Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

**Level 3 Project Study Plan**

***2017 Cuyahoga River Tributaries Environmental Monitoring***

(1) Objectives

The lower Cuyahoga River has been designated as one of 42 Great Lakes Areas of Concern (AOC) by the International Joint Commission. Past monitoring indicated impairment of aquatic biota in the river and was the basis for the establishment of Total Maximum Daily Loads (TMDLs) for the Lower Cuyahoga River. The causes of impairment to the river were classified as organic enrichment, toxicity, low dissolved oxygen, nutrients and flow alteration (Ohio EPA, 2003)[1]. Recent monitoring by the Northeast Ohio Regional Sewer District (NEORSD), however, has shown recovery of the biological community in some reaches of the river. Further monitoring throughout the watershed is necessary to determine what areas may be still impaired.

The objective of this study is to conduct environmental monitoring on six tributaries to the Cuyahoga River as part of the Northeast Ohio Regional Sewer District (NEORSD) general watershed monitoring program. Portions of the tributary data collected will provide additional information to support the continued monitoring of the lower Cuyahoga AOC. Sampling will be conducted by the NEORSD Environmental Assessment group in the Water Quality and Industrial Surveillance (WQIS) Division and will occur from June 15 through September 30, 2017 (through October 15 for fish sampling assessments), as required in the Ohio EPA *Biological Criteria for the Protection of Aquatic Life Volume III* (1987b).

During the course of the study, fish communities, benthic macroinvertebrate communities, habitat, and water chemistry will be surveyed at thirteen sites, in six different streams that are tributary to the Cuyahoga River. Sample sites will be located on Tinkers Creek, Wood Creek, Sagamore Creek, Chippewa Creek, Brandywine Creek, and Furnace Run. The results from these surveys will be used to characterize the overall fish and macroinvertebrate community health in these streams.

Stream monitoring activities will be conducted at each site by NEORSD Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community Biology, Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat

[1] See appendix H for a list of all references.

Assessment. Fish and macroinvertebrate community health will be evaluated through the use of Ohio EPA's Index of Biotic Integrity (IBI), Modified Index of Well-Being (MIwb) and Invertebrate Community Index (ICI). An examination of the specific characteristics of the biological communities will be used in conjunction with water quality data, the NEORSD Macroinvertebrate Field Sheet, and Qualitative Habitat Evaluation Index (QHEI) results in order to identify impacts to the communities. Results will be compared to historic data to show temporal as well as spatial trends. Water chemistry data will also be compared to the Ohio Water Quality Standards to determine attainment of applicable uses (Ohio EPA, 2016).

(2) Point/Nonpoint Sources

| Point Sources | Nonpoint Sources |
|---|---|
| Combined Sewer Overflows | Urban runoff |
| Sanitary Sewer Overflows | Landfills |
| Storm Sewer Outfalls | Spills |
| Home Septic Systems | Agricultural Runoff |

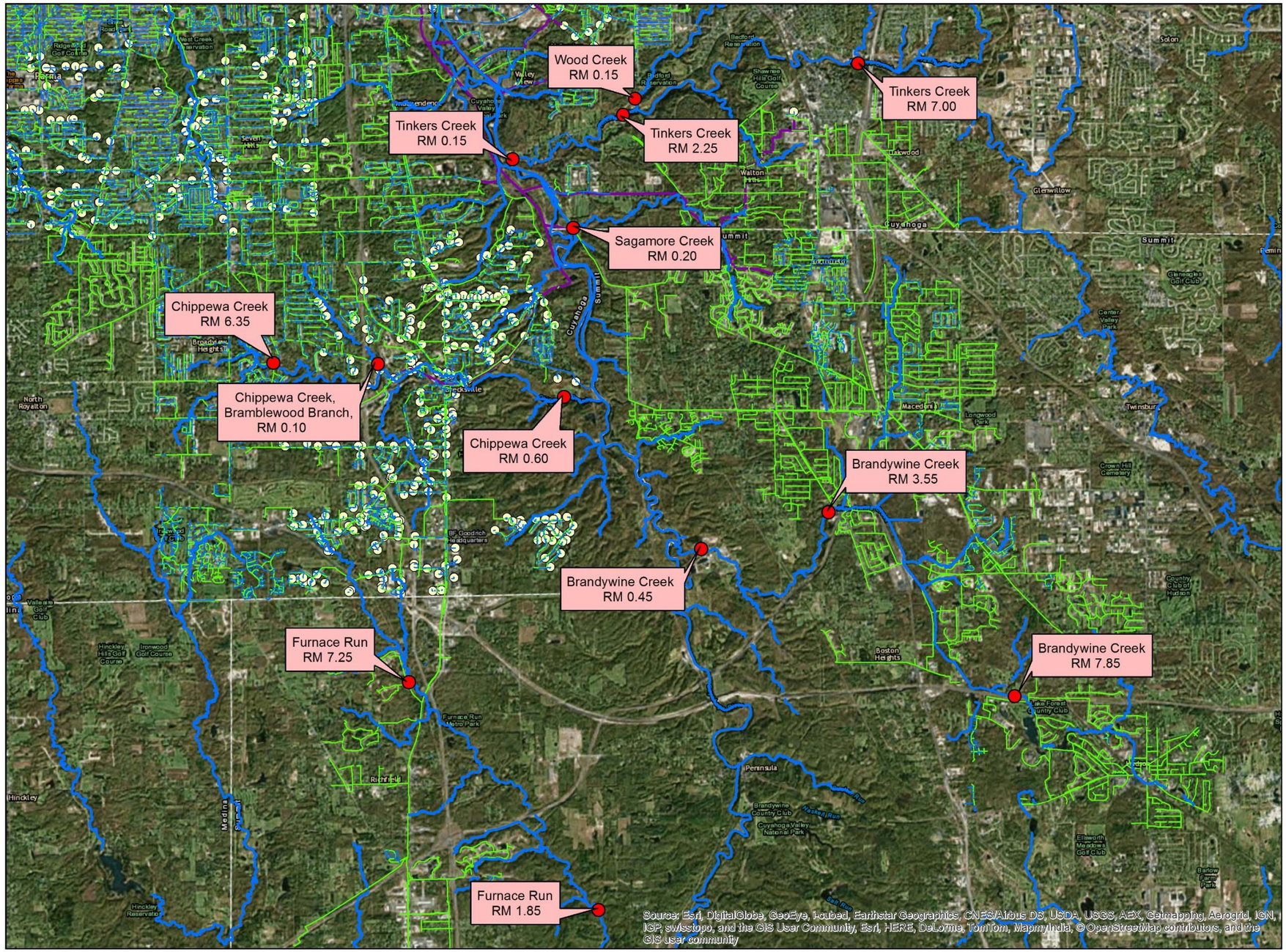
A map has been provided in Section 6 to show point sources that may be influencing the water quality at each sample location. These sources, along with the ones listed in the table above, may be impacting the health of the fish and benthic macroinvertebrate communities in the watersheds of the lower Cuyahoga tributaries.

(6) Sampling Locations

The following electrofishing and macroinvertebrate sample locations, will be surveyed during the 2017 field season. Benthic macroinvertebrate and water chemistry collection sites are located 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.

| Waterbody | Latitude | Longitude | River Mile | Description | HUC | Purpose |
|---|---|---|---|---|---|---|
| Tinkers Creek | 41.38388 | -81.51543 | 7.00 | Upstream of Northfield Road Bridge. Metroparks Bedford Chagrin Parkway. | 04110002 - Cuyahoga | General watershed monitoring. |
| Tinkers Creek | 41.37404 | -81.57854 | 2.25 | Upstream of Dunham Road | 04110002 - Cuyahoga | General watershed monitoring. Support Cuyahoga AOC. |
| Tinkers Creek | 41.3654 | -81.6083 | 0.15 | Upstream of Canal Road | 04110002 - Cuyahoga | General watershed monitoring. Support Cuyahoga AOC. |
| Wood Creek, Tinkers Creek Tributary | 41.37726 | -81.57523 | 0.15 | Upstream of Button Road | 04110002 - Cuyahoga | General watershed monitoring. Support Cuyahoga AOC. |
| Sagamore Creek | 41.3514 | -81.5923 | 0.20 | Upstream of Canal Road | 04110002 - Cuyahoga | General watershed monitoring. |
| Chippewa Creek | 41.3248 | -81.6729 | 6.35 | Upstream of Avery Road Bridge | 04110002 - Cuyahoga | General watershed monitoring. |
| Chippewa Creek | 41.3173 | -81.5952 | 0.60 | Downstream of ford over creek on Chippewa Creek Drive. Metroparks Brecksville Reservation | 04110002 - Cuyahoga | General watershed monitoring. Support Cuyahoga AOC. |
| Chippewa Creek, Bramblewood Branch | 41.3244 | -81.6448 | 0.10 | Bramblewood Branch, upstream of confluence with the main branch. East of Harris Road and Eagle Valley Court | 04110002 - Cuyahoga | General watershed monitoring. |
| Brandywine Creek | 41.25603 | -81.47547 | 7.85 | Downstream of former Hudson WWTP | 04110002 - Cuyahoga | General watershed monitoring. Determine improvements following decommissioning of WWTP. |

| Waterbody | Latitude | Longitude | River Mile | Description | HUC | Purpose |
|---|---|---|---|---|---|---|
| Brandywine Creek | 41.2936 | -81.52473 | 3.55 | Upstream of East Highland Road | 04110002 - Cuyahoga | General watershed monitoring. |
| Brandywine Creek | 41.28647 | -81.55887 | 0.45 | Brandywine Ski Resort | 04110002 - Cuyahoga | General watershed monitoring. Support Cuyahoga AOC. |
| Furnace Run | 41.2602 | -81.63739 | 7.25 | Upstream of Brecksville Road | 04110002 - Cuyahoga | General watershed monitoring. |
| Furnace Run | 41.21384 | -81.58733 | 1.85 | Upstream of Wheatley Road | 04110002 - Cuyahoga | General watershed monitoring. |

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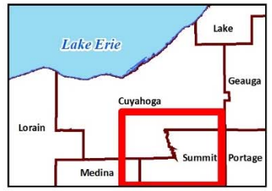



Overview Map

**Legend**

- Sample Sites
- CSO Outfall
- Regional Drainage
- Local Sanitary Sewer
- Local Storm Sewer
- NEORSD CSO Combined Sewer
- NEORSD CSO Responsibility Sewer
- NEORSD Intercommunity Relief Sewer
- NEORSD Interceptor
- Outfalls

N

1
Miles

(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 A) 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. Third Rock Consultants, LLC will identify and enumerate the specimens collected from each site[1]. 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 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. The Lacustuary QHEI (L-QHEI) will be performed at sites that are affected by the water level of Lake Erie. Examples of the Ohio EPA field sheets for the QHEI and the L-QHEI can be found in Appendix A.

Water chemistry samples will be collected at each electrofishing/ 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 A).

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, nitrite, nitrate+nitrite, ammonia, alkalinity, turbidity and

[1] It is anticipated that Third Rock Consultants, LLC will be contracted to complete all macroinvertebrate identification. However, awarding of the contract is dependent upon approval, which, to date, has not occurred. An amended study plan will be submitted if someone else is awarded the contract.

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

suspended solids. In the Cuyahoga River, YSI 6600EDS, or EXO2 data sondes may be installed at RMs 16.20, 10.75, 10.10, and 7.00 around the time that this sampling is conducted to more frequently monitor dissolved oxygen, temperature, conductivity, specific conductivity and pH.

(4) Field Collection and Data Assessment Techniques

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

Fish will be identified to the species level, weighed, 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. Fish species difficult to identify will be brought back to the laboratory for verification by NEORSD Level 3 Fish Qualified Data Collectors (QDC). 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 formalin for approximately 10 to 14 days before being transferred to water and solutions of 30, 50 and 70 percent ethanol. Label information will include location (description and coordinates), date, time, collectors' names and sample identification code for each specimen collected.

Macroinvertebrate sampling will be conducted using 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 may be installed at one or all sampling

locations in case samplers are lost due to vandalism, burial, etc. or 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 each HD retrieval. NEORSD Level 3 QDCs for Benthic Macroinvertebrate Biology Identification may identify specimens in replicate samples to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b).

Macroinvertebrate voucher specimens for both quantitative and qualitative sampling will be collected as described in section (14). Macroinvertebrate community assemblages collected will be shipped to Third Rock Consultants, LLC (Lexington, KY) for identification and enumeration. Third Rock Consultants, LLC 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 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). Methods for assessing fish and macroinvertebrate communities in lacustuary zones can be found in Ohio EPA's draft *Biological Criteria for the Protection of Aquatic Life, Volume IV* (1997).

The QHEI, as described in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006) will be used to assess aquatic habitat conditions at each sample location. The L-QHEI will be used where appropriate and will follow Ohio EPA's *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)* (2010).

Water chemistry sampling may occur across a variety of flow conditions. Techniques used for water chemistry sampling and chemical analyses will follow the *Surface Water Field Sampling Manual* (Ohio EPA, 2015a). Chemical water quality samples from each site will be collected with at least one 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles. Water samples collected for analysis of dissolved reactive phosphorus will be filtered using a 0.45-µm PVDF syringe filter and will be collected in a 125-mL plastic bottle. Bacteriological samples will be collected in a sterile plastic bottle preserved with sodium thiosulfate. All water quality samples will be collected as grab samples. Field blanks and duplicate samples will each comprise not less than 5% of the total samples collected for this study plan, for a

total frequency of quality control samples of not less than 10% of the total samples collected. With the exception of bacteriological duplicate samples, the acceptable percent RPD will be based on the ratio of the sample concentration and detection limit (Ohio EPA, 2015a): Acceptable % RPD = $[(0.9465X^{-0.344})*100] + 5$, where X = sample/detection limit ratio. For bacteriological duplicates, duplicate samples more than 5x apart from one another (%RPD > 133.3%) will be rejected in accordance with the Ohio EPA approved method for data validation of bacteriological samples outlined in Section F of the *Ohio 2012 Integrated Water Quality Monitoring and Assessment Report* (Ohio EPA, 2012). Those RPDs that were higher than acceptable may indicate potential problems with sample collection and, as a result, the data will not be used for comparison to the water quality standards. 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, YSI EXO1 sonde, 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 HQ30d meter with LDO101 probe to measure DO. Field turbidity will be measured using either a Hach 2100P Portable Turbidimeter or Hach 2100Q Turbidimeter. Specifications for these meters have been included in Appendix C.

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). A Chlorophyll *a* Sampling Field Sheet will be completed for each site (Appendix D). 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. Additionally in the Cuyahoga River, approximately 24-hours prior to each chlorophyll *a* sampling event, YSI 6600 EDS, or EXO2 data sondes may be deployed at RMs 16.20, 10.75, 10.10 and 7.00. If installed, each data sonde will record, at fifteen-minute intervals, dissolved oxygen concentration, pH, temperature, and conductivity from the time the data sonde is deployed until the time it is retrieved. These data sondes will be placed in the stream by inserting each one into a 4.5-inch PVC pipe with holes drilled into the sides of the lower third of the pipe to allow water to pass through it. The data sondes will remain in the river for approximately 24-hours or longer following collection of the chlorophyll *a* samples.

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, L-QHEI, IBI, LIBI, MIwb, ICI, and LICI 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 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, a HACH FH950 Flow Meter or an Aquaflow Probe Model 6900, which measure flow in feet per second, when HD samplers are installed and retrieved. The specifications for the flow meters can be found in Appendix C.

(7) Schedule

One to three electrofishing surveys will be conducted at each site between June 15 and October 15, 2017. 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 between June 15 and August 19, 2017, 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, and, if necessary, L-QHEI habitat evaluations will be conducted one time between June 15 and October 15, 2017. QHEI 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, 2017.

Benthic and water column chlorophyll *a* samples may be collected at least one time from stream locations between June 15 and October 15, 2017. 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), *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006), draft *Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indicies for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustuaries* (1997) and *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)* (2010)

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 & Maintenance Services Center, or by contacting the supplier or an appropriate service company.

Fish species difficult to identify will be brought back to the laboratory for verification by Level 3 Fish 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 (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.

All macroinvertebrate community assemblages from stream locations, except for any replicate samples, will be collected and shipped to Third Rock Consultants, LLC 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 (14). 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 & Maintenance Services Center for a period not less than ten years.

Water samples obtained for chemical analyses will be collected, preserved (see Section 4), labeled and then placed on ice inside the field truck. The field truck

will remain locked at all times when not occupied/visible. Sampling activities, including sample time and condition of surface water sampled, will be entered in a field log book and on the Surface Water Condition Sampling Field Data Form. The samples will then be delivered immediately to the NEORSD Analytical Services cooler, after which the door to the cooler will be locked, and the samples will be transferred to the custody of Analytical Services. The NEORSD Analytical Services Quality Manual and associated Standard Operating Procedures are on file with Ohio EPA. The Quality Assurance Officer at Analytical Services will send updates, revisions and any information on document control to Ohio EPA as needed.

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.

Calibration of YSI 6600EDS and EXO2 data sondes will be done according to the YSI Environmental Operations Manual. The conductivity will be calibrated first using a 1.413 mS/cm standard. Second, the pH will be calibrated using two different buffers (7 and 10 s.u.). The DO will be calibrated last with an acceptable error of 0.2 mg/L.

Once the sondes are removed from the river, the accuracy of the data that has been collected will be checked by comparing readings taken by the sondes to known standards. If the measurements taken at this time meet quality control goals, all of the data collected since the last calibration will be considered accurate. The acceptable differences for pH and conductivity will be $\pm$0.3 with pH 7 buffer and $\pm$ 10% of the conductivity standard, respectively (EPA New England- Region 1, 2005). The acceptable difference for DO will be $\pm$0.2 mg/L. If the measurements do not meet quality control goals, best professional judgment will be used to decide if any of the data collected during that period may still be accurate. For example, the data collected from the four locations may be plotted on the same graph, and if it appears that the data points are following similar trends, they may be considered accurate. If any data that do not meet quality control goals are used, a rationale for their inclusion will be provided when the data are submitted.

(9) Work Products

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

graphically presenting and discussing the IBI (LIBI, where applicable), MIwb, ICI (LICI, where applicable) and QHEI (L-QHEI, where applicable) 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) |
|---|---|---|---|---|
| Seth Hothem[1] | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | hothems@neorsd.org | 216-641-6000 | QDC - 00010 CWQA/FCB/SHA/ BMB |
| Kelsey Amidon | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | amidonk@neorsd.org | 216-641-6000 | QDC – 01091 CWQA |
| Nya Aron | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | aronn@neorsd.org | 216-641-6000 | QDC – 01139 BMB |
| Donna Friedman | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | friedmand@neorsd.org | 216-641-6000 | QDC – 01031 CWQA/SHA |
| Jillian Knittle | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | knittlej@neorsd.org | 216-641-6000 | QDC – 00512 CWQA/SHA/BMB |
| Ron Maichle | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | maichler@neorsd.org | 216-641-6000 | QDC - 00145 CWQA/SHA/BMB |
| Mark Matteson | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | mattesonm@neorsd.org | 216-641-6000 | QDC – 01031 CWQA/FCB/SHA |
| John Rhoades | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | rhoadesj@neorsd.org | 216-641-6000 | QDC - 00008 CWQA/FCB/SHA/ BMB |
| Francisco Rivera | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | riveraf@neorsd.org | 216-641-6000 | QDC - 00262 CWQA/SHA |
| Eric Soehnlen | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | soehnlene@neorsd.org | 216-641-6000 | QDC – 01030 CWQA/SHA/BMB |
| Cathy Zamborsky | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | zamborskyc@neorsd.org | 216-641-6000 | QDC - 00009 CWQA/SHA |
| Jonathan Brauer[2] | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | brauerj@neorsd.org | 216-641-6000 | QDC – 00663 SHA |
| Bert Remley[3] | 2526 Regency Road, Suite 180 Lexington, Kentucky 40503 | bremley@thirdrockconsultants.com | 859-977-2000 | QDC – 00837 BMB |

[1] NEORSD Lead Project Manager
[2] See acknowledgement letter for conducting QHEIs (Appendix F)
[3] Benthic Macroinvertebrate Identification

The following is a list of persons not qualified as Level 3 QDCs who may be involved in the project. Prior to the start of sampling, the project managers will explain to each individual the proper methods for sampling. Sampling will only be completed under the direct observation of a QDC. The lead project manager will be responsible for reviewing all reports and data analysis prepared by qualified personnel prior to completion.

| Name | Address | Email Address | Phone Number |
|---|---|---|---|
| Lindsay Baker | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | bakerl@neorsd.org | 216-641-6000 |
| Nick Barille | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | barillen@neorsd.org | 216-641-6000 |
| Mark Colvin | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | colvinm@neorsd.org | 216-641-6000 |
| Rae Grant | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | grantr@neorsd.org | 216-641-6000 |
| Mario Meany | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | meanym@neorsd.org | 216-641-6000 |
| Carrie Millward | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | millwardc@neorsd.org | 216-641-6000 |
| 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 |
| Joseph Schiel | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | schielj@neorsd.org | 216-641-6000 |
| Frank Schuschu | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | schuschuf@neorsd.org | 216-641-6000 |
| William Stanford | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | standfordw@neorsd.org | 216-641-6000 |
| Nicole Velez | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | velezn@neorsd.org | 216-641-6000 |
| Wolfram von Kiparski | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | vonkiparskiw@neorsd.org | 216-641-6000 |
| Hannah Boesinger | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | boesingerh@neors.org | 216-641-6000 |
| James Ferritto | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | ferrittoj@neorsd.org | 216-641-6000 |
| Sarah Foley | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | foleys@neorsd.org | 216-641-6000 |
| Justin Telep | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | telepj@neorsd.org | 216-641-6000 |

(11) Contract laboratory contact information

All bacteriological and/or chemical sample analysis will be completed by NEORSD's Analytical Services Division. Evidence of NEORSD's Analytical Services current accreditation and method dates can be found in Appendix E. The contact information for NEORSD's Analytical Service Division is:

NEORSD Analytical Services
Mr. Mark Citriglia
4747 E. 49th Street
Cuyahoga Heights, Ohio 44056
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.

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 Third Rock Consultants LLC (Lexington, Kentucky)[3]. Benthic macroinvertebrates will be identified to the lowest practical level as recommended by Ohio EPA (1987b). Third Rock Consultants LLC contact information:

Mr. Bert Remley
Third Rock Consultants LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503
bremley@thirdrockconsultants.com
859-977-2000

(12) Copy of ODNR collector's permit

See Appendix G.

