Level 3 Project Study Plan

2012 Greater Cleveland Area Lake Erie Nutrient Study

(1) Objectives

Over the last few years, there has been a significant increase in the occurrence of harmful algal blooms within the central basin of Lake Erie. In 2011, an algal bloom, the majority of which consisted of *Microcystis*, spread east of Cleveland and persisted there until the middle of October. The increase in algae throughout the lake is thought to be due to increases in dissolved reactive phosphorus and other nutrients (Ohio EPA, 2011). Northeast Ohio Regional Sewer District (NEORSD) facilities, such as its wastewater treatment plants and the combined sewer overflows (CSOs), could be a potential source of nutrients to the lake. The extent to which these potential sources, along with other ones within the study area, are contributing to the problem is not well known.

The purpose of this study is to monitor the levels of nutrients and algae in Lake Erie near the greater Cleveland area from May through October and attempt to establish temporal and spatial trends among them. Chlorophyll *a* will be measured as a means of determining the total quantity of algae present. Nutrient analyses will include both phosphorus and nitrogen. Other water quality parameters that may also influence algal production will also be measured (Section 3).

(2) Point/Nonpoint Sources

Point Sources	Nonpoint Sources
Easterly WWTP	Urban Runoff
Westerly WWTC	Spills
NEORSD-owned CSOs	Agriculture
Cuyahoga River	
Rocky River	
Euclid Creek	
Nine-Mile Creek	
Dugway Brook	
Doan Brook	
Shaw Brook	
Green Creek	

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 nutrient and algal levels within Lake Erie.

(3) Parameters Covered

Water chemistry samples will be collected by boat at each site and analyzed by NEORSD's Analytical Services. Chemical and physical water quality parameters to be measured in conjunction with water column chlorophyll *a* samples include total phosphorus, dissolved reactive phosphorus, nitrate+nitrite, alkalinity, turbidity and suspended solids. Appendix A lists the parameters to be tested, detection limits, practical quantitation limits, and the dates that the methods are effective from. Field measurements for dissolved oxygen (DO), 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 B).

(4) Field Collection and Data Assessment Techniques

Techniques used for water chemistry sampling and chemical analyses will follow the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009a). Chemical water quality samples from each site will be collected by boat with one 4-liter disposable polyethylene cubitainer with disposable polypropylene lids and one 473-mL plastic bottle. All water quality samples will be collected as grab samples at a depth of 0.5m. One duplicate sample and one field blank will be collected at randomly selected sites at a frequency of not less than 10% of the total samples collected for this study plan. The acceptable relative percent difference (RPD) for field duplicate samples will be ≤40 percent; results outside this range will trigger further evaluation and investigation into causes for disparities. RPD values above 40 percent, with results less than ten times the practical quantitation limit, will be reviewed on a case-by-case basis to determine if there is any merit for further investigation. Acid preservation of the samples, as specified in the NEORSD laboratory's standard operating procedure for each parameter, will occur in the field. Appendix A lists the analytical method, method detection limit and practical quantitation limit for each parameter analyzed. Field analyses include the use of either a YSI-556 MPS Multi-Parameter Water Quality Meter or YSI 600XL sonde to measure dissolved oxygen (DO), water temperature, conductivity and pH; and when necessary, a Hanna HI 98129 meter to measure pH and a Hach LDO meter to measured DO. Turbidity will be measured using either a Hach 2100P IS Portable Turbidimeter, a Hach 2100Q Portable Turbidimeter, a LaMotte 2020*e* Portable Turbidity Meter, or an Orion AQUAfast AQ4500 Turbidimeter. Specifications for these meters have been included in Appendix C.

Water column chlorophyll *a* samples will be collected during each sampling event using a 1L glass amber-colored jar. Samples will be collected at a depth of 0.5m and placed on ice in a cooler until being transported back to the NEORSD laboratory for filtration and analysis as detailed in US EPA Method 445.0. One duplicate chlorophyll *a* sample will be collected at randomly selected sites at a frequency of not less than 10% of the total samples collected for this study plan.

Where possible, data assessment will include an analysis of spatial and temporal trends in the collected data. 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.

(5) Stream Flow Measurements

Not applicable.

