enterococci (Enumeration)	NELAP	PA	11/22/2010
HACH 8048	Orthophosphate as P	NELAP	PA	11/22/2010
Lachat 10-204-00-1X	Cyanide	NELAP	PA	11/17/2010
OIA 1677	Available (free) cyanide	NELAP	PA	11/29/2007
SM 2340 B	Total hardness as CaCO3	NELAP	PA	10/22/2008
SM 2540 B	Residue, total	NELAP	PA	11/29/2007
SM 2540 C	Residue, filterable (TDS)	NELAP	PA	11/29/2007
SM 2540 D	Residue, nonfilterable (TSS)	NELAP	PA	11/29/2007
SM 2540 F	Residue, settleable	NELAP	PA	11/29/2007
SM 2550 B	Temperature, deg. C	NELAP	PA	10/22/2008
SM 3500-Cr B (20th ed.)	Chromium VI	NELAP	PA	11/29/2007
SM 4500-CN- C	Cyanide distillation	NELAP	PA	10/22/2008
SM 4500-CN- E	Total cyanide	NELAP	PA	11/29/2007
SM 4500-CN- G	Amenable cyanide	NELAP	PA	11/29/2007
SM 4500-Cl E	Total residual chlorine	NELAP	PA	11/29/2007
SM 4500-H+ B	pH	NELAP	PA	11/29/2007
SM 4500-NO2- B	Nitrite as N	NELAP	PA	11/29/2007
SM 4500-Norg B	Kjeldahl nitrogen, total (TKN)	NELAP	PA	10/22/2008
SM 4500-S D	Sulfide	NELAP	PA	11/22/2010
SM 5210 B	Biochemical oxygen demand (BOD)	NELAP	PA	11/29/2007
SM 5210 B	Carbonaceous BOD (CBOD)	NELAP	PA	11/29/2007
SM 9222 B	Total coliform (Enumeration)	NELAP	PA	11/22/2010
SM 9222 D	Fecal coliform (Enumeration)	NELAP	PA	11/29/2007
SM 9222 D	Fecal coliforms with chlorine present (Enumeration)	NELAP	PA	10/22/2008

Laboratory Scope of Accreditation

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State Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **(216) 641-6000**

Northeast Ohio Regional Sewer District Analytical Services
4747 East 49th Street
Cuyahoga Heights, OH 44125

Program Solid and Chemical Materials

Method	Analyte	Accreditation Type	Primary	Effective Date
EPA 245.1	Mercury	NELAP	PA	11/22/2010
EPA 3051	Microwave digestion of solids (HNO3 only)	NELAP	PA	11/17/2010
EPA 6010B	Aluminum	NELAP	PA	11/22/2010
EPA 6010B	Antimony	NELAP	PA	11/22/2010
EPA 6010B	Arsenic	NELAP	PA	11/22/2010
EPA 6010B	Barium	NELAP	PA	11/22/2010
EPA 6010B	Beryllium	NELAP	PA	11/22/2010
EPA 6010B	Boron	NELAP	PA	11/22/2010
EPA 6010B	Cadmium	NELAP	PA	11/22/2010
EPA 6010B	Calcium	NELAP	PA	11/22/2010
EPA 6010B	Chromium	NELAP	PA	11/22/2010
EPA 6010B	Cobalt	NELAP	PA	11/22/2010
EPA 6010B	Copper	NELAP	PA	11/22/2010
EPA 6010B	Iron	NELAP	PA	11/22/2010
EPA 6010B	Lead	NELAP	PA	11/22/2010
EPA 6010B	Magnesium	NELAP	PA	11/22/2010
EPA 6010B	Manganese	NELAP	PA	11/22/2010
EPA 6010B	Molybdenum	NELAP	PA	11/22/2010
EPA 6010B	Nickel	NELAP	PA	11/22/2010
EPA 6010B	Potassium	NELAP	PA	11/22/2010
EPA 6010B	Selenium	NELAP	PA	11/22/2010
EPA 6010B	Silver	NELAP	PA	11/22/2010
EPA 6010B	Sodium	NELAP	PA	11/22/2010
EPA 6010B	Thallium	NELAP	PA	11/22/2010
EPA 6010B	Titanium	NELAP	PA	11/22/2010
EPA 6010B	Vanadium	NELAP	PA	11/22/2010
EPA 6010B	Zinc	NELAP	PA	11/22/2010

Appendix C

NEORSD Surface Water Condition Sampling Field Data Form

Stream: _____ Date: _____ Collectors: _____

Gage Station and ID: _____ Daily Mean Discharge: _____ ft^3/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 to 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): _____

Sample ID:

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 to 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): _____

Sample ID:

General Comments: _____

Appendix D

14.1 Sensor Specifications

Dissolved Oxygen		
Sensor Type		Steady state polarographic
Range:	*% air sat'n*	▪ 0 to 500% air saturation
	mg/L	▪ 0 to 50 mg/L
Accuracy:	*% air sat'n*	▪ 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
	mg/L	▪ 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*	▪ 0.1% air saturation
	mg/L	▪ 0.01 mg/L
Temperature		
Sensor Type:		YSI Precision™ thermistor
Range:		-5 to 45°C
Accuracy:		±0.15°C
Resolution:		0.01°C
Conductivity		
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)
Salinity		
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.