(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: Seth Hothem / _____ Date: 4/19/17

[3] A letter of acknowledgement of the macroinvertebrate identification responsibilities will be added as an addendum to this study plan, in Appendix F, upon finalization of the macroinvertebrate identification contract.

(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 laboratory in the Environmental and Maintenance Services Center.

Print/Signature: Seth Hothem/ _____ Date: 4/19/17

(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: Seth Hothem/ _____ Date: 4/19/17

(16) Additional L3 Data Collector Statement

The Lead Project Manager for all stream locations is approved for all project data types.

Print/Signature: Seth Hothem/ _____ Date: 4/19/17

(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: Seth Hothem/ Seth Hothem Date: 4/19/17

Print/Signature: Kelsey Amidon/ Kelsey Amidon Date: 4/19/17

Print/Signature: Nya Aron/ Nya L Aron Date: 4/19/17

Print/Signature: Donna Friedman/ Donna Friedman Date: 4/19/17

Print/Signature: Jillian Knittle/ Jillian Knittle Date: 4/19/17

Print/Signature: Ron Maichle/ Ron Maichle Date: 04-19-17

Print/Signature: Mark Matteson/ Mark Matteson Date: 4/19/17

Print/Signature: John Rhoades/ John Rhoades Date: 04/19/17

Print/Signature: Francisco Rivera/ Francisco Rivera Date: 4/19/17

Print/Signature: Eric Soehnlen/ Eric Soehnlen Date: 04/19/17

Print/Signature: Cathy Zamborsky/ Cathy Zamborsky Date: 4/19/17

# Appendix A

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**
**D**eformities, **E**rosions, **L**esions, **T**umors
**M**ultiple 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 | | | | | | | | | | | | | | |

**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 (QDC Circled): _____

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

Reinstall Date: _____ Crew (QDC Circled): _____

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

Reinstall Date: _____ Crew (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 (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

**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 over HD:* | Open | 75 % | 50 % | 25 % | Closed | | |

**Comment Section:** _____

**OEPA Comment Field Codes:** _____

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

## 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 | Tree Roots |
| Grass | Water Willow | Woody Debris |
| Shallows | Clay/Hardpan | Macrophytes |
| 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 |
| / / | Heptageniidae, Leptohyphidae, Caenidae |
| | Other _____ |
| / | Zygoptera, Anisoptera |
| | Plecoptera |
| | Hemiptera |
| / | Megaloptera, Neuroptera |
| | Trichoptera |
| | Hydropsychidae |
| / | Hydroptilidae, Leptoceridae |
| | Other _____ |
| | Coleoptera |
| | Elimidae |
| | Other _____ |
| | Diptera |
| | Chironomidae |
| | Other _____ |
| / | Gastropoda, Bivalvia |
| | Other _____ |

*Field Narrative Rating:* E VG G MG F P VP

# Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

OhioEPA

*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

Check ONE (*Or 2 & average*)

| 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]

| ORIGIN | | QUALITY | |
|---|---|---|---|
| ☐ LIMESTONE [1] | SILT | ☐ HEAVY [-2] | |
| ☐ TILLS [1] | | ☐ MODERATE [-1] | |
| ☐ WETLANDS [0] | | ☐ NORMAL [0] | |
| ☐ HARDPAN [0] | | ☐ FREE [1] | |
| ☐ SANDSTONE [0] | EMBEDDEDNESS | ☐ EXTENSIVE [-2] | |
| ☐ RIP/RAP [0] | | ☐ MODERATE [-1] | |
| ☐ LACUSTURINE [0] | | ☐ NORMAL [0] | |
| ☐ SHALE [-1] | | ☐ NONE [1] | |
| ☐ COAL FINES [-2] | | | |

*Substrate* ____ *Maximum 20*

*Comments*

## 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] | ____ POOLS > 70cm [2] | ____ OXBOWS, BACKWATERS [1] |
| ____ OVERHANGING VEGETATION [1] | ____ ROOTWADS [1] | ____ AQUATIC MACROPHYTES [1] |
| ____ SHALLOWS (IN SLOW WATER) [1] | ____ BOULDERS [1] | ____ LOGS OR WOODY DEBRIS [1] |
| ____ ROOTMATS [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 | DEVELOPMENT | CHANNELIZATION | STABILITY |
|---|---|---|---|
| ☐ HIGH [4] | ☐ EXCELLENT [7] | ☐ NONE [6] | ☐ HIGH [3] |
| ☐ MODERATE [3] | ☐ GOOD [5] | ☐ RECOVERED [4] | ☐ MODERATE [2] |
| ☐ LOW [2] | ☐ FAIR [3] | ☐ RECOVERING [3] | ☐ LOW [1] |
| ☐ NONE [1] | ☐ POOR [1] | ☐ RECENT OR NO RECOVERY [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

| L R EROSION | L R RIPARIAN WIDTH | L R FLOOD PLAIN QUALITY | L R |
|---|---|---|---|
| ☐ ☐ NONE / LITTLE [3] | ☐ ☐ WIDE > 50m [4] | ☐ ☐ FOREST, SWAMP [3] | ☐ ☐ CONSERVATION TILLAGE [1] |
| ☐ ☐ MODERATE [2] | ☐ ☐ MODERATE 10-50m [3] | ☐ ☐ SHRUB OR OLD FIELD [2] | ☐ ☐ URBAN OR INDUSTRIAL [0] |
| ☐ ☐ HEAVY / SEVERE [1] | ☐ ☐ NARROW 5-10m [2] | ☐ ☐ RESIDENTIAL, PARK, NEW FIELD [1] | ☐ ☐ MINING / CONSTRUCTION [0] |
| | ☐ ☐ VERY NARROW < 5m [1] | ☐ ☐ FENCED PASTURE [1] | |
| | ☐ ☐ NONE [0] | ☐ ☐ OPEN PASTURE, ROWCROP [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 | RUN DEPTH | RIFFLE / RUN SUBSTRATE | RIFFLE / RUN EMBEDDEDNESS |
|---|---|---|---|
| ☐ BEST AREAS > 10cm [2] | ☐ MAXIMUM > 50cm [2] | ☐ STABLE (e.g., Cobble, Boulder) [2] | ☐ NONE [2] |
| ☐ BEST AREAS 5-10cm [1] | ☐ MAXIMUM < 50cm [1] | ☐ MOD. STABLE (e.g., Large Gravel) [1] | ☐ LOW [1] |
| ☐ BEST AREAS < 5cm [metric=0] | | ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0] | ☐ MODERATE [0] |
| | | | ☐ EXTENSIVE [-1] |

*Comments*

*Riffle / Run Maximum 8* ____

## 6] *GRADIENT* ( ft/mi) **DRAINAGE AREA** ( $mi^2$)

☐ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

**%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:*

# Lake / Lacustuary (Lentic) QHEI Field Sheet

Ohio Environmental Protection Agency

QHEI Score: ☐

RIVERCODE_____ RIVERMILE _____ WATERBODY _____ DISTANCE ASSESSED (m): _____
DATE _____ LOCATION _____
SCORER_____ LAT. _____ LONG. _____ COMMENT _____

**1] SUBSTRATE** (Check *ONLY* Two Substrate TYPE BOXES; Estimate % or note every type present); LAKE:_____ LACUSTUARY:_____

| TYPE | SHORE | BOTTOM | | SHORE | BOTTOM |
|---|---|---|---|---|---|
| ☐☐-BLDR/SLABS [7] | | | ☐☐-HARDPAN [4] | | |
| ☐☐- BOULDER [10] | | | ☐☐- BEDROCK [3] | | |
| ☐☐- COBBLE [8] | | | ☐☐- DETRITUS [3] | | |
| ☐☐- GRAVEL [7] | | | ☐☐- SILT [2] | | |
| ☐☐- SAND [6] | | | ☐☐- MUCK [2] | | |

**SUBSTRATE ORIGIN** Check ONE (or 2 & *AVERAGE*)
☐-LIMESTONE [1]
☐-TILLS [1]
☐-WETLANDS [1]
☐-LACUSTUARINE [1]
☐-SANDSTONE [1]
☐-RIP/RAP [1]
☐-HARDPAN [0]
☐-SHALE [-1]
☐-COAL/ORE [-2]

**SILT ORIGIN:**

**SUBSTRATE QUALITY** Check ONE (or 2 & *AVERAGE*)
☐-SILT HEAVY [-2]
☐-SILT MODERATE [-1]
☐-SILT NORMAL [0]
☐-SILT FREE [1]
☐-CLAY [-2]
☐-INDUSTRIAL [-1]
☐-ORGANIC [1]
☐-NONE [1]

Substrate ☐ Max 20

NOTE: Ignore sludge that originates from point-sources, score on natural substrates
NUMBER OF SUBSTRATE TYPES ☐- 5 or More [2] ☐- 4 or Less [0]

COMMENTS: _____

**2] COVER TYPES** **TYPE:** (Check *All* That Apply) **AMOUNT**: (Check *ONLY* One or check2 and AVERAGE)

| | | |
|---|---|---|
| ☐-OFF-SHORE SAND BARS [4] | ☐-DEEPWATER > 1 M [1] | ☐-WETLAND POOLS [1] |
| ☐-OVERHANGING VEGETATION [1] | ☐-ROOTWADS [1] | ☐-SUBMERGED AQUATIC VEG. [4] |
| ☐-SHALLOWS (ON BEACH) [1] | ☐-BOULDERS [1] | ☐-LOGS OR WOODY DEBRIS [1] |
| ☐-ROOTMATS [1] | ☐-SAND BEACH [1] | ☐-GRAVEL BEACH [1] |

☐-EXTENSIVE > 75% [9]
☐-MODERATE 25-75% [7]
☐-SPARSE 5-25% [3]
☐-NEARLY ABSENT < 5% [1]

Cover ☐ Max 20

COMMENTS: _____

**3] SHORELINE MORPHOLOGY** (Check *ONLY* one PER category or check 2 and *AVERAGE*)

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

**DEVELOPMENT**
☐-EXCELLENT [6]
☐-GOOD [5]
☐-FAIR [3]
☐-POOR [1]

**MODIFICATION**
☐-NONE [7]
☐-RECOVERED [5]
☐-RECOVERING [3]
☐-RECENT OR NO RECOVERY [1]

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

**SHORE to BOTTOM SLOPE MORPHOLOGIES**
☐-SLOPE < 15 deg. [0] ☐- SLOPE > 45 deg. [2]
☐-SLOPE < 25 deg. [1] ☐-SLOPE 90 deg. [0]
☐-SLOPE > 25 deg. [3]

**AVERAGE DEPTH** (of 5 measures)
☐- < 50 cm [0] ☐- > 400 – 500 cm [4]
☐- 50 - <100 cm [1] ☐- > 500 - 900 cm [2]
☐- ≥100 - 200 cm [2] ☐- >900 cm [1]
☐- >200-4 00 cm [3]

**MODIFICATIONS OF SAMPLED SHORELINE**
☐- CEMENTED [-1] ☐- STEEL BULKHEADS [-2]
☐-RIP RAPPED [1] ☐-ISLANDS [1]
☐-RAILROAD TIES [-1] ☐-DIKES [-1]
☐-DREDGED [-1] ☐-BANK SHAPING [-1]
☐-TWO SIDE CHANNEL MODIFICATIONS [-1] ☐-WOOD PILINGS [1]
☐-SHIP CHANNEL [-2]

Shore Line ☐ Max 20

COMMENTS: _____

★ Shore Right Looking East or South on Lake ★
★ Shore Right Looking Toward Lake in Lacustuary ★

**4] RIPARIAN ZONE AND BANK EROSION** (Check *ONE* box PER bank or 2 and *AVERAGE*)

**RIPARIAN WIDTH** L R (Per Bank)
☐☐-WIDE > 50 m [4]
☐☐-MODERATE 10-50 m [3]
☐☐-NARROW 5-10 m [2]
☐☐-VERY NARROW < 5 m [1]
☐☐-NONE [0]

**SHORE LINE QUALITY (PAST 100 FOOT RIPARIAN)** L R (Most Predominant Per Bank)
☐☐-FOREST, WETLAND, LAKE [3]
☐☐- SHRUB OR OLD FIELD [2]
☐☐-VINEYARD, ORCHARD [2]
☐☐-FENCED PASTURE [1]
☐☐-RESIDENTIAL, PARK, NEW FIELD [1]

L R
☐☐-CONSERVATION TILLIAGE [1]
☐☐-URBAN OR INDUSTRIAL [0]
☐☐-OPEN PASUTRE, ROWCROP [0]
☐☐-MINING/CONSTRUCTION [0]
☐☐- DIKED WETLAND [0]

**BANK EROSION** L R (Per Bank)
☐☐-NONE/LITTLE [3]
☐☐-MODERATE [-1]
☐☐-HEAVY/SEVERE [-3]

Riparian ☐ Max 10

COMMENTS: _____

**5] AQUATIC VEGETATION QUALITY:** PLANT SPECIES OBSERVED (Sum All Scores)
(Score all for observed abundance: ABUNDANT = [3]; COMMON = [5]; FEW = [1]; UNCOMMON = [0]) _____NO AQUATIC VEGETATION = 0

____-Pond Lilies (NYMPHAEA) ____-Sedge (CYPERACEAE) ____-Wild Celery (VALLISNERIA)
____-Pond Weed (POTAMOGETON) ____-Bulrush (SCIRPUS) ____-Waterweed (ELODEA) ____-Wild Rice (ZIZANIA)

(Score all for observed abundance: ABUNDANT = [-2]; COMMON = [-1]; FEW = [0])

____-Purple Loosestrife ____-Reed Grass ____-Eurasian Milfoil ____-Cattails ____-Algae (mats) ____-Algae (planktonic)

Vegetation ☐ Max 30

COMMENTS: _____

Is the Sampling Reach Representative of Area Habitat? (Y/N)____ If Not, Explain: _____

Depth measures: | | | | | | |

Zebra Mussel/Quagga Mussel Coverage ☐ - >60% ☐ - 60 - >25% ☐ - 25 - >10% ☐ - <10 - >1% ☐ - 1 – 0%

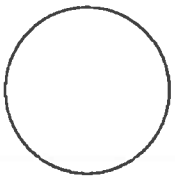
| | Gear | Distance | Water Clarity | Wave Height |
|---|---|---|---|---|
| First Sampling Pass: | _____ | _____ | _____ | _____ |
| Second Sampling Pass: | _____ | _____ | _____ | _____ |
| Third Sampling Pass: | _____ | _____ | _____ | _____ |

Subjective Rating (1 – 10) ☐ Aesthetic Rating (1 – 10) ☐

Photos: _____

WATERBODY MEASUREMENTS: AVERAGE WIDTH: _____ AVERAGE DEPTH: _____ Maximum Depth: _____

**DRAWING OF SITE:**

**North Arrow:** 

# 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 Other: _____

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): _____ Sp. Cond. (µmhos/cm): _____

Dissolved Oxygen (mg/L): _____ D.O. (%): _____

Temperature (°C): _____ pH (s.u.): _____

Turbidity 1 (NTU): _____ Turbidity 2 (NTU): _____ Average (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 Other: _____

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): _____ Sp. Cond. (µmhos/cm): _____

Dissolved Oxygen (mg/L): _____ D.O. (%): _____

Temperature (°C): _____ pH (s.u.): _____

Turbidity 1 (NTU): _____ Turbidity 2 (NTU): _____ Average (NTU): _____

Sample ID:

General Comments: _____

# Appendix B

| Parameter | Additional Name | Test | Unit | 2017 Minimum Detection Limit | 2017 Practical Quantitation Limit |
|---|---|---|---|---|---|
| Alkalinity | Alkalinity | EPA 310.2 | mg/L | 4.36 | 10.0 |
| Mercury | Hg | EPA 245.1 | µg/L | 0.025 | 0.050 |
| Ammonia [1] | $NH_3$ | EPA 350.1 | mg/L | 0.010 | 0.020 |
| Nitrite | NO2 | SM 4500 $NO_2^-$ B [2] | mg/L | 0.005 | 0.020 |
| Nitrite + Nitrate | $NO_2 + NO_3$ | EPA 353.2 | mg/L | 0.010 | 0.020 |
| Total Kjeldahl Nitrogen | TKN | EPA 351.2 | mg/L | 0.237 | 0.500 |
| Dissolved Reactive Phosphorus | DRP | EPA 365.1 | mg/L | 0.0034 | 10.0000 |
| Low Level Dissolved Reactive Phosphorus | LLDRP | EPA 365.1 | µg/L | 0.42[a] | 1.00[a] |
| Total Phosphorus | Total-P | EPA 365.1 | mg/L | 0.002 | 0.010 |
| Chloride | Chloride by IC | EPA 300.0 | mg/L | 2.500 | 5.000 |
| Sulfate | Sulfate by IC | EPA 300.0 | mg/L | 2.500 | 5.000 |
| Silver | Ag | EPA 200.8 | µg/L | 0.127 | 0.500 |
| Aluminum | Al | EPA 200.8 | µg/L | 2.500 | 5.000 |
| Arsenic | As | EPA 200.8 | µg/L | 0.582 | 2.000 |
| Barium | Ba | EPA 200.8 | µg/L | 0.134 | 0.500 |
| Beryllium | Be | EPA 200.8 | µg/L | 0.094 | 0.500 |
| Calcium | Ca | EPA 200.8 | µg/L | 28.216 | 125.000 |
| Cadmium | Cd | EPA 200.8 | µg/L | 0.053 | 0.500 |
| Cobalt | Co | EPA 200.8 | µg/L | 0.036 | 0.500 |
| Chromium | Cr | EPA 200.8 | µg/L | 0.477 | 1.000 |
| Copper | Cu | EPA 200.8 | µg/L | 0.110 | 1.000 |
| Iron | Fe | EPA 200.8 | µg/L | 2.104 | 5.000 |
| Potassium | K | EPA 200.8 | µg/L | 53.799 | 250.000 |
| Magnesium | Mg | EPA 200.8 | µg/L | 12.053 | 125.000 |
| Manganese | Mn | EPA 200.8 | µg/L | 0.127 | 1.000 |
| Molybdenum | Mo | EPA 200.8 | µg/L | 0.119 | 0.500 |
| Sodium | Na | EPA 200.8 | µg/L | 21.836 | 250.000 |
| Nickel | Ni | EPA 200.8 | µg/L | 0.104 | 2.000 |
| Lead | Pb | EPA 200.8 | µg/L | 0.084 | 0.500 |
| Antimony | Sb | EPA 200.8 | µg/L | 0.397 | 1.000 |
| Selenium | Se | EPA 200.8 | µg/L | 0.622 | 2.500 |
| Tin | Sn | EPA 200.8 | µg/L | 0.668 | 5.000 |
| Strontium | Sr | EPA 200.8 | µg/L | 0.066 | 0.500 |
| Titanium | Ti | EPA 200.8 | µg/L | 0.237 | 1.000 |
| Thallium | Tl | EPA 200.8 | µg/L | 0.098 | 0.500 |
| Vanadium | V | EPA 200.8 | µg/L | 2.069 | 5.000 |
| Zinc | Zn | EPA 200.8 | µg/L | 0.313 | 5.000 |
| Total Metals | Total Metals (calc.) | EPA 200.8 | µg/L | µg/L =(Cr µg/L)+(Cu µg/L)+(Ni µg/L)+(Zn µg/L) | |
| Hardness | Hardness (calc.) | SM 2340 [2] | mg/L | CaCO3 mg/L =(2.497*Ca mg/L)+(4.118*Mg mg/L) | |
| *Escherichia coli* | *E. coli* | EPA 1603 | cfu/100mL | 1 colony | -- |
| | | Colilert QT (SM 9223 B 20th Ed) | MPN/100mL | 1 MPN | 1 MPN |
| Chlorophyll *a* | Chlorophyll *a* | EPA 445.0 | µg/L | 0.02 | 0.1 |
| Chemical Oxygen Demand | COD | EPA 410.4 | mg/L | 4.6 | 10 |
| Biological Oxygen Demand | BOD | SM 5210 [2] | mg/L | 2 | N/A |
| Total Solids | TS | SM 2540 B [2] | mg/L | 1 | 5 |
| Total Suspended Solids | TSS | SM 2540 D [2] | mg/L | 0.5 | 1 |
| Total Dissolved Solids | TDS | SM 2540 C [2] | mg/L | 1 | 5 |
| Turbidity ** | | EPA 180.1 | NTU | 0.1 | 0.2 |
| **Field Parameter** | | **Test** | **(Value Reported in)** | | |
| pH | | EPA 150.1 [2] | s.u. | | |
| Conductivity | | SM 2510A [2] | µs/cm | | |
| Specific Conductivity | | SM 2510B [2] | µs/cm | | |
| Dissolved Oxygen | DO | SM 4500-0 G [2] | mg/L | | |
| Temperature | Temp | EPA 1701.1 [2] | °C | | |
| Turbidity ** | | EPA 180.1 | NTU | | |

[1] Listed MDL/PQL is for undistilled samples. Any samples that require distillation will have a MDL = 0.051 mg/L, PQL = 0.100 mg/L

[2] Standard Methods for the Examination of Water and Wastewater, Method approved by Standard Methods Committee, 1997. Editorial revisions, 2011.

[a] 2017 MDL and PQL not yet determined as of 04/27/2017. Values listed are 2016 MDL/PQL.

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

# Appendix C

Y S I Environmental

# YSI 556 Multiparameter System

## *Versatile, multiparameter handheld instrument*

Rugged and reliable, the YSI 556 MPS (Multiprobe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multiparameter system.

- Simultaneously measures dissolved oxygen, pH, conductivity, temperature, and ORP
- Field-replaceable electrodes
- Compatible with EcoWatch® for Windows® data analysis software
- Stores over 49,000 data sets, time and date stamped, interval or manual logging
- Three-year warranty on the instrument; one-year on the probes
- GLP assisting, records calibration data in memory
- Available with 4, 10, and 20-m cable lengths
- IP-67, impact-resistant, waterproof case
- Easy-to-use, screw-on cap DO membranes
- RS-232 interface for PC connection

*The 556 has multiple language capabilities and graphing!*

Pure Data for a Healthy Planet.®

*A rugged, cost-effective multiparameter handheld system designed for the field!*

## *Options to Fit Your Applications!*

- Battery Options – The unit is powered by alkaline batteries or an optional rechargeable battery pack with quick-charge feature.
- Optional Barometer – Internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure. (Choose 556-02)
- Optional Flow Cell - The 5083 flow cell can be used for ground water applications or anytime water is pumped for sampling.
- Carrying Case – The instrument comes standard with YSI 5061, a soft-sided carrying case with enough space for the 556, a 20-meter cable, and calibrating supplies. An optional 5080 hard-sided carrying case is also available.
- Confidence Solution® - Quality assurance ensured. Quickly check conductivity, pH, and ORP readings with one solution.

