

Town Brook Monitoring Procedure Quincy, Massachusetts



Submitted to

City of Quincy

By:

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Introduction

The Town Brook Relocation project proposes to realign 1700 linear feet of culverted river from the Quincy Center to a new location as part of the Quincy Center Urban Revitalization District Plan. The proposed new alignment will consist of 1200 linear feet of channel of which approximately 264 feet will be open channel.

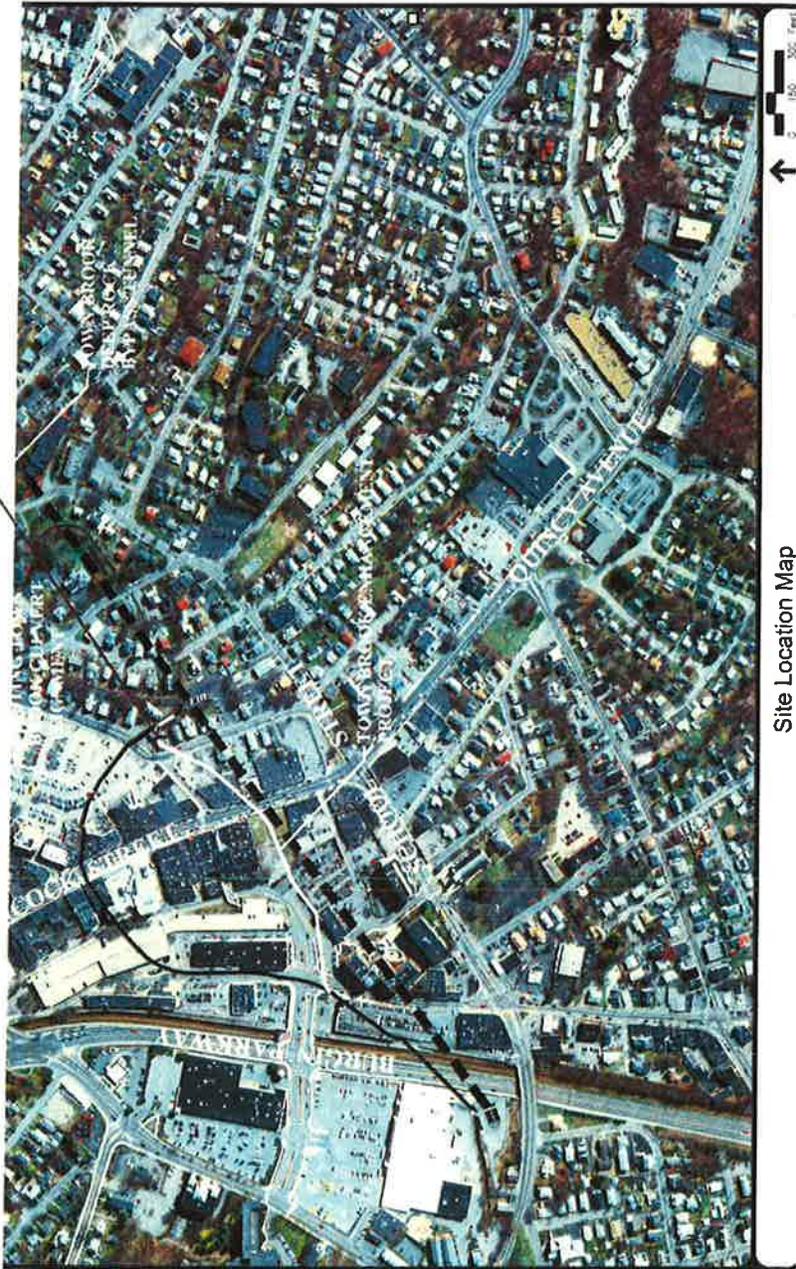
Several features have been incorporated into the proposed project to provide mitigation. The realigned channel will provide for new sections of open channel. This open channel section will incorporate a low-flow channel with spawning substrate secured to the channel bottom. The low flow channel is designed to achieve attraction velocities for smelt during low flows and include resting pools to allow smelt to rest during spawning events.

Wetland plantings are proposed within the open-channel section of the Town Brook just upstream of the connection with the existing channel. The width of the channel in this location provide an opportunity to reduce velocities and create an island with an elevation just above base flow elevations.

Town Brook has been historically subject to diversion of flows such that the smelt run has suffered acute impacts including egg mortality and spawning habitat loss. Maintaining appropriate base flows within Town Brook is a critical Factor in sustaining the existing smelt habitat. To assist in the project's success this Monitoring Plan has been prepared to comply with the Massachusetts Department of Environmental Protection's Order of Conditions # 40 thru #46.