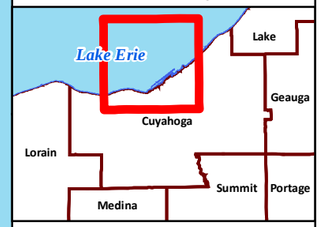
(6) Sampling Locations

The following sample locations on Lake Erie, listed from west to east, will be surveyed during the 2012 field season:

Water Body	Latitude	Longitude	Station ID	Location Information	USGS HUC 8 Number - Name	Purpose
Lake Erie	41.49720	-81.86200	RR1B	Near Rocky River	04120200-Lake Erie	Determine spatial trends in algal densities and nutrient concentrations in Lake Erie.
	41.59630	-81.80000	BRD17D	About 7 miles off shore of Lakewood		
	41.52080	-81.80000	BRD17I	Near Lakewood		
	41.54800	-81.76400	CW82	Near Garrett Morgan Water Intake		
	41.50765	-81.72907	WTP1	Near Westerly WWTC Diffusers		
	41.52500	-81.71170	CW88	Outside the City of Cleveland's Breakwall		
	41.54500	-81.67500	CE92	Outside the City of Cleveland’s Breakwall		
	41.60333	-81.59717	CE100	2 miles north of Easterly WWTP outfall		

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment

Overview Map



Greater Cleveland Area Lake Erie Nutrient Study

- CSO Outfall
- Outfalls
- Stream
- Interceptor
- CSO Responsibility
- Sludge Force Main
- Combined Sewer
- CSO Overflow Sewer
- Culverted Stream
- Sanitary Sewer
- Storm Sewer
- Force Main

Study Sites

- RR1B
  -Lat. 41.49720 Long. -81.86200
- BRD17D
  -Lat. 41.59630 Long. -81.80000
- BRD17I
  -Lat. 41.52080 Long. -81.80000
- CW82
  -Lat. 41.54800 Long. -81.76400
- CW88
  -Lat. 41.52500 Long. -81.71170
- CE92
  -Lat. 41.54500 Long. -81.67500
- CE100
  -Lat. 41.60333 Long. -81.59717
- WTP1
  -Lat. 41.50765 Long. -81.72907

5,200
Feet

N

Date: January 2012
Sources: Cuyahoga County GIS;
NEORSD GIS;

BRD17D
CE100
CW82
CE92
CW88
BRD17I
WTP1
RR1B
Lake Erie
Lake Erie
EASTERLY WWTP
WESTERLY WPCC
GJM ADMINISTRATION
Cleveland
Lakewood
Rocky River
Cuyahoga River
CSO-232
CSO-231
CSO-203
CSO-202
CSO-201
CSO-200
CSO-099
CSO-098
CSO-095
CSO-215
CSO-216
CSO-217
CSO-218
CSO-220
CSO-221
CSO-223
CSO-073
CSO-094
CSO-093
CSO-W3PS
CSO-092
CSO-075
CSO-SAPS
CSO-076
CSO-SLPS
CSO-074
CSO-079
CSO-078
CSO-002
CSO-071
CSO-069
CSO-235
CSO-040
CSO-086
CSO-087
CSO-037
CSO-036
CSO-035
CSO-088
CSO-085
CSO-058
CSO-068
CSO-067
CSO-065

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(7) Schedule

Water chemistry sampling will be attempted at least once per month in May, June, and July 2012 and twice per month in August, September, and October 2012. More frequent sampling may be conducted if deemed necessary based upon the extent of any algal blooms. Specific dates have not been chosen and will be dependent upon weather and lake conditions.

(8) QA/QC

Water samples obtained for chemical analyses will be collected, preserved [see section (4)], labeled and then placed on ice in a cooler on the boat until all samples are collected. The sample cooler will then be transferred to the field truck upon return to shore. The field truck will remain locked at all times when not occupied/visible. Sampling activities, including sample time and condition of surface water sampled, will be entered in a field log book and on the Surface Water Condition Sampling Field Data Form (Appendix B). 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 chlorophyll *a* sampling, three filtrations will be performed for each sample as recommended by US EPA Method 445.0. A field filtration blank will be submitted at a frequency of not less than 5% of the samples collected.