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ISO 9001
ISO 14001



YSI incorporated
Who's Minding the Planet?™

## 5563 MPS Sensor Specifications

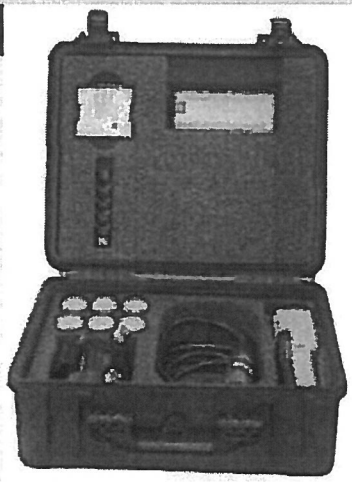
| | | |
|---|---|---|
| Dissolved Oxygen (% saturation) | Sensor Type | Steady state polarographic |
| | Range | 0 to 500% air saturation |
| | Accuracy | 0 to 200% air saturation, ± 2% of the reading or ±2% air saturation, whichever is greater; 200 to 500% air saturation, ± 6% of the reading |
| | Resolution | 0.1% air saturation |
| Dissolved Oxygen (mg/L) | Sensor Type | Steady state polarographic |
| | Range | 0 to 50 mg/L |
| | Accuracy | 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 | 0.01 mg/L |
| Temperature | Sensor Type | YSI Temperature Precision™ thermistor |
| | Range | -5 to 45°C |
| | Accuracy | ± 0.15°C |
| | Resolution | 0.1°C |
| Conductivity | Sensor Type | 4-electrode cell with autoranging |
| | 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 |
| pH (optional) | Sensor Type | Glass combination electrode |
| | Range | 0 to 14 units |
| | Accuracy | ±0.2 units |
| | Resolution | 0.01 units |
| ORP (optional) | Sensor Type | Platinum button |
| | Range | -999 to +999 mV |
| | Accuracy | ± 20 mV |
| | Resolution | 0.1 mV |
| Total Dissolved Solids (TDS) | Sensor Type | Calculated from conductivity (variable constant, default 0.65) |
| | Range | 0 to 100 g/L |
| | Resolution | 4 digits |
| Barometer (optional) | Range | 500 to 800 mm Hg |
| | Accuracy | ± 3 mm Hg within ± 10°C temperature range from calibration point |
| | Resolution | 0.1 mm Hg |

## YSI 556 Instrument Specifications

| | |
|---|---|
| Size | 11.9 cm width x 22.9 cm lenth (4.7 in. x 9 in.) |
| Weight with batteries | 2.1 lbs. (916 grams) |
| Power | 4 alkaline C-cells; optional rechargeable pack |
| Cables | 4-, 10-, and 20-m (13.1, 32.8, 65.6 ft.) lengths |
| Warranty | 3-year instrument; 1-year probes and cables |
| Communication Port | RS-232 Serial |
| Data Logger | 49,000 data sets, date and time stamp, manual or logging, with user-selectable intervals |

## 556 Ordering Information (Order all items separately)

| | |
|---|---|
| 556-01 | Instrument (with 5061 large, soft-sided carrying case) |
| 556-02 | Instrument with barometer option (with 5061 carrying case) |
| 5563-4 | 4-m cable and DO/temp/conductivity |
| 5563-10 | 10-m cable and DO/temp/conductivity |
| 5563-20 | 20-m cable and DO/temp/conductivity |
| 5564 | pH Probe for any 5563 cable |
| 5565 | pH/ORP Probe for any 5563 cable |
| 6118 | Rechargeable battery pack kit (includes battery, adapter, charger) |
| 614 | Ultra clamp, C-clamp mount |
| 616 | Charger, cigarette lighter |
| 4654 | Tripod (small tripod for instrument) |
| 5060 | Small carrying case, soft-sided (fits instrument and 4-m cable) |
| 5065 | Form-fitted carrrier with shoulder strap |
| 5080 | Small carrying case, hard-sided (fits instrument, 4-m cable, flow cell, batteries, membrane kit, calibration bottles) |
| 5083 | Flow cell |
| 5085 | Hands-free harness |
| 5580 | Confidence Solution® (insure probe accuracy with a simple field-check for conductivity, pH, and ORP) |



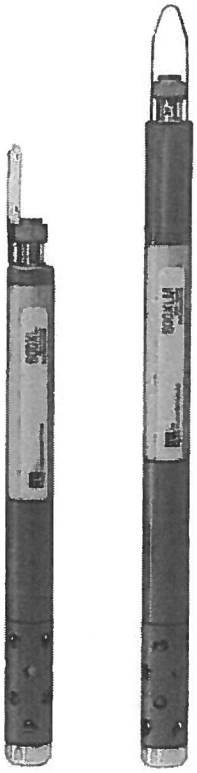
The 5080 carrying case with 556, 5563-4 cable, and 5083 flow cell.

# YSI 600XL and 600XLM Sondes

## *Measure multiple parameters simultaneously*

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

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



*The YSI 600XL and 600XLM*

## *Connect with Data Collection Platforms*

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

## *Economical Logging System*

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

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

Pure Data for a Healthy Planet.®

*Economical, multiparameter sampling or logging in a compact sonde*

## Sensor performance verified*

The 6820 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.

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ISO 9001
ISO 14001
Yellow Springs, Ohio Facility



CE

*Sensors with listed with the ETV logo were submitted to the ETV program on the Xylem 6000XLM. Information on the performance characteristics of YSI water quality sensors can be found at www.ysi.com, ysi.com/etv, or call YSI at 800.897.4151 for the ETV verification report. Use of the ETV name or logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

YSI incorporated
Who's Minding the Planet?

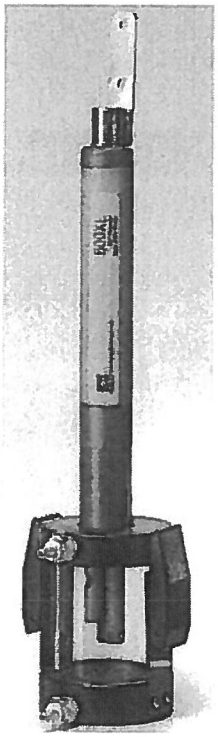
## YSI 600XL & 600XLM Sensor Specifications

| | | Range | Resolution | Accuracy |
|---|---|---|---|---|
| Dissolved Oxygen % Saturation 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 | 0 to 200 ft, 61 m | 0.001 ft, 0.001 m | ±0.4 ft, ±0.12 m |
| | Shallow | 0 to 30 ft, 9.1 m | 0.001 ft, 0.001 m | ±0.06 ft, ±0.02 m |
| | Vented Level | 0 to 30 ft, 9.1 m | 0.001 ft, 0.001 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 | -5 to +50°C |
| | Storage | -10 to +60°C |
| Communications | | RS-232, SDI-12 |
| Software | | EcoWatch® |
| Dimensions 600XL \| 600XLM | Diameter | 1.65 in, 4.19 cm \| 1.65 in, 4.9 cm |
| | Length | 16 in, 40.6 cm \| 21.3 in, 54.1 cm |
| | Weight | 1.3 lbs, 0.59 kg \| 1.5 lbs, 0.69 kg |
| Power | External | 12 V DC |
| | Internal (600XLM only) | 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.) |

# HQ30d Portable pH, Conductivity, Dissolved Oxygen (DO), ORP, and ISE Multi-Parameter Meter

Product #: HQ30D53000000 Quantity
USD Price: $792.00

★★★★★ 5/5
Read 1 review Write a review Follow this product

**Portable meter measures critical water quality parameters - without the need for multiple instruments**
Single input channel for flexible measurement of pH, Conductivity, Dissolved Oxygen (DO), BOD, ORP, Ammonia, Ammonium, Fluoride, Chloride, Sodium, and temperature - any intelliCAL™ smart probe

**Intuitive user interface for simple operation and accurate results**
Guided calibration and check standard routines reduce calibration errors. Stabilization alerts and visual measurement lock ensure that you can trust the accuracy of the results

**Trust your measurements - intelliCAL™ smart probes store all calibrations in the probe**
Calibration history allows quick and easy change out of probes without re-calibrating. The HQd™ smart system records serial numbers, current calibration data, user ID, sample ID, time, and date automatically in the data log for complete GLP traceability

**Designed for demanding conditions**
Rugged, waterproof (IP67) meter provides worry-free, reliable operation in lab or field environments

**Convenient kit includes everything you need to start testing**
Meter kit includes, 4 AA batteries, quick-start guide, user manual, and documentation CD

Specifications

| | |
|---|---|
| AC and USB Operation | optional |
| Automatic Buffer Recognition | Color-coded: 4.01, 7.00, 10.01 pH<br>IUPAC: 1.679, 4.005, 7.000, 10.012, 12.45<br>DIN: 1.09, 4.65, 9.23<br>User-defined custom buffer sets |
| Barometric Pressure Measurement | For automatic compensation of DO when using an LDO or LBOD probe |
| Battery Requirements | 4, AA |
| Benchtop | with stand |
| BOD5/CBOD resolution | Available when used with Hach WIMS BOD Manager software |
| Cable resistance correction | Digital - not needed |
| Calibration curves display | Calibration summary data logged and displayed |
| Calibration Intervals/Alerts/Reminder | 2 hours to 7 days |
| Compliance | CE, WEEE |
| Conductivity Accuracy | ± 0.5 % from (1µS/cm - 200 mS/cm) |
| Conductivity measurement | 5 different stability modes |
| Conductivity Measurement Range | 0.01 µS/cm to 200 mS/cm |
| Conductivity resolution | 0.01 µS/cm with 2 digits |
| Custom Calibration Standards | User-defined standard sets |
| Data Export | Download via USB connection to PC or flash stick.<br>Automatically transfer entire data log or as readings are taken |
| Data Memory | 500 results |
| Digital (intelligent) electrode inputs | 2 |
| Dimensions (H x W x D) | 7.8 in. x 3.7 in. x 1.4 in. (197 mm x 95 mm x 36 mm) |
| Display | Display readings from one or two probes<br>Simultaneous readings from two probes (HQ40d only)<br>pH: pH, mV, temperature<br>Conductivity: Conductivity, TDS, salinity, resistivity, temperature<br>LDO: dissolved oxygen, pressure, temperature<br>LBOD: dissolved oxygen, pressure, temperature<br>ORP/Redox: mV, temperature<br>Sodium: Sodium, mV, temperature |
| Display Lock Function | Continuous measurement or press to read mode available with averaging function for LDO measurement. |
| Display Type | 240 x 160 pixel Display readings from one or two probes<br>pH: pH, mV, temperature<br>Conductivity: Conductivity, TDS, salinity, resistivity, temperature<br>LDO: dissolved oxygen, pressure, temperature<br>ORP/Redox: mV, temperature<br>Sodium: Sodium, mV, temperature |
| DO Measurement Range | 0.01 to 20 mg/L (0 to 200%) |
| DO Resolution | 0.01 mg/L |
| Fixed Buffer Selection | IUPAC standards<br>(DIN 19266) or Technical buffer (DIN 19267) or 4-7-10 series or user defined |
| Inputs | M12 digital (1)<br>for intelliCAL probes |
| Interface Languages | 13** |
| Internal Data Storage | 500 |
| IP Rating | IP67 |
| Languages: | English, French, German, Italian, Spanish, Danish, Dutch, Polish, Portuguese, Turkish, Swedish, Czech, Russian |
| mV Accuracy | ± 0.1 mV |
| mV Measurement at Stable Reading | 5 (auto) stabilization settings |
| mV Resolution | 0.1 mV |
| Operating Error Messages | Text messages displayed |
| Operating Humidity | 90 % relative humidity (non-condensing) |
| Operating Interface | Keypad |
| Operating Temperature | 5 to 45 °C |
| ORP Electrode Calibration | Predefined ORP standards (including Zobell's solution) |
| Outputs | USB to PC / flash stick |
| PC Data Transfer Software | Included |
| pH Measurement at stable reading | 5 stabilization settings |
| Printer | Optional accessory |
| Salinity Resolution | 0.01 ppt |
| Warranty | 3 years |
| Water Resistance | Meter Casing: 1 meter submersion for 30 minutes (IP67) |
| Weight | 0.74 lbs. (0.335 kg) |

# 2100P and 2100P IS Portable Turbidimeter

*The Hach 2100P and 2100P IS Portable Turbidimeters bring laboratory-level performance on-site, offering fast, accurate results and the ease-of-use analysts demand in the field. With a measurement range of 0 to 1000 NTU and a resolution of 0.01 NTU, the 2100P turbidimeter is ideal for regulatory monitoring, process control or field studies.*

## Features and Benefits

### Laboratory Quality in a Portable Unit

The Hach 2100P and 2100P IS Portable Turbidimeters offer a level of performance previously possible only with laboratory instruments. Microprocessor-controlled operation and Hach's unique Ratio™ optics bring great accuracy, sensitivity, and reliability to field and in-plant testing.

### Two Models for Specific Requirements

- **2100P Turbidimeter**—*Get fast, accurate turbidity testing in the field or the lab, over a wide range of samples. Compliant with USEPA Method 180.1 design criteria.*
- **2100P IS Turbidimeter**—*Designed to meet international standards that mandate measurement using an LED light source.*

### Two-detector Optical System

The two-detector optical system compensates for color in the sample, light fluctuation, and stray light, enabling analysts to achieve laboratory-grade performance on a wide range of samples, even under difficult, onsite conditions.

## Specifications*

| | 2100P | 2100P IS |
|---|---|---|
| **Measurement Method** | Nephelometric Ratio | |
| **Regulatory** | Meets EPA Method 180.1 | Meets EN ISO 7027 |
| **Light Source** | Tungsten lamp | Light-emitting diode (LED) @ 860 nm |
| **Range** | | |
| ***Automatic Range Mode*** | 0 to 1000 NTU | 0 to 1000 FNU |
| ***Manual Range Selection*** | 0 to 9.99, 0 to 99.9 and 0 to 1000 NTU | 0 to 9.99, 0 to 99.9 and 0 to 1000 FNU |
| **Accuracy** | ±2% of reading plus stray light | |
| **Repeatability** | ±1% of reading, or 0.01 NTU, whichever is greater | ±1% of reading, or 0.01 FNU, whichever is greater |
| **Resolution** | 0.01 on lowest range | |
| **Signal Averaging** | Selectable on/off | |
| **Power Requirement** | 4 AA alkaline batteries or optional battery eliminator | |
| **Battery Life, Typical** | 300 tests with signal average mode off<br>180 tests with signal average mode on | |
| **Operating Temperature** | 0 to 50°C (32 to 122°F) | |
| **Sample Required** | 15 mL (0.5 oz.) | |
| **Sample Cells** | 60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw caps | |
| **Dimensions** | 22.2 x 9.5 x 7.9 cm (8.75 x 3.75 x 3.12 in.) | |
| **Weight** | 0.5 kg (1.1 lb.); shipping weight 2.7 kg (6 lb.) | |
| **Warranty** | 2 years | |

**Specifications subject to change without notice.*

*DW = drinking water WW = wastewater municipal PW = pure water / power*
*IW = industrial water E = environmental C = collections FB = food and beverage*

HACH®

Be Right™

# 2100Q and 2100Q *is* Portable Turbidimeter




*The Hach 2100Q and 2100Q is Portable Turbidimeters offer unsurpassed ease of use and accuracy in turbidity measurement. Only Hach offers this unique combination of advanced features, such as assisted calibration and simplified data transfer, and measurement innovation, giving you accurate results every time.*



## Features and Benefits

### Easy Calibration and Verification

Hach 2100Q and 2100Q *is* Portable Turbidimeters provide confidence your measurements are right every time. On-screen assisted calibration and verification save you time and ensure accuracy. With an easy-to-follow interface, complicated manuals are not needed to perform routine calibrations. Single-standard RapidCal™ calibration offers a simplified solution for low level measurements.

### Simple Data Transfer

Data transfer with the optional USB + Power Module is simple, flexible, and doesn't require additional software. All data can be transferred to the module and easily downloaded to your computer with a USB connection, providing superior data integrity and availability. With two different module options, you can customize connectivity and power to meet your unique needs.

### Accurate for Rapidly Settling Samples

The Hach 2100Q Portable Turbidimeter incorporates an innovative Rapidly Settling Turbidity™ mode to provide accurate, repeatable measurements for difficult to measure, rapidly settling samples. An exclusive algorithm that calculates turbidity based on a series of automatic readings eliminates redundant measurements and estimating.

### Convenient Data Logging

Up to 500 measurements are automatically stored in the instrument for easy access and backup. Stored information includes: date and time, operator ID, reading mode, sample ID, sample number, units, calibration time, calibration status, error messages and the result.

### Optical System for Precision in the Field

The two-detector optical system compensates for color in the sample, light fluctuation, and stray light, enabling analysts to achieve laboratory-grade performance on a wide range of samples, even under difficult site conditions.

### Two Models for Specific Requirements

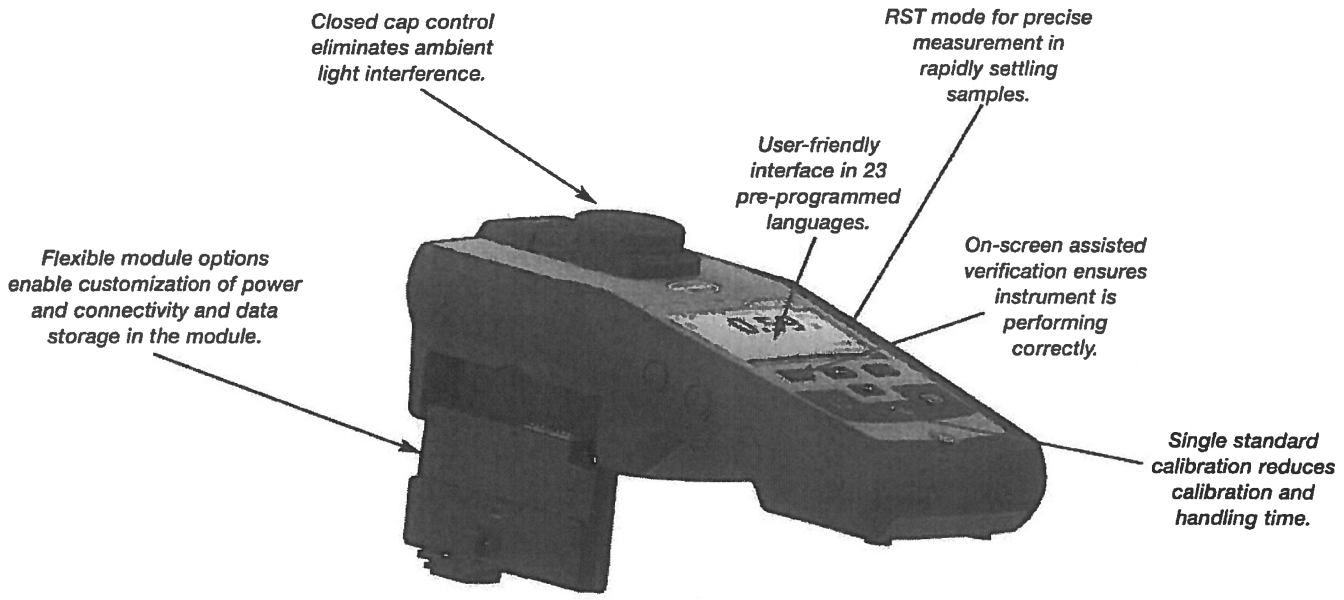
- **2100Q Turbidimeter**—*Compliant with USEPA Method 180.1 design criteria.*
- **2100Q *is* Turbidimeter**—*Compliant with ISO 7027 design criteria.*

*DW = drinking water WW = wastewater municipal PW = pure water / power*
*IW = industrial water E = environmental C = collections FB = food and beverage*

HACH®

*Be Right™*

## Key Features




## Specifications*

*Measurement Method*
Ratio turbidimetric determination using a primary nephelometric light scatter signal (90°) to the transmitted light scatter signal.

*Regulatory*
2100Q: Meets EPA Method 180.1
2100Q *is:* Meets ISO 7027

*Light Source*
2100Q: Tungsten filament lamp
2100Q *is:* Light-emitting diode (LED) @ 860 nm

*Range*
0 to 1000 NTU (FNU)

*Accuracy*
±2% of reading plus stray light from 0 to 1000 NTU

*Repeatability*
±1% of reading, or 0.01 NTU (FNU), whichever is greater

*Resolution*
0.01 NTU on lowest range

*Stray Light*
<0.02 NTU (FNU)

*Signal Averaging*
Selectable on/off

*Detector*
Silicon photovoltaic

*Reading Modes (user selectable)*
Normal (Push to Read)
Signal Averaging
Rapidly Settling Turbidity

*Data Logger*
500 records

*Power Requirement*
110-230 Vac, 50/60 Hz (with Power or USB+Power Module)
4 AA alkaline batteries
Rechargeable NiMH (for use with USB+Power Module)

*Operating Conditions*
*Temperature:* 0 to 50°C (32 to 122°F)
*Relative Humidity:* 0 to 90% @ 30°C,
0 to 80% @ 40°C, 0 to 70% @ 50°C, noncondensing

*Storage Conditions*
-40 to 60°C (-40 to 140°F), instrument only

*Languages*
English, French, German, Italian, Spanish, Portuguese (BR), Portuguese (PT), Bulgarian, Chinese, Czech, Danish, Dutch, Finnish, Greek, Hungarian, Japanese, Korean, Polish, Romanian, Russian, Slovenian, Swedish, Turkish

*Interface*
Optional USB

*Instrument Enclosure Rating*
IP67 (closed lid, battery compartment excluded)

*Protection Class*
Power Supply: Class II

*Certification*
CE certified

*Sample Required*
15 mL (0.3 oz.)