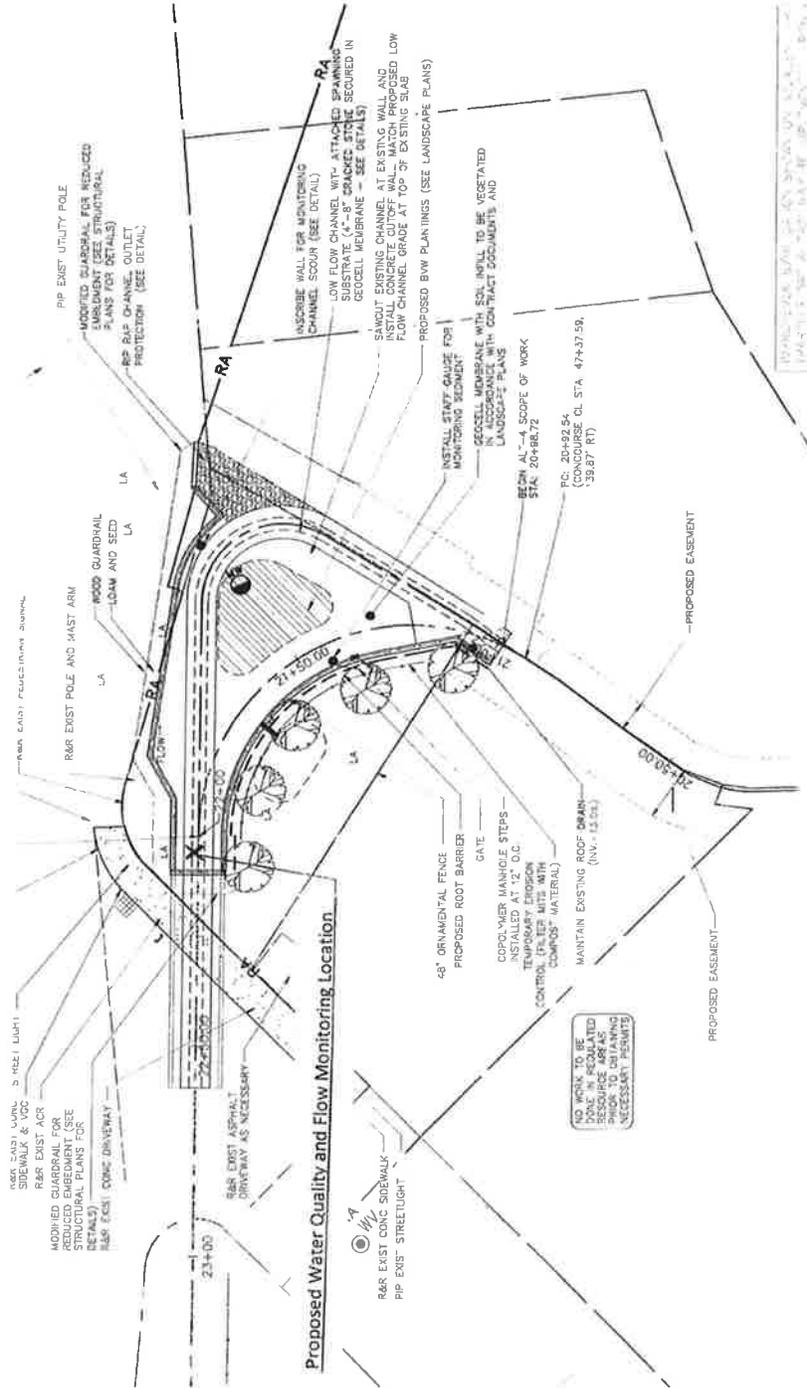
To comply with the Water Quality and Water Flow requirements, electronic instrumentss will be installed in the low flow channel that will monitor the water quality parameters and water flow and depth characteristics on a 15 minute interval. The water quality and water flow information will be collected by telemetry to a web based location for inspection by all interested parties approved for viewing. Monthly reports will summarize the information gathered during the reporting month for review by MassDEP and the Division of Marine Fisheries. The monthly reports will be the basis for remedial action and system revisions, if required, in accordance with Condition #22 and #44.