(9) Work Products

Within one year of completion of the project, water chemistry results will be submitted to the Ohio EPA. Additionally, reports summarizing, interpreting, graphically presenting and discussing the chlorophyll *a* results and any excursions from water quality standards may be prepared for internal use.

(10) Qualified Data Collectors

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

Name	Address	Email Address	Phone Number	QDC Specialty(s)
John W. Rhoades[1]	4747 East 49th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 00008 CWQA
Cathy Zamborsky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 00009 CWQA
Seth Hothem[2]	4747 East 49th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 00010 CWQA
Kathryn Crestani	4747 East 49th Street Cuyahoga Hts., Ohio 44125	crestanik@neorsd.org	216-641-6000	QDC - 00011 CWQA
Tom Zablotny	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zablotnyt@neorsd.org	216-641-6000	QDC - 00018 CWQA
Ron Maichle	4747 East 49th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 00145 CWQA
Francisco Rivera	4747 East 49th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 00262 CWQA
Kristina Granlund	4747 East 49th Street Cuyahoga Hts., Ohio 44125	granlundk@neorsd.org	216-641-6000	QDC – 00511 CWQA
Jillian Novak	4747 East 49th Street Cuyahoga Hts., Ohio 44125	novakj@neorsd.org	216-641-6000	QDC – 00512 CWQA

[1] Lead Project Manager [2] Chemical Water Quality Assessment (CWQA) Project Manager

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
Nick Barille	4747 East 49th Street Cuyahoga Hts., Ohio 44125	barillen@neorsd.org	216-641-6000
Jonathan Brauer	4747 East 49th Street Cuyahoga Hts., Ohio 44125	brauerj@neorsd.org	216-641-6000
Joseph Carbonaro	4747 East 49th Street Cuyahoga Hts., Ohio 44125	carbonaroj@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	dobrianskyt@neorsd.org	216-641-6000
Kyle Frantz	4747 East 49th Street Cuyahoga Hts., Ohio 44125	frantzk@neorsd.org	216-641-6000
Rae Grant	4747 East 49th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Mark Matteson	4747 East 49th Street Cuyahoga Hts., Ohio 44125	mattesonm@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
Kevin Roff	4747 East 49th Street Cuyahoga Hts., Ohio 44125	roffk@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000

Name	Address	Email Address	Phone Number
Wolfram von Kiparski	4747 East 49th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Kelly Boreman Summer Co-Op	4747 East 49th Street Cuyahoga Hts., Ohio 44125	boremank@neorsd.org	216-641-6000
NEORSD Summer Co-op #2	4747 East 49th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
NEORSD Summer Co-op #3	4747 East 49th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
NEORSD Summer Co-op #4	4747 East 49th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000

(11) Contract laboratory contact information

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

(12) Copy of ODNR collector's permit

Not applicable

(13) Catalog Statement

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

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

(14) Voucher Specimen Statement

Not applicable

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

(15) Sample Location Statement

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

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

(16) Additional L3 Data Collector Statement

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

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

(17) Trespassing Statement

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

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

Print/Signature: Cathy Zamborsky / Date: _____

Print/Signature: Seth Hothem / Date: _____

Print/Signature: Kathryn Crestani / Date: _____

Print/Signature: Tom Zablotny / Date: _____

Print/Signature: Ron Maichle / Date: _____

Print/Signature: Francisco Rivera / Date: _____

Print/Signature: Kristina Granlund / Date: _____

Print/Signature: Jillian Novak / Date: _____

References

Chlorophyll a Sampling and Field Filtering Standard Operating Procedure (SOP-EA00100)

Ohio Environmental Protection Agency. (2009b). *State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1* (Revision: Adopted July 9, 2009; Effective October 9, 2009). Columbus, OH: Division of Surface Water, Standards and Technical Support Section.

Ohio Environmental Protection Agency. (2009a). *Ohio EPA manual of surveillance methods and quality assurance practices*. Columbus, OH: Divisions of Surface Water and Environmental Services.

Ohio Environmental Protection Agency. (2011). *Draft Nutrient Reduction Strategy Framework for Ohio Waters*. Columbus, OH: Division of Surface Water.