*Sample Cells*
60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw cap

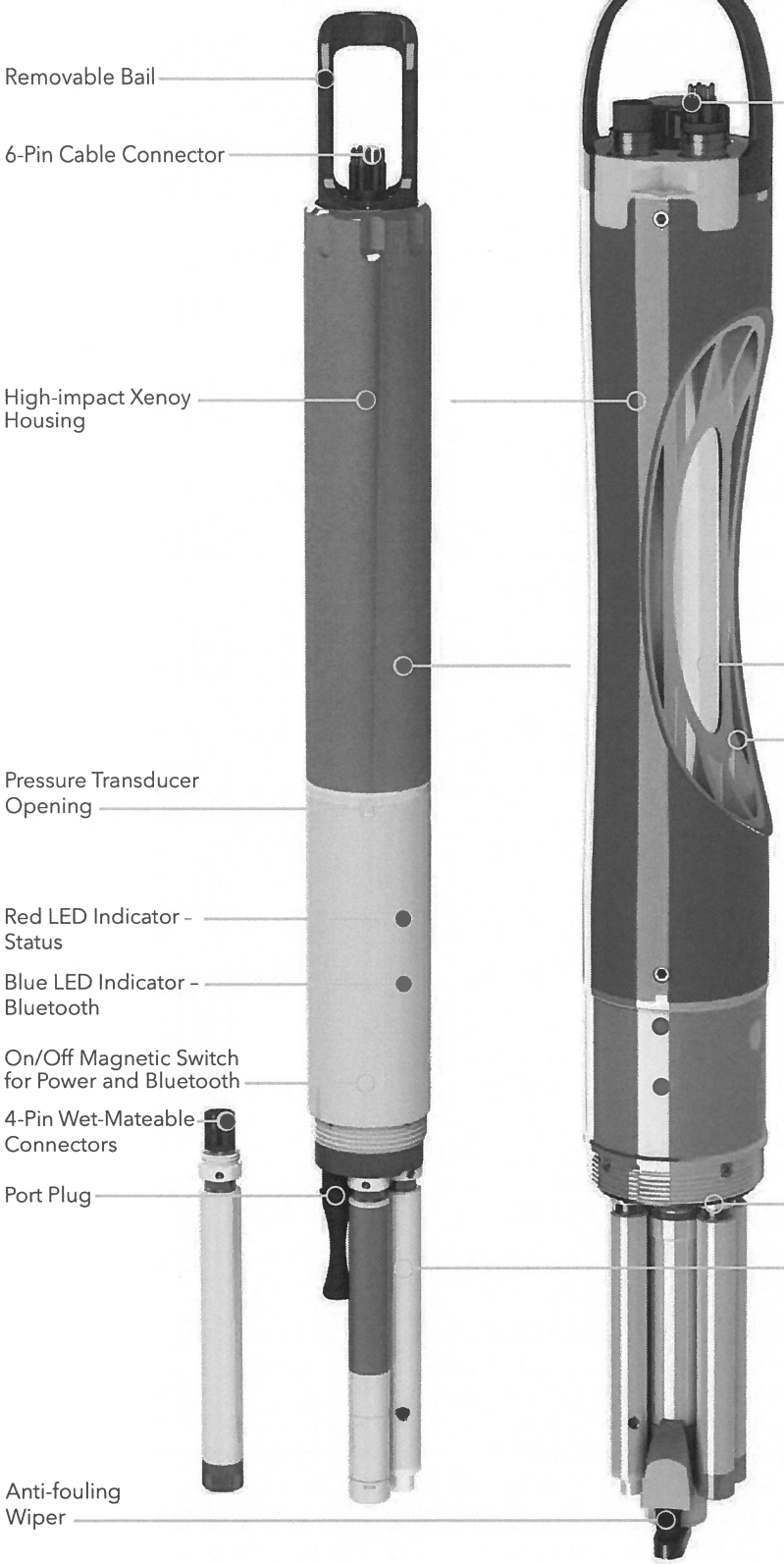
*Dimensions*
22.9 x 10.7 x 7.7 cm (9.0 x4.2 x 3.0 in.)

*Weight*
527 g (1.16 lb) without batteries
618 g (1.36 lb) with four AA alkaline batteries

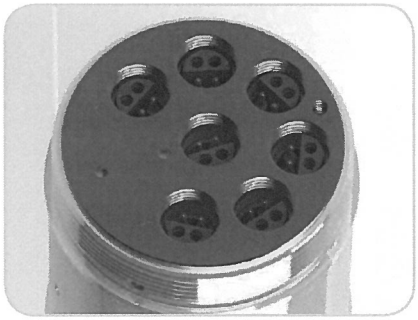
*Warranty*
1 year

**Specifications subject to change without notice.*

# Sondes: EXO1 EXO2



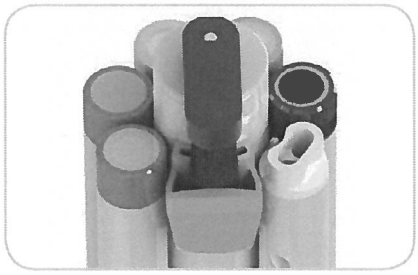

Cable connector, battery valve, and expansion port for an additional sensor



EXO2 sonde contains 6 universal sensor ports plus a central port for an anti-fouling wiper

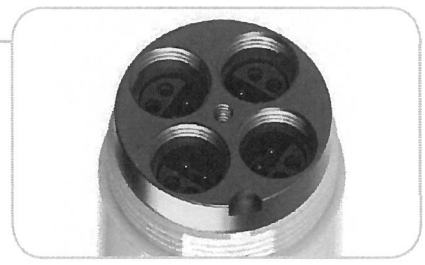
Battery Compartment

Cutaway: Reinforced internal structure



Anti-fouling wiper keeps sensors clear of biofouling and lengthens deployment times by 25%

Welded Titanium Housing



EXO1 sonde contains 4 universal sensor ports

## Instrument Specifications*

| EXO1 Sonde | | |
|---|---|---|
| Ports | 4 sensor ports<br>Peripheral port: 1 power communication port | |
| Size | Diameter: 4.70 cm (1.85 in)<br>Length: 64.77 cm (25.50 in) | |
| Weight | 1.42 kg (3.15 lbs) with 4 probes, guard and batteries installed | |
| **EXO2 Sonde** | | |
| Ports | 7 sensor ports (6 ports available when central wiper used)<br>Peripheral ports: 1 power communication port; 1 auxiliary expansion port | |
| Size | Diameter: 7.62 cm (3.00 in)<br>Length: 71.10 cm (28.00 in) | |
| Weight | 3.60 kg (7.90 lbs) with 5 probes, guard and batteries installed | |
| **Sondes** | | |
| Operating Temperature | -5 to 50°C | |
| Storage Temperature | -20 to 80°C (except 0 to 60°C for pH and pH/ORP sensors) | |
| Depth Rating | 0 to 250 m (0 to 820 ft) | |
| Communications | Computer Interface: Bluetooth wireless technology, RS-485, USB<br>Output Options: USB with signal output adapter (SOA); RS-232 & SDI-12 with DCP-SOA | |
| Sample Rate | Up to 4 Hz | |
| Battery Life | 90 days** | |
| Data Memory | 512 MB total memory; >1,000,000 logged readings | |
| **Sensors** | | **Calculated Parameters** |
| Ammonium | ORP | Salinity |
| Chloride | pH | Specific Conductance |
| Conductivity | Temperature | Total Dissolved Solids |
| Depth | Total Algae (Chlorophyll + BGA-PC or PE) | Total Suspended Solids |
| Dissolved Oxygen | Turbidity | |
| Fluorescent Dissolved Organic Matter (fDOM) | Vented Level | |
| Nitrate | | |
| **EXO Handheld** | | |
| Size | Width: 12.00 cm (4.72 in)<br>Height: 25.00 cm (9.84 in) | |
| Weight | 0.71 kg (1.56 lbs) without batteries | |
| Operating System | Windows CE 5.0 | |
| Operating Temperature | -10 to 50°C | |
| Storage Temperature | -20 to 80°C | |
| IP Rating | IP-67 | |
| Data Memory | 2 GB total memory; >2,000,000 data sets | |
| **Accessories** | | |
| Cables (vented and non-vented) | Flow cells | Sonde/sensor guard |
| Carrying case | KOR software | Calibration cup |
| DCP Signal Output Adapter | USB Signal Output Adapter | Anti-fouling components |
| **Warranty** | | |
| 3 months | Replaceable reagent modules for ammonium, chloride, and nitrate | |
| 1 Year | Optical DO membranes and replaceable reagent moldules for pH and pH/ORP | |
| 2 Years | Cables; sonde bulkheads; handheld; conductivity, temperature, depth, and optical sensors; electronics base for pH, pH/ORP, ammonium, chloride, and nitrate sensors; and accessories | |

* Specifications indicate typical performance and are subject to change. Please check EXOwater.com for up-to-date information.

** Typically 90 days at 20°C at 15-minute logging interval; temperature/conductivity, pH/ORP, DO, and turbidity sensors installed on EXO1; or temperature/conductivity, pH/ORP, DO, total algae, and turbidity sensors installed with central wiper that rotates once per logging interval on EXO2. Battery life is heavily dependent on sensor configuration.

EXO Bluetooth modules comply with Part 15C of FCC Rules and have FCC, CE Mark and C-tick approval. Bluetooth-type approvals and regulations can be country specific. Check local laws and regulations to insure that the use of wireless products purchased from Xylem are in full compliance.

## Sensor Specifications*

| Sensor | Range | Accuracy* | Response | Resolution |
|---|---|---|---|---|
| Ammonium [11] (ammonia with pH sensor) | 0 to 200 mg/L [1] | ±10% of reading or 2 mg/L-N, w.i.g. | - | 0.01 mg/L |
| Barometer | 375 to 825 mmHg | ±1.5 mmHg from 0 to 50°C | - | 0.1 mmHg |
| Blue-green Algae Phycocyanin (PC) (part of Total Algae sensor) | 0 to 100 RFU; 0 to 100 µg/L PC | Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 100 µg/mL PC equivalents | T63<2 sec | 0.01 RFU; 0.01 µg/L PC |
| Blue-green Algae Phycoerythrin (PE) (part of Total Algae sensor) | 0 to 100 RFU; 0 to 280 µg/L PE | Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 280 µg/mL PE equivalents | T63<2 sec | 0.01 RFU; 0.01 µg/L PE |
| Chloride [11] | 0 to 1000 mg/L-Cl [2] | ±15% of reading or 5 mg/L-Cl, w.i.g. | - | 0.01 mg/L |
| Chlorophyll (part of Total Algae sensor) | 0 to 400 µg/L Chl; 0 to 100 RFU | Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 400 µg/L Chl equivalents | T63<2 sec | 0.01 µg/L Chl; 0.01 RFU |
| Conductivity [3] | 0 to 200 mS/cm | 0 to 100: ±0.5% of reading or 0.001 mS/cm, w.i.g.; 100 to 200: ±1% of reading | T63<2 sec | 0.0001 to 0.01 mS/cm (range dependent) |
| Depth [4] (non-vented) | 0 to 10 m (0 to 33 ft) | ±0.04% FS (±0.004 m or ±0.013 ft) | T63<2 sec | 0.001 m (0.001 ft) (auto-ranging) |
| | 0 to 100 m (0 to 328 ft) | ±0.04% FS (±0.04 m or ±0.13 ft) | | |
| | 0 to 250 m (0 to 820 ft) | ±0.04% FS (±0.10 m or ±0.33 ft) | | |
| Vented Level | 0 to 10 m (0 to 33 ft) | ±0.03% FS (±0.003 m or ±0.010 ft) | | |
| Dissolved Oxygen Optical | 0 to 500% air saturation | 0 to 200%: ±1% of reading or 1% saturation, w.i.g.; 200 to 500%: ±5% of reading [5] | T63<5 sec [6] | 0.1% air saturation |
| | 0 to 50 mg/L | 0 to 20 mg/L: ±0.1 mg/L or 1% of reading, w.i.g.; 20 to 50 mg/L: ±5% of reading [5] | | 0.01 mg/L |
| fDOM | 0 to 300 ppb Quinine Sulfate equivalents (QSE) | Linearity: $R^2 > 0.999$ for serial dilution of 300 ppb QS solution Detection Limit: 0.07 ppb QSE | T63<2 sec | 0.01 ppb QSE |
| Nitrate [11] | 0 to 200 mg/L-N [1] | ±10% of reading or 2 mg/L-N, w.i.g. | - | 0.01 mg/L |
| ORP | -999 to 999 mV | ±20 mV in Redox standard solutions | T63<5 sec [7] | 0.1 mV |
| pH | 0 to 14 units | ±0.1 pH units within ±10°C of calibration temp; ±0.2 pH units for entire temp range [8] | T63<3 sec [9] | 0.01 units |
| Salinity (Calculated from Conductivity and Temperature) | 0 to 70 ppt | ±1.0% of reading or 0.1 ppt, w.i.g. | T63<2 sec | 0.01 ppt |
| Specific Conductance (Calculated from Cond. and Temp.) | 0 to 200 mS/cm | ±0.5% of reading or .001 mS/cm, w.i.g. | - | 0.001, 0.01, 0.1 mS/cm (auto-scaling) |
| Temperature | -5 to 50°C | -5 to 35°C: ±0.01°C [10] 35 to 50°C: ±0.05°C [10] | T63<1 sec | 0.001 °C |
| Total Dissolved Solids (TDS) (Calculated from Conductivity and Temperature) | 0 to 100,000 g/L Cal constant range 0.30 to 1.00 (0.64 default) | Not Specified | - | variable |
| Total Suspended Solids (TSS) (Calculated from Turbidity and user reference samples) | 0 to 1500 mg/L | Not Specified | T63<2 sec | variable |
| Turbidity [11] | 0 to 4000 FNU | 0 to 999 FNU: 0.3 FNU or ±2% of reading, w.i.g.; 1000 to 4000 FNU: ±5% of reading [12] | T63<2 sec | 0 to 999 FNU: 0.01 FNU; 1000 to 4000 FNU: 0.1 FNU |

All sensors have a depth rating to 250 m (820 ft), except shallow and medium depth sensors and ISEs. EXO sensors are not backward compatible with 6-Series sondes.

* Specifications indicate typical performance and are subject to change. Please check EXOwater.com for up-to-date information.
Accuracy specification is attained immediately following calibration under controlled and stable environmental conditions. Performance in the natural environment may vary from quoted specification.

[1] 0-30°C [2] 0-40°C w.i.g. = whichever is greater

[3] Outputs of specific conductance (conductivity corrected to 25°C) and total dissolved solids are also provided. The values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (Ed. 1989).

[4] Accuracy specifications apply to conductivity levels of 0 to 100,000 µS/cm.

[5] Relative to calibration gases

[6] When transferred from air-saturated water to stirred deaerated water

[7] When transferred from water-saturated air to Zobell solution

[8] Within the environmental pH range of pH 4 to pH 10

[9] On transfer from water-saturated air to rapidly stirred air-saturated water at a specific conductance of 800 µS/cm at 20°C; T63<5 seconds on transfer from water-saturated air to slowly-stirred air-saturated water.

[10] Temperature accuracy traceable to NIST standards

[11] Calibration: 1-, 2-, or 3-point, user-selectable

[12] Specification is defined in AMCO-AEPA Standards

# FH950 Portable Velocity Meter with 20' Cable

**Product #:** FH950.10020 Quantity
**USD Price:** $4,585.00
**Ships within 2 weeks**

**Reduce manhours 50%**
The step-by-step user interface simplifies programming, delivers real-time data, and downloads directly to PC allowing a single person to take the readings and eliminating post site visit manual data transfer from logbook to PC

**Automatically calculates total discharge based on USGS and ISO methods**
Reduces time to manually calculate and likelihood of errors

**Real-time velocity graphed on color display**
Visualize velocity trends quickly

**Lowest maintenance solution on the market**
Electromagnetic velocity sensor with no moving parts never requires mechanical maintenance

**Lightweight, rugged portable meter**
Only 1.5 pounds

## What's in the box

FH950.1 System Includes:
- Portable Velocity Meter
- Electromagnetic Sensor with 20' cable
- Fabric Carrying Case
- Adjustable Meter Rod Mount
- Universal Sensor Mount
- Battery Charger with Domestic/International Plug Adapters
- USB Cable
- Lanyard
- Sensor Screw Kit
- Absorbent Wipe

## Specifications

| | |
|---|---|
| Accuracy 2: | ± 2% of reading ± 0.05 ft/s (± 0.015 m/s) through the range of 0 to 10 ft/s (0 to 3.04 ms/s); ± 4% of reading from 10 to 16 ft/s (3.04 to 4.87 m/s) |
| Battery Life: | heavy typical day use; 68°F (20°C) |
| Display: LCD: | Color, LCD 3.5 QVGA transflective (readable in direct sunlight) |
| Keypad: | Alpha-numerica |
| Operating Temperature Range: | -20 to 55 °C |
| Range: | to ft/s |
| Resolution: | Measurement Resolution - <10: 0.001; <100: 0.01; >100: 0.1 |
| Storage Conditions: | -20 °C to 60 °C |

Appendix D

# 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 | Area of individual scrape |
|---|---|
| 1_____ | 1_____ |
| 2_____ | 2_____ |
| 3_____ | 3_____ |
| 4_____ | 4_____ |
| 5_____ | 5_____ |
| 6_____ | 6_____ |
| 7_____ | 7_____ |
| 8_____ | 8_____ |
| 9_____ | 9_____ |
| 10_____ | 10_____ |
| 11_____ | 11_____ |
| 12_____ | 12_____ |
| 13_____ | 13_____ |
| 14_____ | 14_____ |
| 15_____ | 15_____ |
| 16_____ | 16_____ |
| 17_____ | 17_____ |
| 18_____ | 18_____ |
| 19_____ | 19_____ |
| 20_____ | 20_____ |
| 21_____ | 21_____ |
| 22_____ | 22_____ |
| 23_____ | 23_____ |
| 24_____ | 24_____ |
| 25_____ | 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*

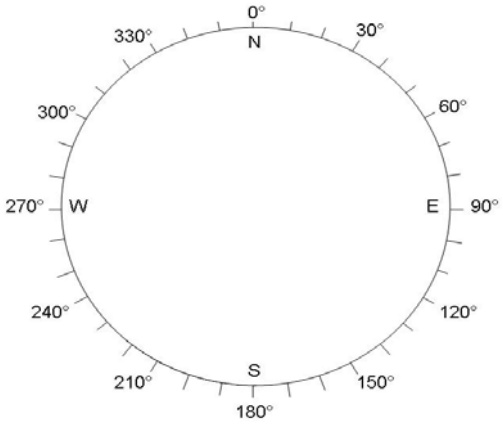
*Explain_____

**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 E

# COMMONWEALTH OF PENNSYLVANIA
# DEPARTMENT OF ENVIRONMENTAL PROTECTION

*BUREAU OF LABORATORIES*

*LABORATORY ACCREDITATION PROGRAM*

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certifies That

**68-03670**

**Northeast Ohio Regional Sewer District Analytical Services**

**4747 East 49th Street, Cuyahoga Heights, OH 44125**

NELAP RECOGNIZED TNI ACCREDITATION BODY

Having duly met the requirement of
The act of June 29, 2002 (P.L. 596, No. 90)
dealing with Environmental Laboratories Accreditation
(27 Pa. C.S. §§4104-4113) and the
National Environmental Laboratory Accreditation Program Standard

is hereby approved as an

## Accredited Laboratory

to conduct analysis within the fields of accreditations more fully described in the attached Scope of Accreditation

Expiration Date: **11/30/2017**

Certificate Number: **010**

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

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

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# Laboratory Scope of Accreditation

**Attached to Certificate of Accreditation 010-001 expiration date November 30, 2017. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.**

**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**
**PADWIS ID: 03670**


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


## Matrix: Drinking Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 1603 | | E. coli (Enumeration) | NELAP | PA | 12/16/2015 |
| SM 9222 B | | Total coliform (Enumeration) | NELAP | PA | 12/16/2015 |

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| ASTM D4839-03 | | Total organic carbon (TOC) | NELAP | PA | 11/25/2014 |
| 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 | E | Mercury | NELAP | PA | 3/31/2008 |
| EPA 1664 | A | Oil and grease | NELAP | PA | 4/27/2015 |
| EPA 180.1 | | Turbidity | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Aluminum | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Antimony | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Arsenic | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Barium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Beryllium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Cadmium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Calcium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Chromium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Cobalt | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Copper | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Iron | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Lead | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Magnesium | NELAP | PA | 11/17/2010 |
| EPA 200.7 | 4.4 | Manganese | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Molybdenum | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Nickel | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Potassium | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Selenium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Silver | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Sodium | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Strontium | NELAP | PA | 4/27/2015 |
| EPA 200.7 | 4.4 | Thallium | NELAP | PA | 4/15/2014 |
| EPA 200.7 | 4.4 | Tin | NELAP | PA | 11/29/2007 |

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**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**
**PADWIS ID: 03670**

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 200.7 | 4.4 | Titanium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Vanadium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Zinc | NELAP | PA | 12/31/2007 |
| EPA 200.8 | 5.4 | Aluminum | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Antimony | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Arsenic | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Barium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Beryllium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Cadmium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Calcium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Chromium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Cobalt | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Copper | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Iron | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Lead | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Magnesium | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Manganese | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Molybdenum | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Nickel | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Potassium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Selenium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Silver | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Sodium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Strontium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Thallium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Tin | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Titanium | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Vanadium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Zinc | NELAP | PA | 4/27/2015 |
| EPA 245.1 | 3.0 | Mercury | NELAP | PA | 11/29/2007 |
| EPA 300.0 | 2.1 | Bromide | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Chloride | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Fluoride | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Nitrate as N | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Nitrite as N | NELAP | PA | 4/27/2015 |
| EPA 300.0 | 2.1 | Orthophosphate as P | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Sulfate | NELAP | PA | 11/22/2010 |
| EPA 3005 | A | Preconcentration under acid | NELAP | PA | 11/29/2007 |
| EPA 3010 | A | 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 | 9/20/2012 |
| 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 |

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

# Laboratory Scope of Accreditation

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**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**