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.

To order, or for more information, contact YSI
+1 937 767 7241
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CE

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Who's Minding the Planet?®

YSI 600XL and 600XLM Sondes

The YSI 600XL and 600XLM

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)

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 V2 and 6920 V2 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.

ETV

To order, or for more info, contact YSI Environmental.

+1 937 767 7241
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www.ysi.com

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ISO 9001
ISO 14001
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YSI incorporated
Who's Minding the Planet?®

YSI 600XL & 600XLM Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen % Saturation ETV 6562 Rapid Pulse™ Sensor*	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 ETV 6562 Rapid Pulse™ Sensor*	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• ETV 6560 Sensor*	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 ETV 6560 Sensor*	-5 to +50°C	0.01°C	±0.15°C
pH ETV 6561 Sensor*	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 600XL | 600XLM	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 (ß). 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 µS/cm
Range	TDS	0 to 2000 ppm
Range	Temperature	0.0 to 60.0°C / 32 to 140.0°F
Resolution	pH	0.01 pH
Resolution	EC	1 µS/cm
Resolution	TDS	1 ppm
Resolution	Temperature	0.1°C / 0.1°F
Accuracy	pH	±0.05 pH
Accuracy	EC/TDS	±2% F.S.
Accuracy	Temperature	±0.5°C / ±1°F
Temperature Compensation		pH: automatic; EC/TDS: automatic with ß 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.)

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

▲ Go to top

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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

geotech

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

CALL GEOTECH TODAY (800) 833-7958

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(303) 320-4764 • **(800) 833-7958** • FAX (303) 322-7242
email: sales@geotechenv.com website: www.geotechenv.com

6600EDS Extended Deployment System

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

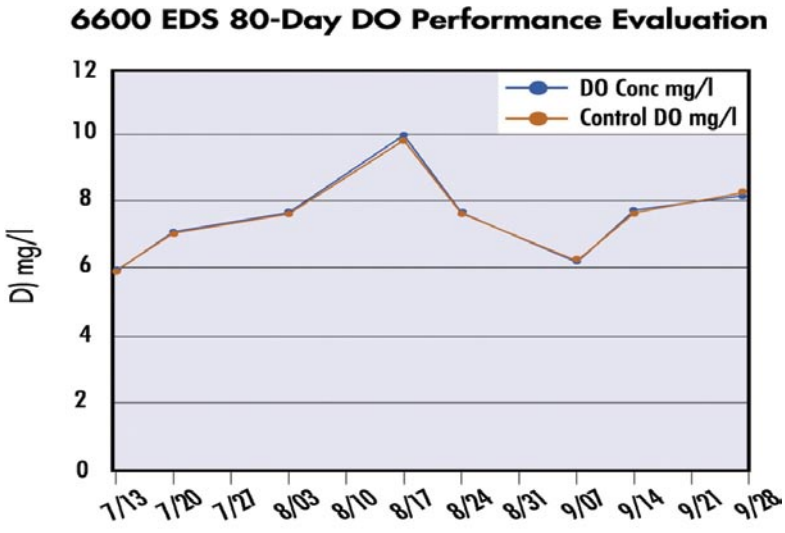
Profile of the 6600EDS depicting (clockwise from bottom) temperature/conductivity, turbidity, Rapid Pulse™ dissolved oxygen, chlorophyll and pH/ORP—all of which (except conductivity) are kept free of fouling by the patented Clean Sweep® universal wiper assembly, as well as individual optical wipers.

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.



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 Program.**

ETV

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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.

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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.

ETV

YSI 6600EDS Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen• % Saturation ETV 6562 Rapid Pulse™ Sensor*	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 ETV 6562 Rapid Pulse™ Sensor*	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•• ETV 6560 Sensor*	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 ETV 6560 Sensor*	-5 to +50°C	0.01°C	±0.15°C
pH ETV 6561 Sensor*	0 to 14 units	0.01 unit	±0.2 unit
ORP	-999 to +999 mV	0.1 mV	±20 mV
Depth — Deep	0 to 656 ft, 200 m	0.001 ft, 0.001 m	±1 ft, ±0.3 m
Depth — Medium	0 to 200 ft, 61 m	0.001 ft, 0.001 m	±0.4 ft, ±0.12 m
Depth — Shallow	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.06 ft, ±0.02 m
Depth — Vented Level	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.01 ft, 0.003 m
Turbidity• ETV 6136 Sensor*	0 to 1,000 NTU	0.1 NTU	±2% of reading or 0.3 NTU, whichever is greater**
Rhodamine•	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•	~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•	~0 to 200,000 cells/mL† 0 to 100 RFU	~450 cells/mL§§	1 cell/mL 0.1 RFU	$R^2 > 0.9999$***
Chlorophyll• ETV 6025 Sensor*	~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 ug/L).
***Relative to serial dilution of Rhodamine WT (0-8 µg/L).
****Relative to serial dilution of Rhodamine WT (0-500 ug/L).