Appendix A

Parameter	Additional Name	Test	Minimum Detection Limit	Practical Quantitation Limit
Alkalinity		EPA 310.2	1.5 mg/L	10 mg/L
Nitrite + Nitrate	$NO_2 + NO_3$	EPA 353.2	0.001 mg/L	0.010 mg/L
Nitrite	NO_2	SM 4500-$N0_2^-$ B. [1]	0.002 mg/L	0.010 mg/L
Nitrate	NO_3	EPA 353.2	0.001 mg/L	0.010 mg/L
Dissolved Reactive Phosphorus	DRPhos	EPA 365.1	0.002 mg/L	0.010 mg/L
Total Phosphorus	Total-P	EPA 365.1	0.001 mg/L	0.010 mg/L
Chlorophyll *a*	Chlorophyll *a*	EPA 445.0	0.03 µg/L	2.0 µg/L
Total Suspended Solids	TSS	SM 2540 D [1]	0.5 mg/L	1.0 mg/L
Turbidity **		EPA 180.1	0.1 NTU	0.2 NTU
Field Parameter		**Test**	**(Value Reported in)**	
pH		EPA 150.1 [1]	s.u.	
Conductivity		SM 2510A [1]	µs/cm	
Dissolved Oxygen	DO	SM 4500-0 G [1]	mg/L	
Temperature	Temp	EPA 1701.1 [1]	°C	
Turbidity *		EPA 180.1	NTU	

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

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

Appendix B

NEORSD Surface Water Condition Sampling Field Data Form

Stream: _____ Date: _____ Collectors: _____

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

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

Water Quality Meters Used: _____

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

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

Flow: Dry Intermittent Minimal Baseline/Normal Elevated Flood

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

Color: Clear Muddy Tea Milky Other: _____

Odor: Normal Petroleum Anaerobic Sewage Chemical Other: _____

Surface Coating: None Foam Oily Scum Other: _____

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

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

Turbidity (NTU): _____

Sample ID:

General Comments: _____

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

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

Flow: Dry Intermittent Minimal Baseline/Normal Elevated Flood

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

Color: Clear Muddy Tea Milky Other: _____

Odor: Normal Petroleum Anaerobic Sewage Chemical Other: _____

Surface Coating: None Foam Oily Scum Other: _____

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

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

Turbidity (NTU): _____

Sample ID:

General Comments: _____

Appendix C

14.1 Sensor Specifications

Dissolved Oxygen		
Sensor Type		Steady state polarographic
Range:	*% air sat'n*	▪ 0 to 500% air saturation
	mg/L	▪ 0 to 50 mg/L
Accuracy:	*% air sat'n*	▪ 0 to 200% air saturation: ±2% of the reading or 2% air saturation; whichever is greater ▪ 200 to 500% air saturation: ±6% of the reading
	mg/L	▪ 0 to 20 mg/L: ±2% of the reading or 0.2 mg/L; whichever is greater ▪ 20 to 50 mg/L: ±6% of the reading
Resolution:	*% air sat'n*	▪ 0.1% air saturation
	mg/L	▪ 0.01 mg/L
Temperature		
Sensor Type:		YSI Precision™ thermistor
Range:		-5 to 45°C
Accuracy:		±0.15°C
Resolution:		0.01°C
Conductivity		
Sensor Type:		4-electrode cell with auto-ranging
Range:		0 to 200 mS/cm
Accuracy:		±0.5% of reading or ±0.001 mS/cm; whichever is greater–4 meter cable ±1.0% of reading or ±0.001 mS/cm; whichever is greater–20 meter cable
Resolution:		0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity		
Sensor Type:		Calculated from conductivity and temperature
Range:		0 to 70 ppt
Accuracy:		±1.0% of reading or 0.1 ppt; whichever is greater
Resolution:		0.01 ppt

YSI 650 Multiparameter Display System

Rugged and Reliable Display and Data Logging System

The YSI 650 Multiparameter Display System

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

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

Feature-Packed Performance

Battery Life

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

Optional Barometer

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

Optional GPS Interface

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

Memory Options

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

Pure Data for a Healthy Planet.®

A powerful logging display for your data collection processes

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

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

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

YSI 650MDS Specifications

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

Ordering Information

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

The 650MDS can interface with any YSI sonde for
- *spot sampling*
- *short-term studies*
- *surface and ground water monitoring*
- *water level monitoring*