**PADWIS ID: 03670**

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 365.1 | | Orthophosphate as P | NELAP | PA | 12/1/2015 |
| 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 6010 | | Aluminum | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Antimony | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Arsenic | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Barium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Beryllium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Cadmium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Calcium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Chromium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Cobalt | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Copper | NELAP | PA | 12/31/2007 |
| EPA 6010 | | Iron | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Lead | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Magnesium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Manganese | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Molybdenum | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Nickel | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Potassium | NELAP | PA | 12/31/2007 |
| EPA 6010 | | Selenium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Silver | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Sodium | NELAP | PA | 12/31/2007 |
| EPA 6010 | | Thallium | NELAP | PA | 4/15/2014 |
| EPA 6010 | | Tin | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Titanium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Vanadium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Zinc | NELAP | PA | 12/31/2007 |
| EPA 7470 | | Mercury | NELAP | PA | 11/29/2007 |
| Enterolert | | Enterococci (Enumeration) | NELAP | PA | 11/22/2010 |
| Lachat 10-204-00-1X | | Cyanide | NELAP | PA | 12/1/2015 |
| OIA 1677 | | Available cyanide | NELAP | PA | 11/29/2007 |
| 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 | 20-22 | Chromium VI | 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-Cl- C | | Chloride | NELAP | PA | 11/19/2012 |
| SM 4500-H+ B | | pH | NELAP | PA | 11/29/2007 |
| SM 4500-NO2- B | | Nitrite as N | NELAP | PA | 11/29/2007 |

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

# Laboratory Scope of Accreditation

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**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**

**PADWIS ID: 03670**

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| SM 4500-Norg B | | Kjeldahl nitrogen, total (TKN) | NELAP | PA | 10/22/2008 |
| SM 4500-P B | | Preliminary treatment of phosphate samples | NELAP | PA | 11/13/2013 |
| SM 4500-P E | | Orthophosphate as P | NELAP | PA | 11/13/2013 |
| 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 D | | Fecal coliform (Enumeration) | NELAP | PA | 11/29/2007 |
| SM 9223 Colilert MPN or QT | | E. coli (Enumeration) | NELAP | PA | 11/29/2007 |
| SM 9223 Colilert MPN or QT | | Total coliform (Enumeration) | NELAP | PA | 11/22/2010 |

## Matrix: Solid and Chemical Materials

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 245.1 | 3.0 | Mercury | NELAP | PA | 11/22/2010 |
| EPA 3051 | | Microwave digestion of solids (HNO3 only) | NELAP | PA | 11/17/2010 |
| EPA 350.1 | | Ammonia as N | NELAP | PA | 4/27/2015 |
| EPA 351.2 | | Kjeldahl nitrogen, total (TKN) | NELAP | PA | 4/27/2015 |
| EPA 365.1 | | Phosphorus, total | NELAP | PA | 4/27/2015 |
| EPA 6010 | | Aluminum | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Antimony | NELAP | PA | 11/13/2013 |
| EPA 6010 | | Arsenic | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Barium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Beryllium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Cadmium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Calcium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Chromium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Cobalt | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Copper | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Iron | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Lead | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Magnesium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Manganese | NELAP | PA | 11/22/2010 |
| EPA 6010 | B | Metals by ICP/AES | NELAP | PA | 1/22/2013 |
| EPA 6010 | | Molybdenum | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Nickel | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Potassium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Selenium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Silver | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Sodium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Strontium | NELAP | PA | 4/27/2015 |
| EPA 6010 | | Thallium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Tin | NELAP | PA | 4/15/2013 |
| EPA 6010 | | Titanium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Vanadium | NELAP | PA | 11/22/2010 |

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

# Laboratory Scope of Accreditation

**Attached to Certificate of Accreditation 010-001 expiration date November 30, 2017. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.**

**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**

**PADWIS ID: 03670**

## Matrix: Solid and Chemical Materials

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 6010 | | Zinc | NELAP | PA | 11/22/2010 |

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Appendix F

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

April 19, 2017

Mr. Seth Hothem
Supervisor of Environmental Assessment
Northeast Ohio Regional Sewer District
4747 East 49th Street
Cuyahoga Heights, Ohio 44125

Dear Mr. Hothem:

This letter is to acknowledge that I am responsible for assisting the Northeast Ohio Regional Sewer District's Water Quality and Industrial Surveillance Division in conducting stream habitat assessments using the Qualitative Habitat Evaluation Index for the 2017 Cuyahoga River, Cuyahoga River Tributaries, Rocky River, Euclid Creek, and Mill Creek Highland Hills Golf Course Restoration Environmental Monitoring Project Study Plans.

It is understood that an Ohio Environmental Protection Agency Level 3 Qualified Data Collector Certification for Stream Habitat Assessment is required to perform these tasks and that I am responsible for maintaining my Level 3 QDC Certification during the term of these Study Plans.

In addition, I have not been convicted nor 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.

Sincerely,

Jonathan Brauer
Stormwater Inspector
Northeast Ohio Regional Sewer District
4747 East 49th Street
Cuyahoga Heights, Ohio, 44125

# Appendix G

*To be submitted once received from Ohio Division of Wildlife*

Appendix H

## References


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

EPA New England- Region 1. (2005). *Standard operating procedure for calibration and field measurement procedures for the YSI Model 6-Series Sondes and Data Logger (Including: temperature, pH, specific conductance, turbidity, dissolved oxygen, chlorophyll, rhodamine WT, ORP, and barometric pressure)* (7th Revision). North Chelmsford, MA: The Office of Environmental Measurement and Evaluation, Ecosystem Assessment- Ecology Monitoring Team.

Ohio Environmental Protection Agency. (1987a). *Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters* (Updated January 1988; September 1989; November 2006; August 2008; May 2015). Columbus, OH: Division of Water Quality Monitoring and Assessment.

Ohio Environmental Protection Agency. (1987b). *Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities* (Updated September 1989; March 2001; November 2006; August 2008; September 2015 ; June 2015). Columbus, OH: Division of Water Quality Monitoring and Assessment.

Ohio Environmental Protection Agency. (1997). Draft. *Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indicies for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustuaries*. Columbus, OH: Division of Surface Water, Ecological Assessment Unit.

Ohio Environmental Protection Agency. (2006). *Methods for assessing habitat in flowing waters: using the Qualitative Habitat Evaluation Index (QHEI)*. (Ohio EPA Technical Bulletin EAS/2006-06-1). Columbus, OH: Division of Surface Water; Division of Ecological Assessment Section.

Ohio Environmental Protection Agency. (2010). *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)*. Columbus, OH: Division of Surface Water.

Ohio Environmental Protection Agency. (2012a). *Field Evaluation Manual for Ohio's Primary Headwater Habitat Stream*. Columbus, OH: Division of Surface Water; Division of Ecological Assessment Section.

Ohio Environmental Protection Agency. (2012b). *Ohio 2012 Integrated Water Quality Monitoring and Assessment Report.* Columbus, Ohio: Division of Surface Water.

Ohio Environmental Protection Agency. (2015a). *Surface Water Field Sampling Manual for water quality parameters and flow.* Columbus, Ohio: Division of Surface Water.

Ohio Environmental Protection Agency. (2015b). *Proposed Stream Nutrient Assessment Procedure*. Columbus, OH: Division of Surface Water, Ohio EPA Nutrients Technical Advisory Group.

Ohio Environmental Protection Agency. (2017). *State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1* (Revision: February 6, 2017). Columbus, OH: Division of Surface Water; Standards and Technical Support Section.

(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 A) 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. Third Rock Consultants, LLC will identify and enumerate the specimens collected from each site[1]. 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 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. The Lacustuary QHEI (L-QHEI) will be performed at sites that are affected by the water level of Lake Erie. Examples of the Ohio EPA field sheets for the QHEI and the L-QHEI can be found in Appendix A.

Water chemistry samples will be collected at each electrofishing/ 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 A).

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, nitrite, nitrate+nitrite, ammonia, alkalinity, turbidity and

[1] It is anticipated that Third Rock Consultants, LLC will be contracted to complete all macroinvertebrate identification. However, awarding of the contract is dependent upon approval, which, to date, has not occurred. An amended study plan will be submitted if someone else is awarded the contract.

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

suspended solids. In the Cuyahoga River, YSI 6600EDS, or EXO2 data sondes may be installed at RMs 16.20, 10.75, 10.10, and 7.00 around the time that this sampling is conducted to more frequently monitor dissolved oxygen, temperature, conductivity, specific conductivity and pH.

(4) Field Collection and Data Assessment Techniques

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

Fish will be identified to the species level, weighed, 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. Fish species difficult to identify will be brought back to the laboratory for verification by NEORSD Level 3 Fish Qualified Data Collectors (QDC). 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 formalin for approximately 10 to 14 days before being transferred to water and solutions of 30, 50 and 70 percent ethanol. Label information will include location (description and coordinates), date, time, collectors' names and sample identification code for each specimen collected.

Macroinvertebrate sampling will be conducted using 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 may be installed at one or all sampling

locations in case samplers are lost due to vandalism, burial, etc. or 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 each HD retrieval. NEORSD Level 3 QDCs for Benthic Macroinvertebrate Biology Identification may identify specimens in replicate samples to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b).

Macroinvertebrate voucher specimens for both quantitative and qualitative sampling will be collected as described in section (14). Macroinvertebrate community assemblages collected will be shipped to Third Rock Consultants, LLC (Lexington, KY) for identification and enumeration. Third Rock Consultants, LLC 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 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). Methods for assessing fish and macroinvertebrate communities in lacustuary zones can be found in Ohio EPA's draft *Biological Criteria for the Protection of Aquatic Life, Volume IV* (1997).

The QHEI, as described in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006) will be used to assess aquatic habitat conditions at each sample location. The L-QHEI will be used where appropriate and will follow Ohio EPA's *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)* (2010).

Water chemistry sampling may occur across a variety of flow conditions. Techniques used for water chemistry sampling and chemical analyses will follow the *Surface Water Field Sampling Manual* (Ohio EPA, 2015a). Chemical water quality samples from each site will be collected with at least one 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles. Water samples collected for analysis of dissolved reactive phosphorus will be filtered using a 0.45-µm PVDF syringe filter and will be collected in a 125-mL plastic bottle. Bacteriological samples will be collected in a sterile plastic bottle preserved with sodium thiosulfate. All water quality samples will be collected as grab samples. Field blanks and duplicate samples will each comprise not less than 5% of the total samples collected for this study plan, for a

total frequency of quality control samples of not less than 10% of the total samples collected. With the exception of bacteriological duplicate samples, the acceptable percent RPD will be based on the ratio of the sample concentration and detection limit (Ohio EPA, 2015a): Acceptable % RPD = $[(0.9465X^{-0.344})*100] + 5$, where X = sample/detection limit ratio. For bacteriological duplicates, duplicate samples more than 5x apart from one another (%RPD > 133.3%) will be rejected in accordance with the Ohio EPA approved method for data validation of bacteriological samples outlined in Section F of the *Ohio 2012 Integrated Water Quality Monitoring and Assessment Report* (Ohio EPA, 2012). Those RPDs that were higher than acceptable may indicate potential problems with sample collection and, as a result, the data will not be used for comparison to the water quality standards. 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, YSI EXO1 sonde, 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 HQ30d meter with LDO101 probe to measure DO. Field turbidity will be measured using either a Hach 2100P Portable Turbidimeter or Hach 2100Q Turbidimeter. Specifications for these meters have been included in Appendix C.

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). A Chlorophyll *a* Sampling Field Sheet will be completed for each site (Appendix D). 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. Additionally in the Cuyahoga River, approximately 24-hours prior to each chlorophyll *a* sampling event, YSI 6600 EDS, or EXO2 data sondes may be deployed at RMs 16.20, 10.75, 10.10 and 7.00. If installed, each data sonde will record, at fifteen-minute intervals, dissolved oxygen concentration, pH, temperature, and conductivity from the time the data sonde is deployed until the time it is retrieved. These data sondes will be placed in the stream by inserting each one into a 4.5-inch PVC pipe with holes drilled into the sides of the lower third of the pipe to allow water to pass through it. The data sondes will remain in the river for approximately 24-hours or longer following collection of the chlorophyll *a* samples.

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, L-QHEI, IBI, LIBI, MIwb, ICI, and LICI 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 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, a HACH FH950 Flow Meter or an Aquaflow Probe Model 6900, which measure flow in feet per second, when HD samplers are installed and retrieved. The specifications for the flow meters can be found in Appendix C.

(7) Schedule

One to three electrofishing surveys will be conducted at each site between June 15 and October 15, 2017. 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 between June 15 and August 19, 2017, 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, and, if necessary, L-QHEI habitat evaluations will be conducted one time between June 15 and October 15, 2017. QHEI 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, 2017.

Benthic and water column chlorophyll *a* samples may be collected at least one time from stream locations between June 15 and October 15, 2017. 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), *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006), draft *Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indicies for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustuaries* (1997) and *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)* (2010)

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 & Maintenance Services Center, or by contacting the supplier or an appropriate service company.

Fish species difficult to identify will be brought back to the laboratory for verification by Level 3 Fish 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 (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.

All macroinvertebrate community assemblages from stream locations, except for any replicate samples, will be collected and shipped to Third Rock Consultants, LLC 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 (14). 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 & Maintenance Services Center for a period not less than ten years.

Water samples obtained for chemical analyses will be collected, preserved (see Section 4), labeled and then placed on ice inside the field truck. The field truck

will remain locked at all times when not occupied/visible. Sampling activities, including sample time and condition of surface water sampled, will be entered in a field log book and on the Surface Water Condition Sampling Field Data Form. The samples will then be delivered immediately to the NEORSD Analytical Services cooler, after which the door to the cooler will be locked, and the samples will be transferred to the custody of Analytical Services. The NEORSD Analytical Services Quality Manual and associated Standard Operating Procedures are on file with Ohio EPA. The Quality Assurance Officer at Analytical Services will send updates, revisions and any information on document control to Ohio EPA as needed.

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.

Calibration of YSI 6600EDS and EXO2 data sondes will be done according to the YSI Environmental Operations Manual. The conductivity will be calibrated first using a 1.413 mS/cm standard. Second, the pH will be calibrated using two different buffers (7 and 10 s.u.). The DO will be calibrated last with an acceptable error of 0.2 mg/L.

Once the sondes are removed from the river, the accuracy of the data that has been collected will be checked by comparing readings taken by the sondes to known standards. If the measurements taken at this time meet quality control goals, all of the data collected since the last calibration will be considered accurate. The acceptable differences for pH and conductivity will be $\pm$0.3 with pH 7 buffer and $\pm$ 10% of the conductivity standard, respectively (EPA New England- Region 1, 2005). The acceptable difference for DO will be $\pm$0.2 mg/L. If the measurements do not meet quality control goals, best professional judgment will be used to decide if any of the data collected during that period may still be accurate. For example, the data collected from the four locations may be plotted on the same graph, and if it appears that the data points are following similar trends, they may be considered accurate. If any data that do not meet quality control goals are used, a rationale for their inclusion will be provided when the data are submitted.

(9) Work Products

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

graphically presenting and discussing the IBI (LIBI, where applicable), MIwb, ICI (LICI, where applicable) and QHEI (L-QHEI, where applicable) 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) |
|---|---|---|---|---|
| Seth Hothem[1] | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | hothems@neorsd.org | 216-641-6000 | QDC - 00010 CWQA/FCB/SHA/ BMB |
| Kelsey Amidon | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | amidonk@neorsd.org | 216-641-6000 | QDC – 01091 CWQA |
| Nya Aron | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | aronn@neorsd.org | 216-641-6000 | QDC – 01139 BMB |
| Donna Friedman | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | friedmand@neorsd.org | 216-641-6000 | QDC – 01031 CWQA/SHA |
| Jillian Knittle | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | knittlej@neorsd.org | 216-641-6000 | QDC – 00512 CWQA/SHA/BMB |
| Ron Maichle | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | maichler@neorsd.org | 216-641-6000 | QDC - 00145 CWQA/SHA/BMB |
| Mark Matteson | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | mattesonm@neorsd.org | 216-641-6000 | QDC – 01031 CWQA/FCB/SHA |
| John Rhoades | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | rhoadesj@neorsd.org | 216-641-6000 | QDC - 00008 CWQA/FCB/SHA/ BMB |
| Francisco Rivera | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | riveraf@neorsd.org | 216-641-6000 | QDC - 00262 CWQA/SHA |
| Eric Soehnlen | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | soehnlene@neorsd.org | 216-641-6000 | QDC – 01030 CWQA/SHA/BMB |
| Cathy Zamborsky | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | zamborskyc@neorsd.org | 216-641-6000 | QDC - 00009 CWQA/SHA |
| Jonathan Brauer[2] | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | brauerj@neorsd.org | 216-641-6000 | QDC – 00663 SHA |
| Bert Remley[3] | 2526 Regency Road, Suite 180 Lexington, Kentucky 40503 | bremley@thirdrockconsultants.com | 859-977-2000 | QDC – 00837 BMB |

[1] NEORSD Lead Project Manager
[2] See acknowledgement letter for conducting QHEIs (Appendix F)
[3] Benthic Macroinvertebrate Identification

The following is a list of persons not qualified as Level 3 QDCs who may be involved in the project. Prior to the start of sampling, the project managers will explain to each individual the proper methods for sampling. Sampling will only be completed under the direct observation of a QDC. The lead project manager will be responsible for reviewing all reports and data analysis prepared by qualified personnel prior to completion.

| Name | Address | Email Address | Phone Number |
|---|---|---|---|
| Lindsay Baker | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | bakerl@neorsd.org | 216-641-6000 |
| Nick Barille | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | barillen@neorsd.org | 216-641-6000 |
| Mark Colvin | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | colvinm@neorsd.org | 216-641-6000 |
| Rae Grant | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | grantr@neorsd.org | 216-641-6000 |
| Mario Meany | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | meanym@neorsd.org | 216-641-6000 |
| Carrie Millward | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | millwardc@neorsd.org | 216-641-6000 |
| 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 |
| Joseph Schiel | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | schielj@neorsd.org | 216-641-6000 |
| Frank Schuschu | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | schuschuf@neorsd.org | 216-641-6000 |
| William Stanford | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | standfordw@neorsd.org | 216-641-6000 |
| Nicole Velez | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | velezn@neorsd.org | 216-641-6000 |
| Wolfram von Kiparski | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | vonkiparskiw@neorsd.org | 216-641-6000 |
| Hannah Boesinger | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | boesingerh@neors.org | 216-641-6000 |
| James Ferritto | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | ferrittoj@neorsd.org | 216-641-6000 |
| Sarah Foley | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | foleys@neorsd.org | 216-641-6000 |
| Justin Telep | 4747 East 49th Street Cuyahoga Hts., Ohio 44125 | telepj@neorsd.org | 216-641-6000 |

(11) Contract laboratory contact information

All bacteriological and/or chemical sample analysis will be completed by NEORSD's Analytical Services Division. Evidence of NEORSD's Analytical Services current accreditation and method dates can be found in Appendix E. The contact information for NEORSD's Analytical Service Division is:

NEORSD Analytical Services
Mr. Mark Citriglia
4747 E. 49th Street
Cuyahoga Heights, Ohio 44056
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.

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 Third Rock Consultants LLC (Lexington, Kentucky)[3]. Benthic macroinvertebrates will be identified to the lowest practical level as recommended by Ohio EPA (1987b). Third Rock Consultants LLC contact information:

Mr. Bert Remley
Third Rock Consultants LLC
2526 Regency Road, Suite 180
Lexington, Kentucky 40503
bremley@thirdrockconsultants.com
859-977-2000

(12) Copy of ODNR collector's permit

See Appendix G.

(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: Seth Hothem / _____ Date: 4/19/17

[3] A letter of acknowledgement of the macroinvertebrate identification responsibilities will be added as an addendum to this study plan, in Appendix F, upon finalization of the macroinvertebrate identification contract.

(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 laboratory in the Environmental and Maintenance Services Center.

Print/Signature: Seth Hothem/ _____ Date: 4/19/17

(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: Seth Hothem/ _____ Date: 4/19/17

(16) Additional L3 Data Collector Statement

The Lead Project Manager for all stream locations is approved for all project data types.