YSI 6600EDS Sonde Specifications

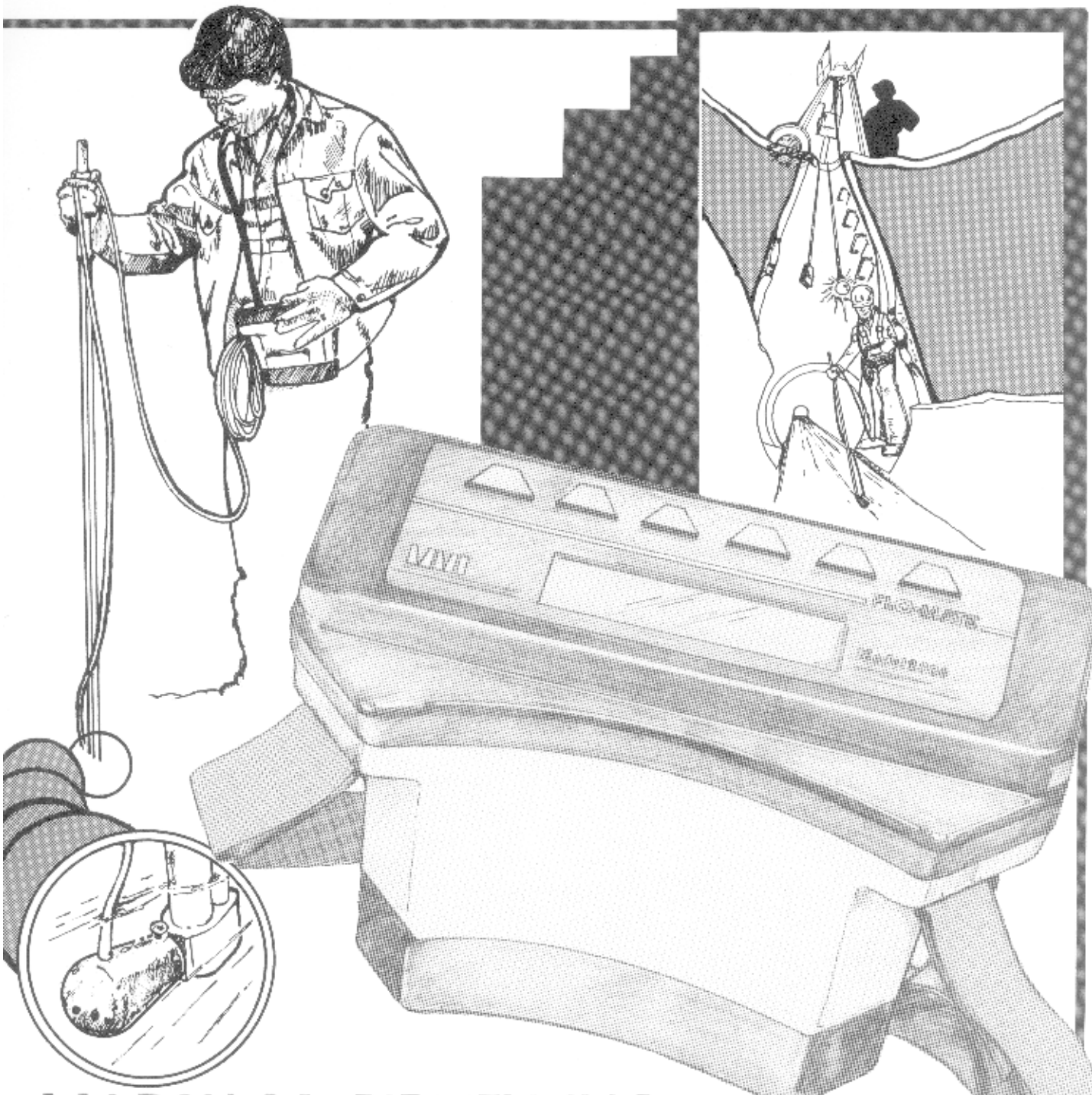
Medium		Fresh, sea or polluted water	Software		EcoWatch®
Temperature	Operating	-5 to +50°C	Dimensions	Diameter	3.5 in, 8.9 cm
	Storage	-10 to +60°C		Length, no depth	19.6 in, 34.3 cm
				Length, depth	21.6 in, 54.9 cm
				Weight, depth and batteries	7 lbs, 3.18 kg
Communications		RS-232, SDI-12	Power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