Proposed Water Quality and Flow Monitoring Location



Site Location Map

Town Brook – Quincy Massachusetts
Monitoring Plan



MONITORING DEVICE LOCATION PLAN

FROM DRAWINGS PREPARED BY Stephenson Design Group



Monitoring Instruments

The quality and velocities of Town Brook are paramount to providing an appropriate environment for the smelt spawning. It is proposed to install a flow monitoring device that will measure the depth and velocity of the brook. A SonTek IQ Plus flow monitor is proposed for the project. The sensor will measure the flow velocity and depth of the brook and store the information in a water tight data collection enclosure. The instrument will be located at the bottom of the low flow channel and anchored to the geocell grid. The Product Specification and Technical Data is provide in Appendix A.

A YSI EXO – 2 is proposed to measure water quality. Sensors in the instrument will measure Temperature, pH, Disolved Oxygen, and Turbidity. The instrument will be placed in a PVC perforated sleeve that will allow water to move freely through the sensors and will protect the device from debris and vandalism. The instrument will be located at the bottom of the low flow channel and anchored to the geocell grid. A wiper system has been included with the instrument to assist in preventing biofouling and reduce maintenance. Information collected from the EXO-2 will be stored in a water tight data collection enclosure. The Product Specification and Technical Data is provide in Appendix B.

Both instruments have the ability to operate continuously provided power is available to operate the system. It is proposed to provide continuous power to the instruments by a solar powered battery recharging system that will be incorporated into the water tight data collection enclosure. It is proposed to collect and report data on a 15 minute interval. A picture of the water tight data collection enclosure with solar panel is provided in Appendix C.

Instrument Location

It is proposed to place both instruments in series near the easterly headwall at Station 22+90, just east of Mechanic Street. This location is proposed due to the straight channel section that will provide stable flow characteristics beneficial to the SonTek Plus measurements and proximity to the spawning habitat. The flow monitoring device can be placed under the roadway as a deterrent to vandalism. The slope of the channel and anticipated water depth appear to be suitable for the 5 inch minimum depth requirement needed for proper operation of the device. The EXO-2 water quality device will be placed downstream from the SonTek Plus. This location is also upstream of the main spawning habitat. This location is shown on the monitoring device location plan in Appendix B.

Information Reporting

Flow monitoring and water quality data reduction and review will be performed on all data obtained on a monthly basis for a period of three years. Site visits will be conducted on a monthly basis noting that bi-weekly visits will occur during March and April for fish observations. The data obtained will be reduced, evaluated, and presented in report form. The monthly report will also include observations from the monthly site and maintenance visits. Copies of the completed report will be submitted to the City of Quincy with electronic versions sent to MassDEP and Massachusetts Division of Marine Fisheries. This will include tabular data based on 15-minute time increments.

The tabular report will be provided and include a summary of daily flow information for a selected time period. The summary presents, for each day, the minimum flow rate, peak flow rate, total daily flow. The summary will also include the total flow volume and average daily flow, for the selected time period.

Water quality sampling results will be provided in a tabular form and a summary of the data provided.

Daily data will be posted to a secure password protected web site that will allow project personnel (as determined by the City of Quincy) access to flow and water quality recorded data. Users then can prepare and review detailed flow reports, graphs and tables. Comparison between wet and dry periods as well as net flows per sub system calculations may also be performed. Online data export format capabilities are available in Excel.

Instrument Installation and Maintenance

During the installation process, the flow meter will be operated in such a way as to instantaneously obtain and display both depth and velocity readings. Manual depth measurements will be obtained and compared to meter readings, any differences will be corrected to within 0.10 inches. Using a hand held velocity meter, readings will be obtained and compared to the metered velocity readings and adjustments to the installed equipment will be made until a reasonable match is obtained. Monthly site visits will verify that the proper depth is recorded.

Prior to installation of the EXO-2, the instrument will be calibrated on site. Once the instrument is installed sampling results will be reviewed from the data collector. Monthly site visits will be conducted to remove the instrument from the stream bed, calibrate and reinstall the instrument.

Appendix A
Sontek IQ- Plus Flow Monitoring



SonTek-IQ™ Series Standard, Plus and Pipe

FLOW, TOTAL VOLUME, LEVEL AND VELOCITY



a xylem brand



Built to Last. Made to Perform.

Developed with assistance from the Cooperative State Research, Education, and Extension Service of the U.S. Department of Agriculture, the SonTek-IQ Series are three products that provide high quality flow, total volume, level and velocity data for challenging conditions that fit your budget. Custom flow algorithms, carefully designed and tested, ensure all these products in the Series will deliver the data you need to make smart decisions about your water. Each system offers four independent velocity beams that work to accurately map the cross-section velocity and feed this data to the flow computation algorithms. This means velocity indexing is not required to get high-accuracy flow data. Additionally, the built-in pressure sensor (standard with each system), works in tandem with the vertical acoustic beam to measure the water level, so you always know what the stage is.