Print/Signature: Seth Hothem/ _____ Date: 4/19/17

(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: Seth Hothem/ Seth Hothem Date: 4/19/17

Print/Signature: Kelsey Amidon/ Kelsey Amidon Date: 4/19/17

Print/Signature: Nya Aron/ Nya L Aron Date: 4/19/17

Print/Signature: Donna Friedman/ Donna Friedman Date: 4/19/17

Print/Signature: Jillian Knittle/ Jillian Knittle Date: 4/19/17

Print/Signature: Ron Maichle/ Ron Maichle Date: 04-19-17

Print/Signature: Mark Matteson/ Mark Matteson Date: 4/19/17

Print/Signature: John Rhoades/ John Rhoades Date: 04/19/17

Print/Signature: Francisco Rivera/ Francisco Rivera Date: 4/19/17

Print/Signature: Eric Soehnlen/ Eric Soehnlen Date: 04/19/17

Print/Signature: Cathy Zamborsky/ Cathy Zamborsky Date: 4/19/17

# Appendix A

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**
**D**eformities, **E**rosions, **L**esions, **T**umors
**M**ultiple 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 | | | | | | | | | | | | | | |

**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 (QDC Circled): _____

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

Reinstall Date: _____ Crew (QDC Circled): _____

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

Reinstall Date: _____ Crew (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 (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

**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 over HD:* | Open | 75 % | 50 % | 25 % | Closed | | |

**Comment Section:** _____

**OEPA Comment Field Codes:** _____

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

## 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 | Tree Roots |
| Grass | Water Willow | Woody Debris |
| Shallows | Clay/Hardpan | Macrophytes |
| 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 |
| / / | Heptageniidae, Leptohyphidae, Caenidae |
| | Other _____ |
| / | Zygoptera, Anisoptera |
| | Plecoptera |
| | Hemiptera |
| / | Megaloptera, Neuroptera |
| | Trichoptera |
| | Hydropsychidae |
| / | Hydroptilidae, Leptoceridae |
| | Other _____ |
| | Coleoptera |
| | Elimidae |
| | Other _____ |
| | Diptera |
| | Chironomidae |
| | Other _____ |
| / | Gastropoda, Bivalvia |
| | Other _____ |

*Field Narrative Rating:* E VG G MG F P VP

# 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

Check ONE (*Or 2 & average*)

| 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]

**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]

***Substrate*** ____ *Maximum 20*

***Comments***

## 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]

***Cover*** ____ *Maximum 20*

***Comments***

## 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]

***Channel*** ____ *Maximum 20*

***Comments***

## 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.*

***Riparian*** ____ *Maximum 10*

***Comments***

## 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)**

***Pool / Current*** ____ *Maximum 12*

***Comments***

**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]

***Riffle / Run*** ____ *Maximum 8*

***Comments***

## 6] *GRADIENT* ( ft/mi)

**DRAINAGE AREA** ( mi²)

- ☐ VERY LOW - LOW [2-4]
- ☐ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

**%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

1st pass _____ cm

2nd _____ cm

### C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

*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:*

# Lake / Lacustuary (Lentic) QHEI Field Sheet

Ohio Environmental Protection Agency

QHEI Score: ☐

RIVERCODE_____ RIVERMILE _____ WATERBODY _____ DISTANCE ASSESSED (m): _____
DATE _____ LOCATION _____
SCORER_____ LAT. _____ LONG. _____ COMMENT _____

**1] SUBSTRATE** (Check *ONLY* Two Substrate TYPE BOXES; Estimate % or note every type present); LAKE:_____ LACUSTUARY:_____

| TYPE | SHORE | BOTTOM | | SHORE | BOTTOM |
|---|---|---|---|---|---|
| ☐☐-BLDR/SLABS [7] | | | ☐☐-HARDPAN [4] | | |
| ☐☐- BOULDER [10] | | | ☐☐- BEDROCK [3] | | |
| ☐☐- COBBLE [8] | | | ☐☐- DETRITUS [3] | | |
| ☐☐- GRAVEL [7] | | | ☐☐- SILT [2] | | |
| ☐☐- SAND [6] | | | ☐☐- MUCK [2] | | |

**SUBSTRATE ORIGIN** Check ONE (or 2 & *AVERAGE*)
☐-LIMESTONE [1]
☐-TILLS [1]
☐-WETLANDS [1]
☐-LACUSTUARINE [1]
☐-SANDSTONE [1]
☐-RIP/RAP [1]
☐-HARDPAN [0]
☐-SHALE [-1]
☐-COAL/ORE [-2]

**SILT ORIGIN:**

**SUBSTRATE QUALITY** Check ONE (or 2 & *AVERAGE*)
☐-SILT HEAVY [-2]
☐-SILT MODERATE [-1]
☐-SILT NORMAL [0]
☐-SILT FREE [1]
☐-CLAY [-2]
☐-INDUSTRIAL [-1]
☐-ORGANIC [1]
☐-NONE [1]

Substrate ☐ Max 20

NOTE: Ignore sludge that originates from point-sources, score on natural substrates
NUMBER OF SUBSTRATE TYPES ☐- 5 or More [2] ☐- 4 or Less [0]

COMMENTS: _____

**2] COVER TYPES** **TYPE:** (Check *All* That Apply) **AMOUNT**: (Check *ONLY* One or check2 and AVERAGE)

| | | |
|---|---|---|
| ☐-OFF-SHORE SAND BARS [4] | ☐-DEEPWATER > 1 M [1] | ☐-WETLAND POOLS [1] |
| ☐-OVERHANGING VEGETATION [1] | ☐-ROOTWADS [1] | ☐-SUBMERGED AQUATIC VEG. [4] |
| ☐-SHALLOWS (ON BEACH) [1] | ☐-BOULDERS [1] | ☐-LOGS OR WOODY DEBRIS [1] |
| ☐-ROOTMATS [1] | ☐-SAND BEACH [1] | ☐-GRAVEL BEACH [1] |

☐-EXTENSIVE > 75% [9]
☐-MODERATE 25-75% [7]
☐-SPARSE 5-25% [3]
☐-NEARLY ABSENT < 5% [1]

Cover ☐ Max 20

COMMENTS: _____

**3] SHORELINE MORPHOLOGY** (Check *ONLY* one PER category or check 2 and *AVERAGE*)

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

**DEVELOPMENT**
☐-EXCELLENT [6]
☐-GOOD [5]
☐-FAIR [3]
☐-POOR [1]

**MODIFICATION**
☐-NONE [7]
☐-RECOVERED [5]
☐-RECOVERING [3]
☐-RECENT OR NO RECOVERY [1]

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

**SHORE to BOTTOM SLOPE MORPHOLOGIES**
☐-SLOPE < 15 deg. [0] ☐- SLOPE > 45 deg. [2]
☐-SLOPE < 25 deg. [1] ☐-SLOPE 90 deg. [0]
☐-SLOPE > 25 deg. [3]

**AVERAGE DEPTH** (of 5 measures)
☐- < 50 cm [0] ☐- > 400 – 500 cm [4]
☐- 50 - <100 cm [1] ☐- > 500 - 900 cm [2]
☐- ≥100 - 200 cm [2] ☐- >900 cm [1]
☐- >200-4 00 cm [3]

**MODIFICATIONS OF SAMPLED SHORELINE**
☐- CEMENTED [-1] ☐- STEEL BULKHEADS [-2]
☐-RIP RAPPED [1] ☐-ISLANDS [1]
☐-RAILROAD TIES [-1] ☐-DIKES [-1]
☐-DREDGED [-1] ☐-BANK SHAPING [-1]
☐-TWO SIDE CHANNEL MODIFICATIONS [-1] ☐-WOOD PILINGS [1]
☐-SHIP CHANNEL [-2]

Shore Line ☐ Max 20

COMMENTS: _____

★ Shore Right Looking East or South on Lake ★
★ Shore Right Looking Toward Lake in Lacustuary ★

**4] RIPARIAN ZONE AND BANK EROSION** (Check *ONE* box PER bank or 2 and *AVERAGE*)

**RIPARIAN WIDTH** L R (Per Bank)
☐☐-WIDE > 50 m [4]
☐☐-MODERATE 10-50 m [3]
☐☐-NARROW 5-10 m [2]
☐☐-VERY NARROW < 5 m [1]
☐☐-NONE [0]

**SHORE LINE QUALITY (PAST 100 FOOT RIPARIAN)** L R (Most Predominant Per Bank)
☐☐-FOREST, WETLAND, LAKE [3]
☐☐- SHRUB OR OLD FIELD [2]
☐☐-VINEYARD, ORCHARD [2]
☐☐-FENCED PASTURE [1]
☐☐-RESIDENTIAL, PARK, NEW FIELD [1]

L R
☐☐-CONSERVATION TILLIAGE [1]
☐☐-URBAN OR INDUSTRIAL [0]
☐☐-OPEN PASUTRE, ROWCROP [0]
☐☐-MINING/CONSTRUCTION [0]
☐☐- DIKED WETLAND [0]

**BANK EROSION** L R (Per Bank)
☐☐-NONE/LITTLE [3]
☐☐-MODERATE [-1]
☐☐-HEAVY/SEVERE [-3]

Riparian ☐ Max 10

COMMENTS: _____

**5] AQUATIC VEGETATION QUALITY:** PLANT SPECIES OBSERVED (Sum All Scores)
(Score all for observed abundance: ABUNDANT = [3]; COMMON = [5]; FEW = [1]; UNCOMMON = [0]) _____NO AQUATIC VEGETATION = 0

____-Pond Lilies (NYMPHAEA) ____-Sedge (CYPERACEAE) ____-Wild Celery (VALLISNERIA)
____-Pond Weed (POTAMOGETON) ____-Bulrush (SCIRPUS) ____-Waterweed (ELODEA) ____-Wild Rice (ZIZANIA)

(Score all for observed abundance: ABUNDANT = [-2]; COMMON = [-1]; FEW = [0])

____-Purple Loosestrife ____-Reed Grass ____-Eurasian Milfoil ____-Cattails ____-Algae (mats) ____-Algae (planktonic)

Vegetation ☐ Max 30

COMMENTS: _____

Is the Sampling Reach Representative of Area Habitat? (Y/N)____ If Not, Explain: _____

Depth measures: | | | | | | |

Zebra Mussel/Quagga Mussel Coverage ☐ - >60% ☐ - 60 - >25% ☐ - 25 - >10% ☐ - <10 - >1% ☐ - 1 – 0%

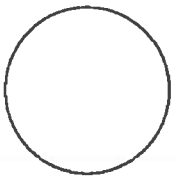
| | Gear | Distance | Water Clarity | Wave Height |
|---|---|---|---|---|
| First Sampling Pass: | _____ | _____ | _____ | _____ |
| Second Sampling Pass: | _____ | _____ | _____ | _____ |
| Third Sampling Pass: | _____ | _____ | _____ | _____ |

Subjective Rating (1 – 10) ☐ Aesthetic Rating (1 – 10) ☐

Photos: _____

WATERBODY MEASUREMENTS: AVERAGE WIDTH: _____ AVERAGE DEPTH: _____ Maximum Depth: _____

**DRAWING OF SITE:**

**North Arrow:** 

# 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 Other: _____

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): _____ Sp. Cond. (µmhos/cm): _____

Dissolved Oxygen (mg/L): _____ D.O. (%): _____

Temperature (°C): _____ pH (s.u.): _____

Turbidity 1 (NTU): _____ Turbidity 2 (NTU): _____ Average (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 Other: _____

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): _____ Sp. Cond. (µmhos/cm): _____

Dissolved Oxygen (mg/L): _____ D.O. (%): _____

Temperature (°C): _____ pH (s.u.): _____

Turbidity 1 (NTU): _____ Turbidity 2 (NTU): _____ Average (NTU): _____

Sample ID:

General Comments: _____

# Appendix B

| Parameter | Additional Name | Test | Unit | 2017 Minimum Detection Limit | 2017 Practical Quantitation Limit |
|---|---|---|---|---|---|
| Alkalinity | Alkalinity | EPA 310.2 | mg/L | 4.36 | 10.0 |
| Mercury | Hg | EPA 245.1 | µg/L | 0.025 | 0.050 |
| Ammonia [1] | $NH_3$ | EPA 350.1 | mg/L | 0.010 | 0.020 |
| Nitrite | NO2 | SM 4500 $NO_2^-$ B [2] | mg/L | 0.005 | 0.020 |
| Nitrite + Nitrate | $NO_2 + NO_3$ | EPA 353.2 | mg/L | 0.010 | 0.020 |
| Total Kjeldahl Nitrogen | TKN | EPA 351.2 | mg/L | 0.237 | 0.500 |
| Dissolved Reactive Phosphorus | DRP | EPA 365.1 | mg/L | 0.0034 | 10.0000 |
| Low Level Dissolved Reactive Phosphorus | LLDRP | EPA 365.1 | µg/L | 0.42[a] | 1.00[a] |
| Total Phosphorus | Total-P | EPA 365.1 | mg/L | 0.002 | 0.010 |
| Chloride | Chloride by IC | EPA 300.0 | mg/L | 2.500 | 5.000 |
| Sulfate | Sulfate by IC | EPA 300.0 | mg/L | 2.500 | 5.000 |
| Silver | Ag | EPA 200.8 | µg/L | 0.127 | 0.500 |
| Aluminum | Al | EPA 200.8 | µg/L | 2.500 | 5.000 |
| Arsenic | As | EPA 200.8 | µg/L | 0.582 | 2.000 |
| Barium | Ba | EPA 200.8 | µg/L | 0.134 | 0.500 |
| Beryllium | Be | EPA 200.8 | µg/L | 0.094 | 0.500 |
| Calcium | Ca | EPA 200.8 | µg/L | 28.216 | 125.000 |
| Cadmium | Cd | EPA 200.8 | µg/L | 0.053 | 0.500 |
| Cobalt | Co | EPA 200.8 | µg/L | 0.036 | 0.500 |
| Chromium | Cr | EPA 200.8 | µg/L | 0.477 | 1.000 |
| Copper | Cu | EPA 200.8 | µg/L | 0.110 | 1.000 |
| Iron | Fe | EPA 200.8 | µg/L | 2.104 | 5.000 |
| Potassium | K | EPA 200.8 | µg/L | 53.799 | 250.000 |
| Magnesium | Mg | EPA 200.8 | µg/L | 12.053 | 125.000 |
| Manganese | Mn | EPA 200.8 | µg/L | 0.127 | 1.000 |
| Molybdenum | Mo | EPA 200.8 | µg/L | 0.119 | 0.500 |
| Sodium | Na | EPA 200.8 | µg/L | 21.836 | 250.000 |
| Nickel | Ni | EPA 200.8 | µg/L | 0.104 | 2.000 |
| Lead | Pb | EPA 200.8 | µg/L | 0.084 | 0.500 |
| Antimony | Sb | EPA 200.8 | µg/L | 0.397 | 1.000 |
| Selenium | Se | EPA 200.8 | µg/L | 0.622 | 2.500 |
| Tin | Sn | EPA 200.8 | µg/L | 0.668 | 5.000 |
| Strontium | Sr | EPA 200.8 | µg/L | 0.066 | 0.500 |
| Titanium | Ti | EPA 200.8 | µg/L | 0.237 | 1.000 |
| Thallium | Tl | EPA 200.8 | µg/L | 0.098 | 0.500 |
| Vanadium | V | EPA 200.8 | µg/L | 2.069 | 5.000 |
| Zinc | Zn | EPA 200.8 | µg/L | 0.313 | 5.000 |
| Total Metals | Total Metals (calc.) | EPA 200.8 | µg/L | µg/L =(Cr µg/L)+(Cu µg/L)+(Ni µg/L)+(Zn µg/L) | |
| Hardness | Hardness (calc.) | SM 2340 [2] | mg/L | CaCO3 mg/L =(2.497*Ca mg/L)+(4.118*Mg mg/L) | |
| *Escherichia coli* | *E. coli* | EPA 1603 | cfu/100mL | 1 colony | -- |
| | | Colilert QT (SM 9223 B 20th Ed) | MPN/100mL | 1 MPN | 1 MPN |
| Chlorophyll *a* | Chlorophyll *a* | EPA 445.0 | µg/L | 0.02 | 0.1 |
| Chemical Oxygen Demand | COD | EPA 410.4 | mg/L | 4.6 | 10 |
| Biological Oxygen Demand | BOD | SM 5210 [2] | mg/L | 2 | N/A |
| Total Solids | TS | SM 2540 B [2] | mg/L | 1 | 5 |
| Total Suspended Solids | TSS | SM 2540 D [2] | mg/L | 0.5 | 1 |
| Total Dissolved Solids | TDS | SM 2540 C [2] | mg/L | 1 | 5 |
| Turbidity ** | | EPA 180.1 | NTU | 0.1 | 0.2 |
| **Field Parameter** | | **Test** | **(Value Reported in)** | | |
| pH | | EPA 150.1 [2] | s.u. | | |
| Conductivity | | SM 2510A [2] | µs/cm | | |
| Specific Conductivity | | SM 2510B [2] | µs/cm | | |
| Dissolved Oxygen | DO | SM 4500-0 G [2] | mg/L | | |
| Temperature | Temp | EPA 1701.1 [2] | °C | | |
| Turbidity ** | | EPA 180.1 | NTU | | |

[1] Listed MDL/PQL is for undistilled samples. Any samples that require distillation will have a MDL = 0.051 mg/L, PQL = 0.100 mg/L

[2] Standard Methods for the Examination of Water and Wastewater, Method approved by Standard Methods Committee, 1997. Editorial revisions, 2011.

[a] 2017 MDL and PQL not yet determined as of 04/27/2017. Values listed are 2016 MDL/PQL.

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

# Appendix C

Y S I Environmental

# YSI 556 Multiparameter System

## *Versatile, multiparameter handheld instrument*

Rugged and reliable, the YSI 556 MPS (Multiprobe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multiparameter system.

- Simultaneously measures dissolved oxygen, pH, conductivity, temperature, and ORP
- Field-replaceable electrodes
- Compatible with EcoWatch® for Windows® data analysis software
- Stores over 49,000 data sets, time and date stamped, interval or manual logging
- Three-year warranty on the instrument; one-year on the probes
- GLP assisting, records calibration data in memory
- Available with 4, 10, and 20-m cable lengths
- IP-67, impact-resistant, waterproof case
- Easy-to-use, screw-on cap DO membranes
- RS-232 interface for PC connection

*The 556 has multiple language capabilities and graphing!*

Pure Data for a Healthy Planet.®

*A rugged, cost-effective multiparameter handheld system designed for the field!*

## *Options to Fit Your Applications!*

- Battery Options – The unit is powered by alkaline batteries or an optional rechargeable battery pack with quick-charge feature.
- Optional Barometer – Internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure. (Choose 556-02)
- Optional Flow Cell - The 5083 flow cell can be used for ground water applications or anytime water is pumped for sampling.
- Carrying Case – The instrument comes standard with YSI 5061, a soft-sided carrying case with enough space for the 556, a 20-meter cable, and calibrating supplies. An optional 5080 hard-sided carrying case is also available.
- Confidence Solution® - Quality assurance ensured. Quickly check conductivity, pH, and ORP readings with one solution.

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ISO 9001
ISO 14001



YSI incorporated
Who's Minding the Planet?™

## 5563 MPS Sensor Specifications

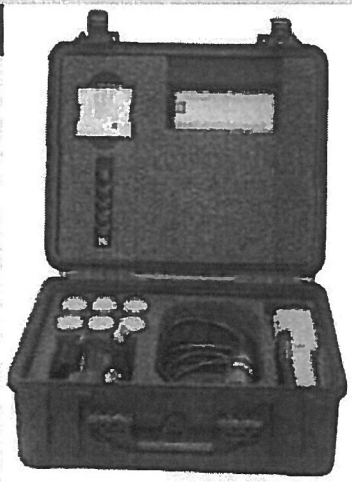
| | | |
|---|---|---|
| Dissolved Oxygen (% saturation) | Sensor Type | Steady state polarographic |
| | Range | 0 to 500% air saturation |
| | Accuracy | 0 to 200% air saturation, ± 2% of the reading or ±2% air saturation, whichever is greater; 200 to 500% air saturation, ± 6% of the reading |
| | Resolution | 0.1% air saturation |
| Dissolved Oxygen (mg/L) | Sensor Type | Steady state polarographic |
| | Range | 0 to 50 mg/L |
| | Accuracy | 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 | 0.01 mg/L |
| Temperature | Sensor Type | YSI Temperature Precision™ thermistor |
| | Range | -5 to 45°C |
| | Accuracy | ± 0.15°C |
| | Resolution | 0.1°C |
| Conductivity | Sensor Type | 4-electrode cell with autoranging |
| | 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 |
| pH (optional) | Sensor Type | Glass combination electrode |
| | Range | 0 to 14 units |
| | Accuracy | ±0.2 units |
| | Resolution | 0.01 units |
| ORP (optional) | Sensor Type | Platinum button |
| | Range | -999 to +999 mV |
| | Accuracy | ± 20 mV |
| | Resolution | 0.1 mV |
| Total Dissolved Solids (TDS) | Sensor Type | Calculated from conductivity (variable constant, default 0.65) |
| | Range | 0 to 100 g/L |
| | Resolution | 4 digits |
| Barometer (optional) | Range | 500 to 800 mm Hg |
| | Accuracy | ± 3 mm Hg within ± 10°C temperature range from calibration point |
| | Resolution | 0.1 mm Hg |

## YSI 556 Instrument Specifications

| | |
|---|---|
| Size | 11.9 cm width x 22.9 cm lenth (4.7 in. x 9 in.) |
| Weight with batteries | 2.1 lbs. (916 grams) |
| Power | 4 alkaline C-cells; optional rechargeable pack |
| Cables | 4-, 10-, and 20-m (13.1, 32.8, 65.6 ft.) lengths |
| Warranty | 3-year instrument; 1-year probes and cables |
| Communication Port | RS-232 Serial |
| Data Logger | 49,000 data sets, date and time stamp, manual or logging, with user-selectable intervals |

## 556 Ordering Information (Order all items separately)

| | |
|---|---|
| 556-01 | Instrument (with 5061 large, soft-sided carrying case) |
| 556-02 | Instrument with barometer option (with 5061 carrying case) |
| 5563-4 | 4-m cable and DO/temp/conductivity |
| 5563-10 | 10-m cable and DO/temp/conductivity |
| 5563-20 | 20-m cable and DO/temp/conductivity |
| 5564 | pH Probe for any 5563 cable |
| 5565 | pH/ORP Probe for any 5563 cable |
| 6118 | Rechargeable battery pack kit (includes battery, adapter, charger) |
| 614 | Ultra clamp, C-clamp mount |
| 616 | Charger, cigarette lighter |
| 4654 | Tripod (small tripod for instrument) |
| 5060 | Small carrying case, soft-sided (fits instrument and 4-m cable) |
| 5065 | Form-fitted carrrier with shoulder strap |
| 5080 | Small carrying case, hard-sided (fits instrument, 4-m cable, flow cell, batteries, membrane kit, calibration bottles) |
| 5083 | Flow cell |
| 5085 | Hands-free harness |
| 5580 | Confidence Solution® (insure probe accuracy with a simple field-check for conductivity, pH, and ORP) |



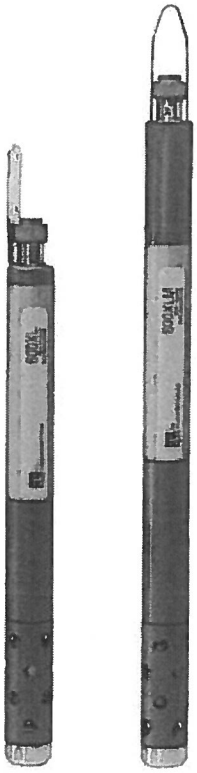
The 5080 carrying case with 556, 5563-4 cable, and 5083 flow cell.

# YSI 600XL and 600XLM Sondes

## *Measure multiple parameters simultaneously*

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

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



*The YSI 600XL and 600XLM*

## *Connect with Data Collection Platforms*

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

## *Economical Logging System*

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

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

Pure Data for a Healthy Planet.®

*Economical, multiparameter sampling or logging in a compact sonde*

## Sensor performance verified*

The 6820 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.

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ISO 9001
ISO 14001
Yellow Springs, Ohio Facility



CE

*Sensors with listed with the ETV logo were submitted to the ETV program on the Xylem 6000XLM. Information on the performance characteristics of YSI water quality sensors can be found at www.ysi.com, ysi.com/etv, or call YSI at 800.897.4151 for the ETV verification report. Use of the ETV name or logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

YSI incorporated
Who's Minding the Planet?