VII. Specifications

Range:	0.3-19.9 FT/S (0.1-6.1 M/S)
Accuracy:	0.1 FT/S (0.1 M/S)
Averaging:	True digital running average Updated once per second
Display:	LCD, Glare and UV Protected
Sensor Type:	Turbo-Prop propeller with magnetic pickup
Length and Weight:	FP111: 3' to 6', 2 Lbs. FP211: 5' to 15', 3 Lbs. FP311: 2.5' to 5.5', 2 Lbs.
Shipping Weight (US):	FP111: 10 lbs. FP211: 13 lbs FP311: 5 Lbs.
Materials:	Probe: PVC and anodized aluminum with stainless steel water bearing Computer: ABS/Polycarbonate housing with polyester overlay
Power:	Internal Lithium, Approx 5 year life Non-Replaceable
Operating Temperature:	-20° to 70° C (-4° to 158° F) Non-Freezing
Storage Temperature:	-30° to 80° C (-22° to 176° F)

VIII. Maintenance

a. Probe Handle:
When the Flow Probe expansion joint becomes submerged, water will enter the Probe handle. After use, dry the Probe by separating the two handle sections, draining the water inside the Probe handle, and letting the handle dry out in a warm place before reassembling. The Flow Probe handle can be cleaned with mild soap and water. You should not submerge the top of the pole and the computer. If the computer gets submerged, remove it from the Flow Probe and dry with a soft cloth



MARSH-McBIRNEY, INC.

FLO-MATE™

MODEL 2000 PORTABLE FLOWMETER
INSTRUCTION MANUAL

SPECIFICATIONS

Velocity Measurement

Method
Electromagnetic

Zero Stability
± 0.05 ft/sec

Accuracy
± 2% of reading + zero stability

Range
-0.5 to +19.99 ft/sec
-0.15 m/sec to +6 m/sec

Power Requirements

Batteries
Two D Cells

Battery Life Continuous ON hours
Alkaline 25-30
NiCad 10-15 per charge

External Power Supply (Optional)
120 V, 1 W or 220 V, 1 W

Water Resistant Electronic Case

Submersible
One Foot for 30 Seconds

Outputs

Display
$3^{1}/_{2}$ Digit

Signal Output Connector (Optional)
Analog 0.1 V = 1 ft/sec or 1 m/sec
2 V = Full Scale

Materials

Sensor
Polyurethane

Cable
Polyurethane jacket

Electronic Case
High Impact Molded Plastic

Weight

3 lb 9 oz with case and 20 ft of cable

2 lb 10 oz without sensor and cable

Temperature

Open-Channel-Velocity Sensor
32° F to 160° F (0° C to 72° C)

Full-Pipe Sensor (S/S Insertion Tube)
32° F to 160° F (0° C to 72° C) @ 250 psi

Electronics
32° F to 122° F (0° C to 50° C)

Appendix E

NEORSD Chlorophyll *a* Sampling Field Sheet

Stream:_____ Collectors:_____
Location:_____ Date:_____
RM:_____ Time:_____
Lat/Long:_____

Number of Rocks:_____ Total Area Scraped:_____cm^2

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 (cm2)
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*

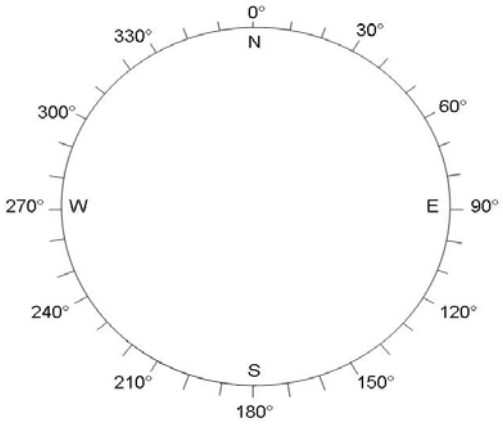
*Explain_____

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

Appendix F

Northeast Ohio Regional Sewer District

Protecting Your Health and Environment

Water Quality Industrial Surveillance
4747 East 49th Street
Cuyahoga Hts., OH 44125

Chlorophyll *a* Sampling and Field Filtering
SOP-EA001-01

Effective Date: 03/28/2011

COPY

Approvals

Prepared By: Seth Hothem Date: 3/25/11

Reviewed By Supervisor: John Rhoades Date: 03/25/11

Approved By Manager: Scott Broski Date: 3/25/11

Approved By Superintendent: Frank Foley Date: 3/25/11

Table of Contents

1.0 Scope and Application

1.1 The chlorophyll *a* sampling procedures provided herein apply to the collection of samples from streams by the WQIS Environmental Assessment group. Chlorophyll *a* is a pigment used by plants in the photosynthesis process and can be used to estimate the amount of algal biomass in a system. Sampling is usually conducted in the summer during low flow periods, when algal productivity is expected to be the highest.