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

To order, or for more information, contact YSI

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CE

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Who's Minding the Planet?®

YSI 600XL and 600XLM Sondes

The YSI 600XL and 600XLM

Measure multiple parameters simultaneously

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

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

Connect with Data Collection Platforms

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

Economical Logging System

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

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

Pure Data for a Healthy Planet.®

Economical, multiparameter sampling or logging in a compact sonde

Sensor performance verified*

The 6820 V2 and 6920 V2 sondes use sensor technology that was verified through the US EPA's Environmental Technology Verification Program (ETV). For information on which sensors were performance-verified, turn this sheet over and look for the ETV logo.

ETV

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ISO 9001
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Yellow Springs, Ohio Facility

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

YSI incorporated
Who's Minding the Planet?®

YSI 600XL & 600XLM Sensor Specifications

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

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

YSI 600XL & 600XLM Sonde Specifications

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

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

HI 98129

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

Description

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

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

Specifications

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

2100P IS Portable Turbidimeter

Specifications

2100P Portable Turbidimeter Specifications:

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

Specifications subject to change.

MAIN PRODUCT PAGE

» 2100P IS Portable Turbidimeter

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USA: 800.344.3100
FAX: 410.778.6394

2020we & 2020wi Portable Turbidity Meters

The Clear Choice for Turbidity Measurement!

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

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

2020we Complies with USEPA 180.1 Standard

2020wi Complies with ISO 7027 Standard

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

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

Turbidity Specifications Meter Features Order Codes

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

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

Water Quality Turbidity Meter

geotech

Orion AQUAfast AQ4500 Turbidimeter

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

FEATURES

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

SPECIFICATIONS

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

CALL GEOTECH TODAY (800) 833-7958

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6600EDS Extended Deployment System

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

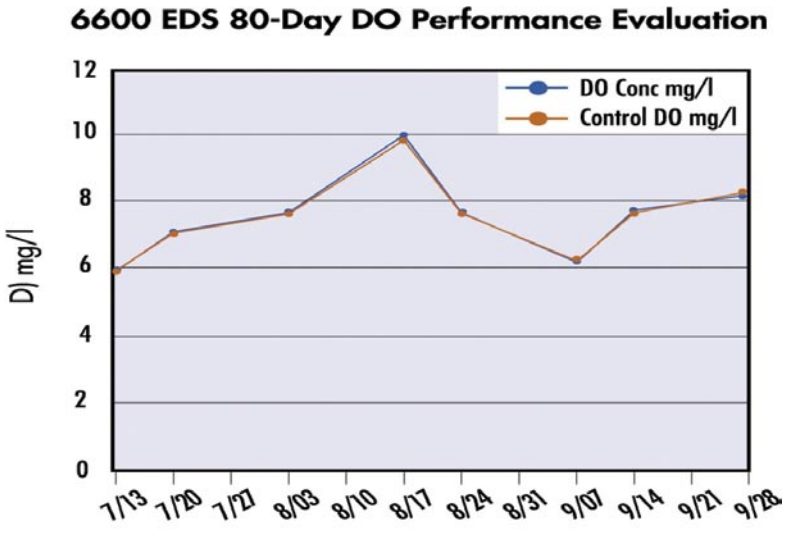
Profile of the 6600EDS depicting (clockwise from bottom) temperature/conductivity, turbidity, Rapid Pulse™ dissolved oxygen, chlorophyll and pH/ORP—all of which (except conductivity) are kept free of fouling by the patented Clean Sweep® universal wiper assembly, as well as individual optical wipers.

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

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

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

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



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

Pure Data for a Healthy Planet.®

*Sensor Performance verified by the EPA Environmental Technology Verification Program.**

ETV

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Sensor performance verified*

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

ETV

YSI 6600EDS Sensor Specifications

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

• Maximum depth rating for all standard optical sensors is 200 feet, 61 m. Also available in Deep Depth option: 656 feet, 200 m.
•• Report outputs of specific conductance (conductivity corrected to 25° C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed 1989).

**In YSI AMCO-AEPA Polymer Standards.

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

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

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

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

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

YSI 6600EDS Sonde Specifications

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

VII. Specifications

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

VIII. Maintenance

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