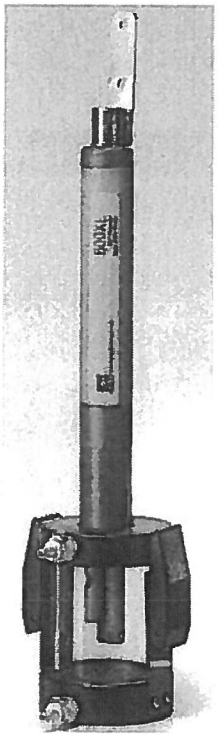
## YSI 600XL & 600XLM Sensor Specifications

| | | Range | Resolution | Accuracy |
|---|---|---|---|---|
| Dissolved Oxygen % Saturation 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 | 0 to 200 ft, 61 m | 0.001 ft, 0.001 m | ±0.4 ft, ±0.12 m |
| | Shallow | 0 to 30 ft, 9.1 m | 0.001 ft, 0.001 m | ±0.06 ft, ±0.02 m |
| | Vented Level | 0 to 30 ft, 9.1 m | 0.001 ft, 0.001 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 | -5 to +50°C |
| | Storage | -10 to +60°C |
| Communications | | RS-232, SDI-12 |
| Software | | EcoWatch® |
| Dimensions 600XL \| 600XLM | Diameter | 1.65 in, 4.19 cm \| 1.65 in, 4.9 cm |
| | Length | 16 in, 40.6 cm \| 21.3 in, 54.1 cm |
| | Weight | 1.3 lbs, 0.59 kg \| 1.5 lbs, 0.69 kg |
| Power | External | 12 V DC |
| | Internal (600XLM only) | 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.) |

# HQ30d Portable pH, Conductivity, Dissolved Oxygen (DO), ORP, and ISE Multi-Parameter Meter

Product #: HQ30D53000000 Quantity
USD Price: $792.00

★★★★★ 5/5
Read 1 review Write a review Follow this product

**Portable meter measures critical water quality parameters - without the need for multiple instruments**
Single input channel for flexible measurement of pH, Conductivity, Dissolved Oxygen (DO), BOD, ORP, Ammonia, Ammonium, Fluoride, Chloride, Sodium, and temperature - any intelliCAL™ smart probe

**Intuitive user interface for simple operation and accurate results**
Guided calibration and check standard routines reduce calibration errors. Stabilization alerts and visual measurement lock ensure that you can trust the accuracy of the results

**Trust your measurements - intelliCAL™ smart probes store all calibrations in the probe**
Calibration history allows quick and easy change out of probes without re-calibrating. The HQd™ smart system records serial numbers, current calibration data, user ID, sample ID, time, and date automatically in the data log for complete GLP traceability

**Designed for demanding conditions**
Rugged, waterproof (IP67) meter provides worry-free, reliable operation in lab or field environments

**Convenient kit includes everything you need to start testing**
Meter kit includes, 4 AA batteries, quick-start guide, user manual, and documentation CD

Specifications

| | |
|---|---|
| AC and USB Operation | optional |
| Automatic Buffer Recognition | Color-coded: 4.01, 7.00, 10.01 pH<br>IUPAC: 1.679, 4.005, 7.000, 10.012, 12.45<br>DIN: 1.09, 4.65, 9.23<br>User-defined custom buffer sets |
| Barometric Pressure Measurement | For automatic compensation of DO when using an LDO or LBOD probe |
| Battery Requirements | 4, AA |
| Benchtop | with stand |
| BOD5/CBOD resolution | Available when used with Hach WIMS BOD Manager software |
| Cable resistance correction | Digital - not needed |
| Calibration curves display | Calibration summary data logged and displayed |
| Calibration Intervals/Alerts/Reminder | 2 hours to 7 days |
| Compliance | CE, WEEE |
| Conductivity Accuracy | ± 0.5 % from (1µS/cm - 200 mS/cm) |
| Conductivity measurement | 5 different stability modes |
| Conductivity Measurement Range | 0.01 µS/cm to 200 mS/cm |
| Conductivity resolution | 0.01 µS/cm with 2 digits |
| Custom Calibration Standards | User-defined standard sets |
| Data Export | Download via USB connection to PC or flash stick.<br>Automatically transfer entire data log or as readings are taken |
| Data Memory | 500 results |
| Digital (intelligent) electrode inputs | 2 |
| Dimensions (H x W x D) | 7.8 in. x 3.7 in. x 1.4 in. (197 mm x 95 mm x 36 mm) |
| Display | Display readings from one or two probes<br>Simultaneous readings from two probes (HQ40d only)<br>pH: pH, mV, temperature<br>Conductivity: Conductivity, TDS, salinity, resistivity, temperature<br>LDO: dissolved oxygen, pressure, temperature<br>LBOD: dissolved oxygen, pressure, temperature<br>ORP/Redox: mV, temperature<br>Sodium: Sodium, mV, temperature |
| Display Lock Function | Continuous measurement or press to read mode available with averaging function for LDO measurement. |
| Display Type | 240 x 160 pixel Display readings from one or two probes<br>pH: pH, mV, temperature<br>Conductivity: Conductivity, TDS, salinity, resistivity, temperature<br>LDO: dissolved oxygen, pressure, temperature<br>ORP/Redox: mV, temperature<br>Sodium: Sodium, mV, temperature |
| DO Measurement Range | 0.01 to 20 mg/L (0 to 200%) |
| DO Resolution | 0.01 mg/L |
| Fixed Buffer Selection | IUPAC standards<br>(DIN 19266) or Technical buffer (DIN 19267) or 4-7-10 series or user defined |
| Inputs | M12 digital (1)<br>for intelliCAL probes |
| Interface Languages | 13** |
| Internal Data Storage | 500 |
| IP Rating | IP67 |
| Languages: | English, French, German, Italian, Spanish, Danish, Dutch, Polish, Portuguese, Turkish, Swedish, Czech, Russian |
| mV Accuracy | ± 0.1 mV |
| mV Measurement at Stable Reading | 5 (auto) stabilization settings |
| mV Resolution | 0.1 mV |
| Operating Error Messages | Text messages displayed |
| Operating Humidity | 90 % relative humidity (non-condensing) |
| Operating Interface | Keypad |
| Operating Temperature | 5 to 45 °C |
| ORP Electrode Calibration | Predefined ORP standards (including Zobell's solution) |
| Outputs | USB to PC / flash stick |
| PC Data Transfer Software | Included |
| pH Measurement at stable reading | 5 stabilization settings |
| Printer | Optional accessory |
| Salinity Resolution | 0.01 ppt |
| Warranty | 3 years |
| Water Resistance | Meter Casing: 1 meter submersion for 30 minutes (IP67) |
| Weight | 0.74 lbs. (0.335 kg) |

# 2100P and 2100P IS Portable Turbidimeter

*The Hach 2100P and 2100P IS Portable Turbidimeters bring laboratory-level performance on-site, offering fast, accurate results and the ease-of-use analysts demand in the field. With a measurement range of 0 to 1000 NTU and a resolution of 0.01 NTU, the 2100P turbidimeter is ideal for regulatory monitoring, process control or field studies.*

## Features and Benefits

### Laboratory Quality in a Portable Unit

The Hach 2100P and 2100P IS Portable Turbidimeters offer a level of performance previously possible only with laboratory instruments. Microprocessor-controlled operation and Hach's unique Ratio™ optics bring great accuracy, sensitivity, and reliability to field and in-plant testing.

### Two Models for Specific Requirements

- **2100P Turbidimeter**—*Get fast, accurate turbidity testing in the field or the lab, over a wide range of samples. Compliant with USEPA Method 180.1 design criteria.*
- **2100P IS Turbidimeter**—*Designed to meet international standards that mandate measurement using an LED light source.*

### Two-detector Optical System

The two-detector optical system compensates for color in the sample, light fluctuation, and stray light, enabling analysts to achieve laboratory-grade performance on a wide range of samples, even under difficult, onsite conditions.

## Specifications*

| | 2100P | 2100P IS |
|---|---|---|
| **Measurement Method** | Nephelometric Ratio | |
| **Regulatory** | Meets EPA Method 180.1 | Meets EN ISO 7027 |
| **Light Source** | Tungsten lamp | Light-emitting diode (LED) @ 860 nm |
| **Range** | | |
| ***Automatic Range Mode*** | 0 to 1000 NTU | 0 to 1000 FNU |
| ***Manual Range Selection*** | 0 to 9.99, 0 to 99.9 and 0 to 1000 NTU | 0 to 9.99, 0 to 99.9 and 0 to 1000 FNU |
| **Accuracy** | ±2% of reading plus stray light | |
| **Repeatability** | ±1% of reading, or 0.01 NTU, whichever is greater | ±1% of reading, or 0.01 FNU, whichever is greater |
| **Resolution** | 0.01 on lowest range | |
| **Signal Averaging** | Selectable on/off | |
| **Power Requirement** | 4 AA alkaline batteries or optional battery eliminator | |
| **Battery Life, Typical** | 300 tests with signal average mode off<br>180 tests with signal average mode on | |
| **Operating Temperature** | 0 to 50°C (32 to 122°F) | |
| **Sample Required** | 15 mL (0.5 oz.) | |
| **Sample Cells** | 60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw caps | |
| **Dimensions** | 22.2 x 9.5 x 7.9 cm (8.75 x 3.75 x 3.12 in.) | |
| **Weight** | 0.5 kg (1.1 lb.); shipping weight 2.7 kg (6 lb.) | |
| **Warranty** | 2 years | |

**Specifications subject to change without notice.*

*DW = drinking water WW = wastewater municipal PW = pure water / power*
*IW = industrial water E = environmental C = collections FB = food and beverage*

HACH®

Be Right™

# 2100Q and 2100Q *is* Portable Turbidimeter




*The Hach 2100Q and 2100Q is Portable Turbidimeters offer unsurpassed ease of use and accuracy in turbidity measurement. Only Hach offers this unique combination of advanced features, such as assisted calibration and simplified data transfer, and measurement innovation, giving you accurate results every time.*



## Features and Benefits

### Easy Calibration and Verification

Hach 2100Q and 2100Q *is* Portable Turbidimeters provide confidence your measurements are right every time. On-screen assisted calibration and verification save you time and ensure accuracy. With an easy-to-follow interface, complicated manuals are not needed to perform routine calibrations. Single-standard RapidCal™ calibration offers a simplified solution for low level measurements.

### Simple Data Transfer

Data transfer with the optional USB + Power Module is simple, flexible, and doesn't require additional software. All data can be transferred to the module and easily downloaded to your computer with a USB connection, providing superior data integrity and availability. With two different module options, you can customize connectivity and power to meet your unique needs.

### Accurate for Rapidly Settling Samples

The Hach 2100Q Portable Turbidimeter incorporates an innovative Rapidly Settling Turbidity™ mode to provide accurate, repeatable measurements for difficult to measure, rapidly settling samples. An exclusive algorithm that calculates turbidity based on a series of automatic readings eliminates redundant measurements and estimating.

### Convenient Data Logging

Up to 500 measurements are automatically stored in the instrument for easy access and backup. Stored information includes: date and time, operator ID, reading mode, sample ID, sample number, units, calibration time, calibration status, error messages and the result.

### Optical System for Precision in the Field

The two-detector optical system compensates for color in the sample, light fluctuation, and stray light, enabling analysts to achieve laboratory-grade performance on a wide range of samples, even under difficult site conditions.

### Two Models for Specific Requirements

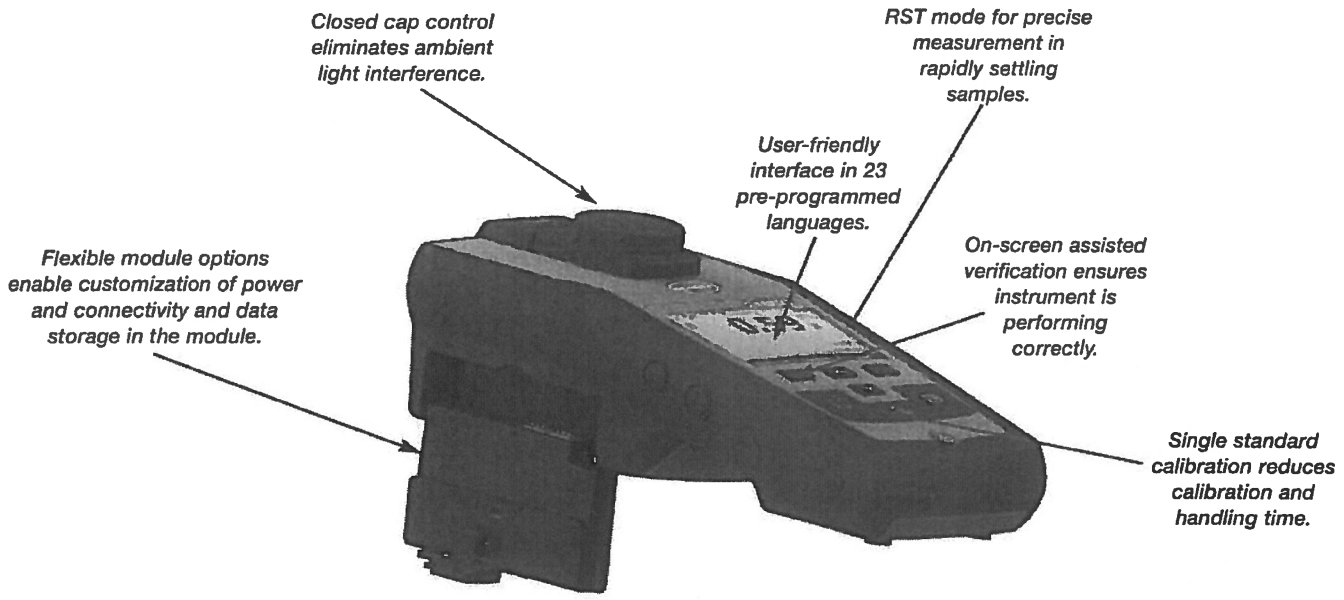
- **2100Q Turbidimeter**—*Compliant with USEPA Method 180.1 design criteria.*
- **2100Q *is* Turbidimeter**—*Compliant with ISO 7027 design criteria.*

*DW = drinking water WW = wastewater municipal PW = pure water / power*
*IW = industrial water E = environmental C = collections FB = food and beverage*

HACH®

*Be Right™*

## Key Features




## Specifications*

*Measurement Method*
Ratio turbidimetric determination using a primary nephelometric light scatter signal (90°) to the transmitted light scatter signal.

*Regulatory*
2100Q: Meets EPA Method 180.1
2100Q *is:* Meets ISO 7027

*Light Source*
2100Q: Tungsten filament lamp
2100Q *is:* Light-emitting diode (LED) @ 860 nm

*Range*
0 to 1000 NTU (FNU)

*Accuracy*
±2% of reading plus stray light from 0 to 1000 NTU

*Repeatability*
±1% of reading, or 0.01 NTU (FNU), whichever is greater

*Resolution*
0.01 NTU on lowest range

*Stray Light*
<0.02 NTU (FNU)

*Signal Averaging*
Selectable on/off

*Detector*
Silicon photovoltaic

*Reading Modes (user selectable)*
Normal (Push to Read)
Signal Averaging
Rapidly Settling Turbidity

*Data Logger*
500 records

*Power Requirement*
110-230 Vac, 50/60 Hz (with Power or USB+Power Module)
4 AA alkaline batteries
Rechargeable NiMH (for use with USB+Power Module)

*Operating Conditions*
*Temperature:* 0 to 50°C (32 to 122°F)
*Relative Humidity:* 0 to 90% @ 30°C,
0 to 80% @ 40°C, 0 to 70% @ 50°C, noncondensing

*Storage Conditions*
-40 to 60°C (-40 to 140°F), instrument only

*Languages*
English, French, German, Italian, Spanish, Portuguese (BR), Portuguese (PT), Bulgarian, Chinese, Czech, Danish, Dutch, Finnish, Greek, Hungarian, Japanese, Korean, Polish, Romanian, Russian, Slovenian, Swedish, Turkish

*Interface*
Optional USB

*Instrument Enclosure Rating*
IP67 (closed lid, battery compartment excluded)

*Protection Class*
Power Supply: Class II

*Certification*
CE certified

*Sample Required*
15 mL (0.3 oz.)

*Sample Cells*
60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw cap

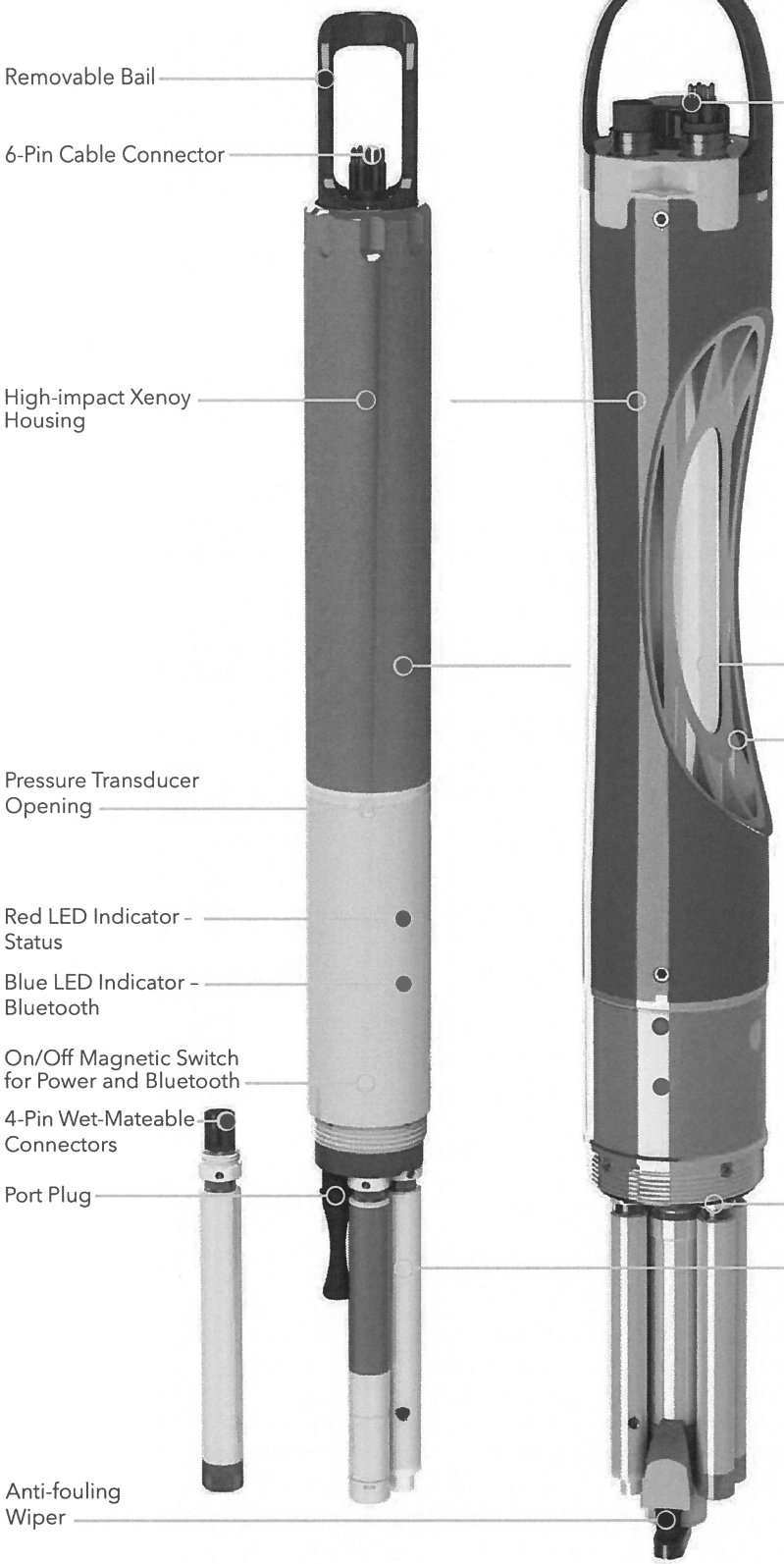
*Dimensions*
22.9 x 10.7 x 7.7 cm (9.0 x4.2 x 3.0 in.)