2.0 Summary of Method

2.1 Two different types of chlorophyll *a* samples are collected for each site to determine algal production. Benthic chlorophyll *a* samples are collected to determine algal biomass that is attached to the stream substrate. Water column chlorophyll *a* samples are collected to determine algal biomass that has sloughed off from the substrate. Samples that are collected are homogenized and then filtered through glass fiber filters. Filtering is either completed in the field or at the Environmental Maintenance and Services Center (EMSC). The time required for sampling with three individuals is approximately one hour per site.

3.0 Definitions

3.1 Clinometer- device used to determine angles of incline for canopy cover

4.0 Qualified Personnel

4.1 If data is needed to be credible, at least one person conducting the evaluation is a certified Ohio EPA Level III Qualified Data Collector for chemical water quality assessment.

5.0 Equipment and Supplies

5.1 Equipment and Supplies for Collection of Benthic Samples

5.1.1 Waders

5.1.2 Buckets

5.1.3 Clinometer

5.1.4 GPS

5.1.5 NEORSD Chlorophyll *a* Sampling Field Sheet

5.1.6 Chisel

5.1.7 Gloves, nitrile or shoulder length

5.1.8 Clipboard

5.1.9 Writing implement

5.2 Equipment and Supplies for Processing Benthic Samples

5.2.1 Non-functioning ball-point pen

5.2.2 Medium or hard bristle brush (diameter less than or equal to 20 mm)

5.2.3 Electric drink stirrer

5.2.4 Forceps

5.2.5 Container for algal slurry

5.2.6 Graduated cylinder

5.2.7 Squirt bottles filled with tap water

5.2.8 Pipetter and 5 mL pipette

5.2.9 Aluminum foil

5.2.10 Cut off syringe (diameter about 22 mm)

5.2.11 Ruler

5.2.12 Scalpel

5.2.13 Sample labels and tape

5.2.14 Erlenmeyer flask with one-hole stopper

5.2.15 300mL filter funnel with magnetic base (For field filtering)

5.2.16 47mm glass fiber filters, (Like Millipore Cat. No. APFF04700)

5.2.17 Vacuum system (3-4 psi) (For field filtering)

5.2.18 Vacuum source or pump capable of maintaining a vacuum up to 6 in. Hg. (For laboratory filtering)

5.2.19 6.7 Filtering Apparatus, (Like Gelman Sciences Cat. No. 4205) (For laboratory filtering)

5.2.20 Microspatula

5.2.21 15mL centrifuge tube with screw cap

5.2.22 Cooler (ice or dry ice to be determined by project)

5.3 Equipment and Supplies for Water Column Sampling

5.3.1 Glass container (which holds about 0.5 liters)

5.3.2 Graduated cylinder (at least 100 mL)

5.3.3 Aluminum foil and masking tape

5.3.4 Filtering equipment from benthic sampling

5.3.5 Forceps

5.3.6 15mL centrifuge tubes with screw cap

5.3.7 Cooler with sample preservation method to be determined by project

6.0 Procedure

6.1 For a representative benthic sample, select approximately 15 rocks from the middle of the stream. Rocks should not be collected from margin areas because they may be light limited.

6.2 Determine the angle of light at all locations where rocks are collected using the clinometer. If the angle is greater than 45°, it can be assumed that the rocks at that location are not light limited and can be included in the sample.

6.3 Select rocks that have not been recently disturbed. This can be determined by examining the rock and noting differences in coloration due to the presence of algae.

6.4 If necessary, bedrock samples can be obtained by chiseling out a section at least 50mm x 50mm.

6.5 Place collected samples in a bucket that contains enough water to cover all the rocks.

6.6 Fill out all information on NEORSD Chlorophyll *a* Sampling Field Sheet (Attachment A) regarding stream and weather conditions. Include a drawing of the stream reach where the samples were collected.

6.7 Samples should be processed immediately after collection to minimize light degradation.

6.8 The rocks should be processed over a pan to allow for the collection of all water used in processing. Be conservative in the amount of water that is used to allow for it all to be collected in the graduated cylinder.

6.9 Prior to processing the rocks, cut off the tip of a 5mL pipette.

6.10 Place the cut off end of the syringe around a representative area on rock.

6.11 Use a non-functioning pen tip to scribe a circle around the inside of the cut off syringe (Figure 1).

6.12 Use a squirt bottle to rinse the inside of the syringe into the pan.

6.13 Break up algae within the circle by scoring it with a scalpel.

6.14 Scrape surface of the rock using the scalpel.

6.15 Use the brush to remove the scraped algal mass. Use the squirt bottle to rinse off the scraped material from the brush.

6.16 Continue scraping rock until all the algal mass has been removed (Figure 2).

6.17 Rinse rock with water.

6.18 Measure the diameter of each circle scraped (Figure 3) and record on sample form. Two measurements per circle should be taken and averaged.

6.19 Filtering can either be completed in the field or at EMSC. If filtering occurs in the field, a filtering apparatus should be set up using the Erlenmeyer flask, filter funnel, and hand-operated vacuum pump (Figure 4). Filters should be glass fiber with a 47 mm diameter.