- Fully self-contained, all-in-one design
- Measure flow in man-made or natural channels, pipes or streams between 8 cm (3 inches) and 5 m (16 ft) deep
- Four, pulsed Doppler velocity beams for great section coverage
- RS-232, SDI-12, Modbus, Analog communication/output
- Specialized flow algorithms for open channels and/or closed pipes
- Uses SonTek's exclusive SmartPulse^{HD}* adaptive sampling technology
- Self-calibrating water level using vertical beam and pressure sensor
- Standard package includes instrument, SonTek-IQ Software, easy mounting hardware, cable, adaptor and power supply

*Patent pending

Whether you need just a practical and cost-effective solution for a single canal, or you operate a large public utility with dozens of monitoring sites, there's a SonTek-IQ right for your application. Simply input the channel geometry using the intuitive SonTek-IQ software and you are outputting accurate flow data in minutes!

The SonTek-IQ software package is the starting point for interfacing with the instrument.

The "SmartPage" has built-in icons that guide users through the configuration steps to collect the best possible data. Want to run some statistics on the data? You can do that too, with just one click.





SonTek-IQ Standard: Big Quality for Small Budgets

The SonTek-IQ Standard version is a “no frills” option for the budget-minded operator. But with the SonTek-IQ Standard, low budgets do not mean low quality data! Using the same powerful SmartPulse^{HD} technology that is used in the SonTek-IQ Plus system, you won't be sacrificing quality while monitoring your flow.

The Standard version allows measurement for depths up to 1.5 m in open-channels only, and basic data parameters output for display or export based on a dynamic, single integrated velocity cell.

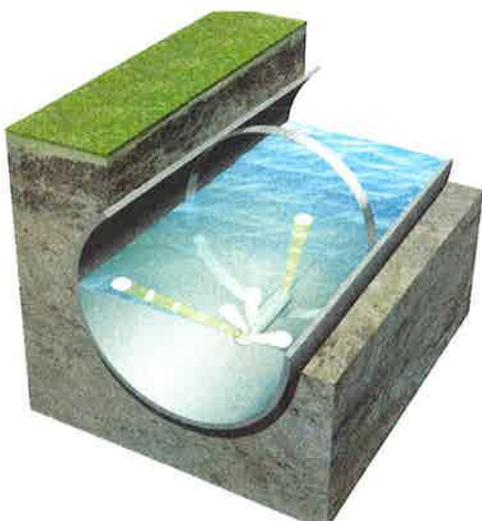
SonTek-IQ Plus: Monitoring in Complex Environments

The SonTek-IQ Plus version offers a flow monitoring solution for larger canals and natural environments with depths up to 5 m. With the ability to collect velocity profiling data in cells as small as 2 cm across a channel horizontally and vertically, this version offers the user complete flexibility in applications and detailed flow velocity parameters for those times when “just flow” isn't enough.

The SonTek-IQ Plus is capable of handling not just regular trapezoidal canals, but any irregular/naturally-shaped channel, up to 5 m deep, where flow, velocity and/or level need to be measured. And with the flexibility of the SonTek-IQ software, the opportunities are endless.



SonTek-IQ Pipe: Accurate Flow in Totally or Partially Full Pipes



The SonTek-IQ Pipe is intended as either a bottom or top mounted flow meter that can be used in most industrial or agricultural applications. Unlike many other flow meters available today, the SonTek-IQ Pipe automatically determines if the pipe is full or partially full, and the best technique to use to measure the velocity of the water. This information is then used to compute flow, along with accurate water level data provided by the vertical beam and/or pressure sensor. All this without additional configuration.

With a special form factor, the SonTek-IQ Pipe can provide accurate flow values in pipes from 0.5 all the way to 5.0 m, independent of whether these pipes are full or have only a few inches of water in them.