*Weight*
527 g (1.16 lb) without batteries
618 g (1.36 lb) with four AA alkaline batteries

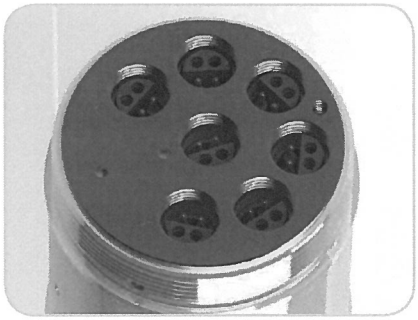
*Warranty*
1 year

**Specifications subject to change without notice.*

# Sondes: EXO1 EXO2



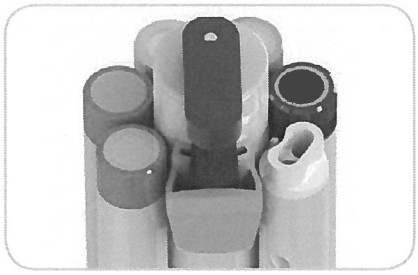

Cable connector, battery valve, and expansion port for an additional sensor



EXO2 sonde contains 6 universal sensor ports plus a central port for an anti-fouling wiper

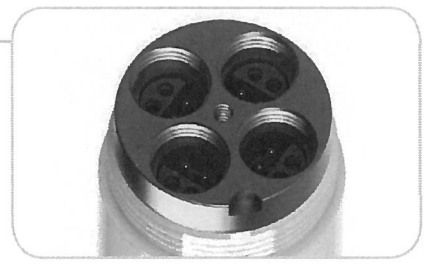
Battery Compartment

Cutaway: Reinforced internal structure



Anti-fouling wiper keeps sensors clear of biofouling and lengthens deployment times by 25%

Welded Titanium Housing



EXO1 sonde contains 4 universal sensor ports

## Instrument Specifications*

| EXO1 Sonde | | |
|---|---|---|
| Ports | 4 sensor ports<br>Peripheral port: 1 power communication port | |
| Size | Diameter: 4.70 cm (1.85 in)<br>Length: 64.77 cm (25.50 in) | |
| Weight | 1.42 kg (3.15 lbs) with 4 probes, guard and batteries installed | |
| **EXO2 Sonde** | | |
| Ports | 7 sensor ports (6 ports available when central wiper used)<br>Peripheral ports: 1 power communication port; 1 auxiliary expansion port | |
| Size | Diameter: 7.62 cm (3.00 in)<br>Length: 71.10 cm (28.00 in) | |
| Weight | 3.60 kg (7.90 lbs) with 5 probes, guard and batteries installed | |
| **Sondes** | | |
| Operating Temperature | -5 to 50°C | |
| Storage Temperature | -20 to 80°C (except 0 to 60°C for pH and pH/ORP sensors) | |
| Depth Rating | 0 to 250 m (0 to 820 ft) | |
| Communications | Computer Interface: Bluetooth wireless technology, RS-485, USB<br>Output Options: USB with signal output adapter (SOA); RS-232 & SDI-12 with DCP-SOA | |
| Sample Rate | Up to 4 Hz | |
| Battery Life | 90 days** | |
| Data Memory | 512 MB total memory; >1,000,000 logged readings | |
| **Sensors** | | **Calculated Parameters** |
| Ammonium | ORP | Salinity |
| Chloride | pH | Specific Conductance |
| Conductivity | Temperature | Total Dissolved Solids |
| Depth | Total Algae (Chlorophyll + BGA-PC or PE) | Total Suspended Solids |
| Dissolved Oxygen | Turbidity | |
| Fluorescent Dissolved Organic Matter (fDOM) | Vented Level | |
| Nitrate | | |
| **EXO Handheld** | | |
| Size | Width: 12.00 cm (4.72 in)<br>Height: 25.00 cm (9.84 in) | |
| Weight | 0.71 kg (1.56 lbs) without batteries | |
| Operating System | Windows CE 5.0 | |
| Operating Temperature | -10 to 50°C | |
| Storage Temperature | -20 to 80°C | |
| IP Rating | IP-67 | |
| Data Memory | 2 GB total memory; >2,000,000 data sets | |
| **Accessories** | | |
| Cables (vented and non-vented) | Flow cells | Sonde/sensor guard |
| Carrying case | KOR software | Calibration cup |
| DCP Signal Output Adapter | USB Signal Output Adapter | Anti-fouling components |
| **Warranty** | | |
| 3 months | Replaceable reagent modules for ammonium, chloride, and nitrate | |
| 1 Year | Optical DO membranes and replaceable reagent moldules for pH and pH/ORP | |
| 2 Years | Cables; sonde bulkheads; handheld; conductivity, temperature, depth, and optical sensors; electronics base for pH, pH/ORP, ammonium, chloride, and nitrate sensors; and accessories | |

* Specifications indicate typical performance and are subject to change. Please check EXOwater.com for up-to-date information.

** Typically 90 days at 20°C at 15-minute logging interval; temperature/conductivity, pH/ORP, DO, and turbidity sensors installed on EXO1; or temperature/conductivity, pH/ORP, DO, total algae, and turbidity sensors installed with central wiper that rotates once per logging interval on EXO2. Battery life is heavily dependent on sensor configuration.

EXO Bluetooth modules comply with Part 15C of FCC Rules and have FCC, CE Mark and C-tick approval. Bluetooth-type approvals and regulations can be country specific. Check local laws and regulations to insure that the use of wireless products purchased from Xylem are in full compliance.

## Sensor Specifications*

| Sensor | Range | Accuracy* | Response | Resolution |
|---|---|---|---|---|
| Ammonium [11] (ammonia with pH sensor) | 0 to 200 mg/L [1] | ±10% of reading or 2 mg/L-N, w.i.g. | - | 0.01 mg/L |
| Barometer | 375 to 825 mmHg | ±1.5 mmHg from 0 to 50°C | - | 0.1 mmHg |
| Blue-green Algae Phycocyanin (PC) (part of Total Algae sensor) | 0 to 100 RFU; 0 to 100 µg/L PC | Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 100 µg/mL PC equivalents | T63<2 sec | 0.01 RFU; 0.01 µg/L PC |
| Blue-green Algae Phycoerythrin (PE) (part of Total Algae sensor) | 0 to 100 RFU; 0 to 280 µg/L PE | Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 280 µg/mL PE equivalents | T63<2 sec | 0.01 RFU; 0.01 µg/L PE |
| Chloride [11] | 0 to 1000 mg/L-Cl [2] | ±15% of reading or 5 mg/L-Cl, w.i.g. | - | 0.01 mg/L |
| Chlorophyll (part of Total Algae sensor) | 0 to 400 µg/L Chl; 0 to 100 RFU | Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 400 µg/L Chl equivalents | T63<2 sec | 0.01 µg/L Chl; 0.01 RFU |
| Conductivity [3] | 0 to 200 mS/cm | 0 to 100: ±0.5% of reading or 0.001 mS/cm, w.i.g.; 100 to 200: ±1% of reading | T63<2 sec | 0.0001 to 0.01 mS/cm (range dependent) |
| Depth [4] (non-vented) | 0 to 10 m (0 to 33 ft) | ±0.04% FS (±0.004 m or ±0.013 ft) | T63<2 sec | 0.001 m (0.001 ft) (auto-ranging) |
| | 0 to 100 m (0 to 328 ft) | ±0.04% FS (±0.04 m or ±0.13 ft) | | |
| | 0 to 250 m (0 to 820 ft) | ±0.04% FS (±0.10 m or ±0.33 ft) | | |
| Vented Level | 0 to 10 m (0 to 33 ft) | ±0.03% FS (±0.003 m or ±0.010 ft) | | |
| Dissolved Oxygen Optical | 0 to 500% air saturation | 0 to 200%: ±1% of reading or 1% saturation, w.i.g.; 200 to 500%: ±5% of reading [5] | T63<5 sec [6] | 0.1% air saturation |
| | 0 to 50 mg/L | 0 to 20 mg/L: ±0.1 mg/L or 1% of reading, w.i.g.; 20 to 50 mg/L: ±5% of reading [5] | | 0.01 mg/L |
| fDOM | 0 to 300 ppb Quinine Sulfate equivalents (QSE) | Linearity: $R^2 > 0.999$ for serial dilution of 300 ppb QS solution Detection Limit: 0.07 ppb QSE | T63<2 sec | 0.01 ppb QSE |
| Nitrate [11] | 0 to 200 mg/L-N [1] | ±10% of reading or 2 mg/L-N, w.i.g. | - | 0.01 mg/L |
| ORP | -999 to 999 mV | ±20 mV in Redox standard solutions | T63<5 sec [7] | 0.1 mV |
| pH | 0 to 14 units | ±0.1 pH units within ±10°C of calibration temp; ±0.2 pH units for entire temp range [8] | T63<3 sec [9] | 0.01 units |
| Salinity (Calculated from Conductivity and Temperature) | 0 to 70 ppt | ±1.0% of reading or 0.1 ppt, w.i.g. | T63<2 sec | 0.01 ppt |
| Specific Conductance (Calculated from Cond. and Temp.) | 0 to 200 mS/cm | ±0.5% of reading or .001 mS/cm, w.i.g. | - | 0.001, 0.01, 0.1 mS/cm (auto-scaling) |
| Temperature | -5 to 50°C | -5 to 35°C: ±0.01°C [10] 35 to 50°C: ±0.05°C [10] | T63<1 sec | 0.001 °C |
| Total Dissolved Solids (TDS) (Calculated from Conductivity and Temperature) | 0 to 100,000 g/L Cal constant range 0.30 to 1.00 (0.64 default) | Not Specified | - | variable |
| Total Suspended Solids (TSS) (Calculated from Turbidity and user reference samples) | 0 to 1500 mg/L | Not Specified | T63<2 sec | variable |
| Turbidity [11] | 0 to 4000 FNU | 0 to 999 FNU: 0.3 FNU or ±2% of reading, w.i.g.; 1000 to 4000 FNU: ±5% of reading [12] | T63<2 sec | 0 to 999 FNU: 0.01 FNU; 1000 to 4000 FNU: 0.1 FNU |

All sensors have a depth rating to 250 m (820 ft), except shallow and medium depth sensors and ISEs. EXO sensors are not backward compatible with 6-Series sondes.

* Specifications indicate typical performance and are subject to change. Please check EXOwater.com for up-to-date information.
Accuracy specification is attained immediately following calibration under controlled and stable environmental conditions. Performance in the natural environment may vary from quoted specification.

[1] 0-30°C [2] 0-40°C w.i.g. = whichever is greater

[3] Outputs of specific conductance (conductivity corrected to 25°C) and total dissolved solids are also provided. The values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (Ed. 1989).

[4] Accuracy specifications apply to conductivity levels of 0 to 100,000 µS/cm.

[5] Relative to calibration gases

[6] When transferred from air-saturated water to stirred deaerated water

[7] When transferred from water-saturated air to Zobell solution

[8] Within the environmental pH range of pH 4 to pH 10

[9] On transfer from water-saturated air to rapidly stirred air-saturated water at a specific conductance of 800 µS/cm at 20°C; T63<5 seconds on transfer from water-saturated air to slowly-stirred air-saturated water.

[10] Temperature accuracy traceable to NIST standards

[11] Calibration: 1-, 2-, or 3-point, user-selectable

[12] Specification is defined in AMCO-AEPA Standards

# FH950 Portable Velocity Meter with 20' Cable

**Product #:** FH950.10020 Quantity
**USD Price:** $4,585.00
**Ships within 2 weeks**

**Reduce manhours 50%**
The step-by-step user interface simplifies programming, delivers real-time data, and downloads directly to PC allowing a single person to take the readings and eliminating post site visit manual data transfer from logbook to PC

**Automatically calculates total discharge based on USGS and ISO methods**
Reduces time to manually calculate and likelihood of errors

**Real-time velocity graphed on color display**
Visualize velocity trends quickly

**Lowest maintenance solution on the market**
Electromagnetic velocity sensor with no moving parts never requires mechanical maintenance

**Lightweight, rugged portable meter**
Only 1.5 pounds

## What's in the box

FH950.1 System Includes:
- Portable Velocity Meter
- Electromagnetic Sensor with 20' cable
- Fabric Carrying Case
- Adjustable Meter Rod Mount
- Universal Sensor Mount
- Battery Charger with Domestic/International Plug Adapters
- USB Cable
- Lanyard
- Sensor Screw Kit
- Absorbent Wipe

## Specifications

| | |
|---|---|
| Accuracy 2: | ± 2% of reading ± 0.05 ft/s (± 0.015 m/s) through the range of 0 to 10 ft/s (0 to 3.04 ms/s); ± 4% of reading from 10 to 16 ft/s (3.04 to 4.87 m/s) |
| Battery Life: | heavy typical day use; 68°F (20°C) |
| Display: LCD: | Color, LCD 3.5 QVGA transflective (readable in direct sunlight) |
| Keypad: | Alpha-numerica |
| Operating Temperature Range: | -20 to 55 °C |
| Range: | to ft/s |
| Resolution: | Measurement Resolution - <10: 0.001; <100: 0.01; >100: 0.1 |
| Storage Conditions: | -20 °C to 60 °C |

Appendix D

# 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 | Area of individual scrape |
|---|---|
| 1_____ | 1_____ |
| 2_____ | 2_____ |
| 3_____ | 3_____ |
| 4_____ | 4_____ |
| 5_____ | 5_____ |
| 6_____ | 6_____ |
| 7_____ | 7_____ |
| 8_____ | 8_____ |
| 9_____ | 9_____ |
| 10_____ | 10_____ |
| 11_____ | 11_____ |
| 12_____ | 12_____ |
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| 14_____ | 14_____ |
| 15_____ | 15_____ |
| 16_____ | 16_____ |
| 17_____ | 17_____ |
| 18_____ | 18_____ |
| 19_____ | 19_____ |
| 20_____ | 20_____ |
| 21_____ | 21_____ |
| 22_____ | 22_____ |
| 23_____ | 23_____ |
| 24_____ | 24_____ |
| 25_____ | 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*

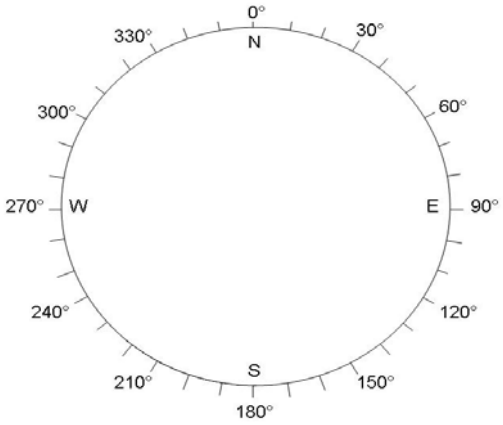
*Explain_____

**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 E

# COMMONWEALTH OF PENNSYLVANIA
# DEPARTMENT OF ENVIRONMENTAL PROTECTION

*BUREAU OF LABORATORIES*

*LABORATORY ACCREDITATION PROGRAM*

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certifies That

**68-03670**

**Northeast Ohio Regional Sewer District Analytical Services**

**4747 East 49th Street, Cuyahoga Heights, OH 44125**

NELAP RECOGNIZED TNI ACCREDITATION BODY

Having duly met the requirement of
The act of June 29, 2002 (P.L. 596, No. 90)
dealing with Environmental Laboratories Accreditation
(27 Pa. C.S. §§4104-4113) and the
National Environmental Laboratory Accreditation Program Standard

is hereby approved as an

## Accredited Laboratory

to conduct analysis within the fields of accreditations more fully described in the attached Scope of Accreditation

Expiration Date: **11/30/2017**

Certificate Number: **010**

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

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

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

# Laboratory Scope of Accreditation

**Attached to Certificate of Accreditation 010-001 expiration date November 30, 2017. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.**

**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**
**PADWIS ID: 03670**


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


## Matrix: Drinking Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 1603 | | E. coli (Enumeration) | NELAP | PA | 12/16/2015 |
| SM 9222 B | | Total coliform (Enumeration) | NELAP | PA | 12/16/2015 |

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| ASTM D4839-03 | | Total organic carbon (TOC) | NELAP | PA | 11/25/2014 |
| 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 | E | Mercury | NELAP | PA | 3/31/2008 |
| EPA 1664 | A | Oil and grease | NELAP | PA | 4/27/2015 |
| EPA 180.1 | | Turbidity | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Aluminum | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Antimony | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Arsenic | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Barium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Beryllium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Cadmium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Calcium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Chromium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Cobalt | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Copper | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Iron | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Lead | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Magnesium | NELAP | PA | 11/17/2010 |
| EPA 200.7 | 4.4 | Manganese | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Molybdenum | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Nickel | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Potassium | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Selenium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Silver | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Sodium | NELAP | PA | 12/31/2007 |
| EPA 200.7 | 4.4 | Strontium | NELAP | PA | 4/27/2015 |
| EPA 200.7 | 4.4 | Thallium | NELAP | PA | 4/15/2014 |
| EPA 200.7 | 4.4 | Tin | NELAP | PA | 11/29/2007 |

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

# Laboratory Scope of Accreditation

**Attached to Certificate of Accreditation 010-001 expiration date November 30, 2017. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.**

**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**
**PADWIS ID: 03670**

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 200.7 | 4.4 | Titanium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Vanadium | NELAP | PA | 11/29/2007 |
| EPA 200.7 | 4.4 | Zinc | NELAP | PA | 12/31/2007 |
| EPA 200.8 | 5.4 | Aluminum | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Antimony | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Arsenic | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Barium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Beryllium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Cadmium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Calcium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Chromium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Cobalt | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Copper | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Iron | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Lead | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Magnesium | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Manganese | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Molybdenum | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Nickel | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Potassium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Selenium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Silver | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Sodium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Strontium | NELAP | PA | 12/1/2015 |
| EPA 200.8 | 5.4 | Thallium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Tin | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Titanium | NELAP | PA | 8/12/2015 |
| EPA 200.8 | 5.4 | Vanadium | NELAP | PA | 4/27/2015 |
| EPA 200.8 | 5.4 | Zinc | NELAP | PA | 4/27/2015 |
| EPA 245.1 | 3.0 | Mercury | NELAP | PA | 11/29/2007 |
| EPA 300.0 | 2.1 | Bromide | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Chloride | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Fluoride | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Nitrate as N | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Nitrite as N | NELAP | PA | 4/27/2015 |
| EPA 300.0 | 2.1 | Orthophosphate as P | NELAP | PA | 11/22/2010 |
| EPA 300.0 | 2.1 | Sulfate | NELAP | PA | 11/22/2010 |
| EPA 3005 | A | Preconcentration under acid | NELAP | PA | 11/29/2007 |
| EPA 3010 | A | 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 | 9/20/2012 |
| 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 |

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

# Laboratory Scope of Accreditation

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**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**

**PADWIS ID: 03670**

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 365.1 | | Orthophosphate as P | NELAP | PA | 12/1/2015 |
| 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 6010 | | Aluminum | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Antimony | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Arsenic | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Barium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Beryllium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Cadmium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Calcium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Chromium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Cobalt | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Copper | NELAP | PA | 12/31/2007 |
| EPA 6010 | | Iron | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Lead | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Magnesium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Manganese | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Molybdenum | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Nickel | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Potassium | NELAP | PA | 12/31/2007 |
| EPA 6010 | | Selenium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Silver | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Sodium | NELAP | PA | 12/31/2007 |
| EPA 6010 | | Thallium | NELAP | PA | 4/15/2014 |
| EPA 6010 | | Tin | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Titanium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Vanadium | NELAP | PA | 11/29/2007 |
| EPA 6010 | | Zinc | NELAP | PA | 12/31/2007 |
| EPA 7470 | | Mercury | NELAP | PA | 11/29/2007 |
| Enterolert | | Enterococci (Enumeration) | NELAP | PA | 11/22/2010 |
| Lachat 10-204-00-1X | | Cyanide | NELAP | PA | 12/1/2015 |
| OIA 1677 | | Available cyanide | NELAP | PA | 11/29/2007 |
| 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 | 20-22 | Chromium VI | 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-Cl- C | | Chloride | NELAP | PA | 11/19/2012 |
| SM 4500-H+ B | | pH | NELAP | PA | 11/29/2007 |
| SM 4500-NO2- B | | Nitrite as N | NELAP | PA | 11/29/2007 |

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# Laboratory Scope of Accreditation

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**DEP Laboratory ID: 68-03670** **EPA Lab Code: OH00300** **TNI Code: TNI02140** **(216) 641-6000**

**PADWIS ID: 03670**

## Matrix: Non-Potable Water

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| SM 4500-Norg B | | Kjeldahl nitrogen, total (TKN) | NELAP | PA | 10/22/2008 |
| SM 4500-P B | | Preliminary treatment of phosphate samples | NELAP | PA | 11/13/2013 |
| SM 4500-P E | | Orthophosphate as P | NELAP | PA | 11/13/2013 |
| 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 D | | Fecal coliform (Enumeration) | NELAP | PA | 11/29/2007 |
| SM 9223 Colilert MPN or QT | | E. coli (Enumeration) | NELAP | PA | 11/29/2007 |
| SM 9223 Colilert MPN or QT | | Total coliform (Enumeration) | NELAP | PA | 11/22/2010 |

## Matrix: Solid and Chemical Materials

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 245.1 | 3.0 | Mercury | NELAP | PA | 11/22/2010 |
| EPA 3051 | | Microwave digestion of solids (HNO3 only) | NELAP | PA | 11/17/2010 |
| EPA 350.1 | | Ammonia as N | NELAP | PA | 4/27/2015 |
| EPA 351.2 | | Kjeldahl nitrogen, total (TKN) | NELAP | PA | 4/27/2015 |
| EPA 365.1 | | Phosphorus, total | NELAP | PA | 4/27/2015 |
| EPA 6010 | | Aluminum | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Antimony | NELAP | PA | 11/13/2013 |
| EPA 6010 | | Arsenic | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Barium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Beryllium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Cadmium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Calcium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Chromium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Cobalt | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Copper | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Iron | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Lead | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Magnesium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Manganese | NELAP | PA | 11/22/2010 |
| EPA 6010 | B | Metals by ICP/AES | NELAP | PA | 1/22/2013 |
| EPA 6010 | | Molybdenum | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Nickel | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Potassium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Selenium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Silver | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Sodium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Strontium | NELAP | PA | 4/27/2015 |
| EPA 6010 | | Thallium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Tin | NELAP | PA | 4/15/2013 |
| EPA 6010 | | Titanium | NELAP | PA | 11/22/2010 |
| EPA 6010 | | Vanadium | NELAP | PA | 11/22/2010 |

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**PADWIS ID: 03670**

## Matrix: Solid and Chemical Materials

| Method | Revision | Analyte | Accreditation Type | Primary | Effective Date |
|---|---|---|---|---|---|
| EPA 6010 | | Zinc | NELAP | PA | 11/22/2010 |

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Appendix F

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

April 19, 2017

Mr. Seth Hothem
Supervisor of Environmental Assessment
Northeast Ohio Regional Sewer District
4747 East 49th Street
Cuyahoga Heights, Ohio 44125

Dear Mr. Hothem:

This letter is to acknowledge that I am responsible for assisting the Northeast Ohio Regional Sewer District's Water Quality and Industrial Surveillance Division in conducting stream habitat assessments using the Qualitative Habitat Evaluation Index for the 2017 Cuyahoga River, Cuyahoga River Tributaries, Rocky River, Euclid Creek, and Mill Creek Highland Hills Golf Course Restoration Environmental Monitoring Project Study Plans.

It is understood that an Ohio Environmental Protection Agency Level 3 Qualified Data Collector Certification for Stream Habitat Assessment is required to perform these tasks and that I am responsible for maintaining my Level 3 QDC Certification during the term of these Study Plans.

In addition, I have not been convicted nor 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.

Sincerely,

Jonathan Brauer
Stormwater Inspector
Northeast Ohio Regional Sewer District
4747 East 49th Street
Cuyahoga Heights, Ohio, 44125

# Appendix G

*To be submitted once received from Ohio Division of Wildlife*

Appendix H

## References


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

EPA New England- Region 1. (2005). *Standard operating procedure for calibration and field measurement procedures for the YSI Model 6-Series Sondes and Data Logger (Including: temperature, pH, specific conductance, turbidity, dissolved oxygen, chlorophyll, rhodamine WT, ORP, and barometric pressure)* (7th Revision). North Chelmsford, MA: The Office of Environmental Measurement and Evaluation, Ecosystem Assessment- Ecology Monitoring Team.

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