6.20 Establish a vacuum first. The filter frit should then be wetted before the filter is placed on it.

6.21 Composite samples from all rocks collected into one container. Measure total volume of the sample using the graduated cylinder and record on field sheet.

6.22 Use an electric drink stirrer to adequately mix the sample.

6.23 Take one 5mL aliquot of the algal slurry with the cut off pipette and put into the filter funnel.

6.24 After the sample is filtered, remove the filter from the frit using the forceps. Place the filter in a centrifuge tube and completely cover the tube with aluminum foil.

6.25 Seal the aluminum foil with masking tape and put on ice. If the samples will be returned to the Environmental Maintenance Service Center (EMSC) at the end of sampling, regular ice can be used. For longer than 12 hours, use dry ice.

6.26 Three replicate samples should be done at each site to allow for an assessment of precision.

6.27 For every ten samples, put tap water through the filtering procedures for use as a field blank.

6.28 For use in the determination of water column chlorophyll *a* concentrations, obtain a grab sample from the middle of the stream in the same vicinity in which the rocks were collected.

6.29 Filtering of the water column sample can either take place in the field or once back at EMSC.

6.30 If filtering in the field, use an electric drink stirrer to adequately mix the sample.

6.31 Filter three separate 100 mL samples using the filtering apparatus and glass fiber filters.

6.32 After the sample is filtered, remove the filter from the frit using the forceps. Place the filter in a centrifuge tube and completely cover the tube with aluminum foil.

6.33 Place centrifuge tubes on ice. If the samples will be returned to the Environmental Maintenance Service Center (EMSC) at the end of sampling, regular ice can be used. For longer than 12 hours, use dry ice.

6.34 If samples are not filtered in the field, place them in a cooler filled with regular ice.

6.35 Upon return to EMSC, filter the benthic and water column samples if necessary.

6.35.1 Gently agitate the sample to suspend the particulates

6.35.2 Measure the sample in a graduated cylinder: 5mL for the benthic samples and 100mL for the water column samples.

6.35.3 Secure the filtration unit onto the vacuum apparatus.

6.35.4 Place 47 mm glass, fiber filter onto the filtration base.

6.35.5 Filter the sample under vacuum not exceeding 6 in. Hg (20 kPa).

6.35.6 Monitor the pressure of the vacuum during filtration and adjust as needed during the process.

6.35.7 Do not suck the filter dry with the vacuum; instead slowly release the vacuum as the final volume approaches the level of the filter, add 3 drops of magnesium carbonate.

6.35.8 Completely release the vacuum as the last bit of water is pulled through the filter.

6.35.9 Fold the fiber filter in half with the particulate matter inside.

6.35.10 Lightly blot the outside of the filter with a paper towel to remove excess moisture.

6.35.11 Remove the filter from the filtration unit with smooth tip tweezers.

6.35.12 Place the filter into a 15-mL screw-cap centrifuge tube and cover the outside of the tube with foil.

6.36 Enter sample collection times, field parameters and any necessary observations into LabLynx.

6.37 Print chain of custody forms from LabLynx and hand deliver along with the samples to the Sample Control Specialist or an Analytical Services Supervisor in the sample receiving area. The Chain of Custody(s) must be signed off by the WQIS Investigator, or QDC Level 3 for Chemistry if credible data is required, and either the Sample Control Specialist or Analytical Services Supervisor.

7.0 References

7.1 U.S. Environmental Protection Agency. (1997). Method 445.0 *In Vitro* determination of chlorophyll *a* and pheophytin *a* in marine and freshwater algae by fluorescence (Revision 1.2). Cincinnati, OH: National Exposure Research Laboratory, Office of Research and Development.

8.0 Revision History

7/20/2010 – Original SOP

3/28/2011 – Added description for laboratory filtering of samples

Figure 1. Scribing of circle inside syringe

Figure 2. Rock with algae scraped off

Figure 3. Measurement of scraped area

Figure 4. Filtering set-up

Appendix G

OhioEPA **FISH DATA SHEET**

Sheet ID For Office Use Only

New Station (requires lat/long & county) ☐ **Mix Zone** ☐ **Page____of ____**

Station ID_____ **River Code**_____ **RM**_____ **Date**_____ **Time**_____

Stream_____ **Location**_____

Comments_____

Lat_____ **Long**_____ **County**_____ **ALP**_____ **Time Fished**_____

Crew_____ **Netter**_____ **Others**_____ **Sampler Type**_____

Distance_____ **Flow**_____ **Temp. C**_____ **Secchi**_____ **Source**_____ **Project**_____

DELT ANOMALIES
Deformities, **E**rosions, **L**esions, **T**umors
Multiple DELTs on one fish

	Fins Code	Number Weighed	Total Counted	Total Weight	Weights	Counts	D	E	L	T	M	*
1												
	V	10x										
2												
	V	10x										
3												
	V	10x										
4												
	V	10x										
5												
	V	10x										
6												
	V	10x										
7												
	V	10x										
8												
	V	10x										
9												
	V	10x										

* A-anchor worm; B-black spot; C-leeches; F-fungus; N-blind; P-parasites; S-emaciated, W-swirled scales Y-popeye; Z-other

	Fins Code	Number Weighed	Total Counted	Total Weight	Weights Counts											
10								D	E	L	T	M	*
	V	10x														
11								D	E	L	T	M	*
	V	10x														
12								D	E	L	T	M	*
	V	10x														
13								D	E	L	T	M	*
	V	10x														
14								D	E	L	T	M	*
	V	10x														
15								D	E	L	T	M	*
	V	10x														
16								D	E	L	T	M	*
	V	10x														
17								D	E	L	T	M	*
	V	10x														
18								D	E	L	T	M	*
	V	10x														
19								D	E	L	T	M	*
	V	10x														
20								D	E	L	T	M	*
	V	10x														
21								D	E	L	T	M	*
	V	10x														

Appendix H

Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: ____

Stream & Location: _____ RM: _ _._ _ Date: _ _/ _ _/ _ _

Scorers Full Name & Affiliation: Northeast Ohio Regional Sewer District

River Code: _ _ _-_ _ _-_ _ _ STORET #: _ _ _ _ _ _ Lat./ Long.: (NAD 83 - decimal °) _ _ . _ _ _ _ /8_ . _ _ _ _ Office verified location ☐

1] *SUBSTRATE* Check *ONLY* **Two** substrate *TYPE BOXES*; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]	____	____	☐☐ HARDPAN [4]	____	____
☐☐ BOULDER [9]	____	____	☐☐ DETRITUS [3]	____	____
☐☐ COBBLE [8]	____	____	☐☐ MUCK [2]	____	____
☐☐ GRAVEL [7]	____	____	☐☐ SILT [2]	____	____
☐☐ SAND [6]	____	____	☐☐ ARTIFICIAL [0]	____	____
☐☐ BEDROCK [5]	____	____			

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (*Or 2 & average*)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☐ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Comments

Substrate ____ Maximum 20

2] *INSTREAM COVER* Indicate presence 0 to 3: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- ____ UNDERCUT BANKS [1]
- ____ OVERHANGING VEGETATION [1]
- ____ SHALLOWS (IN SLOW WATER) [1]
- ____ ROOTMATS [1]
- ____ POOLS > 70cm [2]
- ____ ROOTWADS [1]
- ____ BOULDERS [1]
- ____ OXBOWS, BACKWATERS [1]
- ____ AQUATIC MACROPHYTES [1]
- ____ LOGS OR WOODY DEBRIS [1]

AMOUNT

Check ONE (*Or 2 & average*)
- ☐ EXTENSIVE >75% [11]
- ☐ MODERATE 25-75% [7]
- ☐ SPARSE 5-<25% [3]
- ☐ NEARLY ABSENT <5% [1]

Comments

Cover Maximum 20 ____

3] *CHANNEL MORPHOLOGY* Check ONE in each category (*Or 2 & average*)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☐ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☐ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☐ RECOVERED [4]
- ☐ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☐ LOW [1]

Comments

Channel Maximum 20 ____

4] *BANK EROSION AND RIPARIAN ZONE* Check **ONE** in each category for *EACH BANK* (*Or 2 per bank & average*)

River right looking downstream

EROSION

L	R	
☐	☐	NONE / LITTLE [3]
☐	☐	MODERATE [2]
☐	☐	HEAVY / SEVERE [1]

RIPARIAN WIDTH

L	R	
☐	☐	WIDE > 50m [4]
☐	☐	MODERATE 10-50m [3]
☐	☐	NARROW 5-10m [2]
☐	☐	VERY NARROW < 5m [1]
☐	☐	NONE [0]

FLOOD PLAIN QUALITY

L	R	
☐	☐	FOREST, SWAMP [3]
☐	☐	SHRUB OR OLD FIELD [2]
☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]
☐	☐	FENCED PASTURE [1]
☐	☐	OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☐	☐	URBAN OR INDUSTRIAL [0]
☐	☐	MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian Maximum 10 ____

5] *POOL / GLIDE AND RIFFLE / RUN QUALITY*

MAXIMUM DEPTH

Check **ONE** (*ONLY!*)
- ☐ > 1m [6]
- ☐ 0.7-<1m [4]
- ☐ 0.4-<0.7m [2]
- ☐ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH

Check ONE (*Or 2 & average*)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY

Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☐ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current Maximum 12 ____

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (*Or 2 & average*). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5-10cm [1]
- ☐ BEST AREAS < 5cm [metric=0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Comments

Riffle / Run Maximum 8 ____

6] *GRADIENT* (ft/mi) ☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (mi²)

%POOL: ____ %GLIDE: ____ %RUN: ____ %RIFFLE: ____

Gradient Maximum 10 ____

A] SAMPLED REACH

Check ALL that apply

METHOD

- ☐ BOAT
- ☐ WADE
- ☐ L. LINE
- ☐ OTHER

STAGE

1st -sample pass- 2nd	
☐ HIGH	☐
☐ UP	☐
☐ NORMAL	☐
☐ LOW	☐
☐ DRY	☐

DISTANCE

- ☐ 0.5 Km
- ☐ 0.2 Km
- ☐ 0.15 Km
- ☐ 0.12 Km
- ☐ OTHER

_____ meters

CLARITY

1st --sample pass-- 2nd	
☐ < 20 cm	☐
☐ 20-<40 cm	☐
☐ 40-70 cm	☐
☐ > 70 cm/ CTB	☐
☐ SECCHI DEPTH	☐

CANOPY

- ☐ > 85%- OPEN
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%- CLOSED

pass 1st _____ cm

pass 2nd _____ cm

C] RECREATION

POOL: ☐ >100ft² ☐ >3ft (AREA / DEPTH)

Comment RE: Reach consistency/ Is reach typical of steam?*, Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

B] AESTHETICS

- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

D] MAINTENANCE

Circle some & *COMMENT*

PUBLIC / PRIVATE / BOTH / NA
ACTIVE / HISTORIC / BOTH / NA
YOUNG-SUCCESSION-OLD
SPRAY / SNAG / REMOVED
MODIFIED / DIPPED OUT / NA
LEVEED / ONE SIDED
RELOCATED / CUTOFFS
MOVING-BEDLOAD-STABLE
ARMOURED / SLUMPS
ISLANDS / SCOURED
IMPOUNDED / DESICCATED
FLOOD CONTROL / DRAINAGE

E] ISSUES

WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:

Appendix I

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: 13-84

SCIENTIFIC COLLECTION

Scott Zody
Chief, Division of Wildlife

DATE ISSUED
4/5/2012

Others authorized on permit
YES (SEE ATTACHMENT)

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

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: 3/16/2012 to: 3/15/2013

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, macroinvertebrates, amphibians and mussels for survey and inventory purposes. All endangered species are to be released at site of capture. Dead mussel shells not easily idenitified, may be collected and taken to NEORSD.
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).
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 NEORSD.
4. Collection is prohibited in Big Darby, Little Darby, tributaries to and the east branch of the Chagrin river north of I-90, Fish Creek (Williams County) and Division of Wildlife property without explicit written permission from the Division of Wildlife.
5. Permittee must provide an annual report of collecting activities in the Diversity Database Excel spreadsheet format 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, MACROINVERTEBRATES, MUSSELS AND AMPHIBIANS AS REQUIRED. DEAD MUSSEL SHELLS MAY ALSO BE COLLECTED AS NECESSARY FOR IDENTIFICATION. ALL FISH (EXCEPT VOUCHER SPECIES) MUST BE RELEASED AT THE COLLECTION SITE. ALL ENDANGERED SPECIES MUST BE IMMEDIATELY RELEASED.

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

OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF
WILDLIFE

ATTACHMENT

This attachment to Scientific Collecting Permit #13-84 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.

Name	SSN or Driver License
SETH HOTHEM	XXX-XX-6166
THOMAS ZABLOTNY	XXX-XX-6448
JON BRAUER	SJ925295
FRANCISO RIVERA	XXX-XX-5886
JILLIAN NOVAK	SA294701
ROBIN HALPERIN	RP564031
RON MAICHLE	XXX-XX-8924
KRISTINA GRANLUND	SJ501394
ELIZABETH TOOT-LEVY	RJ947174

Appendix J

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

OFFICE OF FIELD OPERATIONS
BUREAU OF LABORATORIES

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certifies that

68-03670
NORTHEAST OHIO REGIONAL SEWER DISTRICT ANALYTICAL SERVICES
4747 EAST 49TH STREET
CUYAHOGA HEIGHTS, OH 44125

Having duly met the requirement of
The Act of June 29, 2002 (P.L. 596, No. 90)
dealing with Environmental Laboratory Accreditation
(27 Pa. C.S. §§4101-4113) and the
National Environmental Laboratory Accreditation Conference Standard

is hereby approved as an

Accredited Laboratory

As more fully described in the attached Scope of Accreditation

Expiration Date: **11/30/2012**
Certificate Number: **005**

Continued accreditation status depends on successful ongoing participation in the Program
Certificate not transferable Surrender upon revocation
To be conspicuously displayed at the Laboratory
Not valid unless accompanied by a valid Scope of Accreditation
Shall not be used to imply endorsement by the Commonwealth of Pennsylvania
Customers are urged to verify the laboratory's current accreditation status
PA DEP is a NELAP recognized accreditation body

Aaren S. Alger, Chief
Laboratory Accreditation Program
Bureau of Laboratories

1500-FM-LAB0016 Rev. 8/2009

Appendix K

References

Chlorophyll a Sampling and Field Filtering Standard Operating Procedure (SOP-EA001-00)

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