SonTek-IQ ACCESSORIES AND SPECIFICATIONS

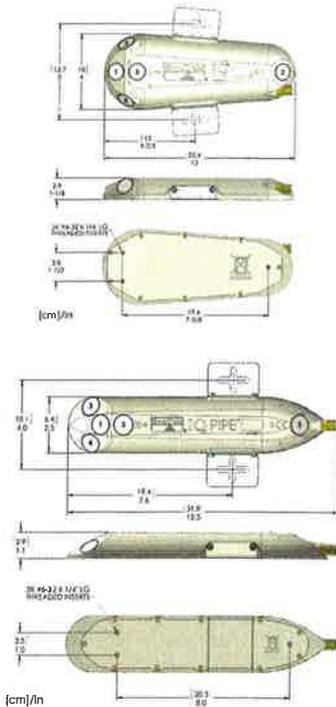


Custom-fit for the IQ Pipe, this easy to use mounting ring will make system installation a breeze. Fits pipe diameters from 16 in (41 cm) to 36 in (91 cm).



With the press of a single button, data is yours with the SonTek-IQ Flow Display. No PC required!

Product Dimensions



Specifications	SonTek-IQ Standard	SonTek-IQ Plus	SonTek-IQ Pipe
Application	Regular Canals	All Open Channels	Pipes & Culverts
Velocity Measurement			
-Sampling Range	0.08 - 1.5 m (0.3 - 5 ft)	0.08 - 5.0 m (0.3 - 16 ft)	0.08 - 5.0 m (0.3 - 16 ft)
-Number of Cells	1	Up to 100	Up to 100
-Cell Size	Dynamically integrated	2 cm - 10 cm (0.8 - 4 in)	2 cm - 10 cm (0.8 - 4 in)
Advanced Data Reprocessing	N/A	✓	✓
Increased Number of Data Fields	N/A	✓	✓
Velocity Measurement			
-Velocity Range		±5 m/s (16 ft/s)	
-Resolution		0.0001 m/s (0.0003 ft/s)	
-Accuracy		±1% of measured velocity, ±0.5 cm/s (0.2 in/s)	
Water Level			
-Vertical Beam Range		0.05 - 1.5 m (0.2 - 5 ft) (Standard); 0.05 - 5.0 m (0.2 - 16 ft) (Plus/Pipe)	
-Water Level Accuracy		0.1% of measured depth or ±0.003 m (0.01 ft) whichever is greater	
-Pressure Sensor Range ¹		30 m (98 ft; 42 psi)	
-Pressure Sensor Accuracy		0.1% of full scale	
Acoustics			
-Acoustic Frequency		3.0 MHz	
-(2) Along Axis Beams		25° off vertical axis, along axis of channel	
-(2) Skew Beams		60° off vertical and 60° off center axis of channel (Standard/Plus); 37° off vertical and 45° off center axis of channel (Pipe)	
Communications		RS232, SDI-12, Modbus, Analog (via optional Flow Display)	
Data Storage		4 GB (approximately 1 year)	
Operating/Storage Temperature		-5 to 60° C (23 - 140° F)	
Temperature Sensor		Accuracy ± 0.2° C; Resolution ± 0.01° C	
Tilt Sensor		Accuracy ± 1.0°	
SmartPulse^{HD}		Yes	
Power			
-Input		8-15 VDC	
-Consumption		0.5 - 1.0 W (0.02 when idle)	

¹For use in pressurized pipes. Housing rated to 42 psi.



Founded in 1992 and advancing environmental science globally, SonTek manufactures acoustic Doppler instrumentation for water velocity measurement in oceans, rivers, lakes, harbors, canals, estuaries, industrial pipes and laboratories. SonTek's sophisticated and proprietary technology serves as the foundation for some of the industry's most trusted flow data collection systems. SonTek is headquartered in San Diego, California, and is a division of Xylem Inc.

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S16-01

Product Introduction: The SonTek-IQ

Over the years the demand for monitoring flow in open channels has evolved significantly. Climate change and water scarcity issues have increased the demand to quantify increasingly smaller flows. In the past, the irrigation community has applied a variety of technologies for “good enough” or “close enough” flow measurements and total volume deliveries. SonTek has been involved in measuring flow for almost 20 years, and decided to take on the challenge of developing an affordable instrument that can accurately measure flow.

Combining our previous expertise with feedback from the flow monitoring industry, engineers at SonTek took on the challenge. Working with funding from a Small Business Innovation Research (SBIR) grant from the United States Department of Agriculture (USDA) SonTek has developed an innovative and advanced solution for monitoring in open channels; the SonTek-IQ or commonly known as the IQ. The IQ has been extensively tested at flow laboratories and field sites making sure that the solution is not only robust and provides high quality data, but also is user friendly and easy to use.

The IQ is an intelligent flow meter specifically designed for measuring flow in open channels. The innovative 5-beam design incorporates a vertical beam and four velocity profiling beams. The vertical beam works in tandem with

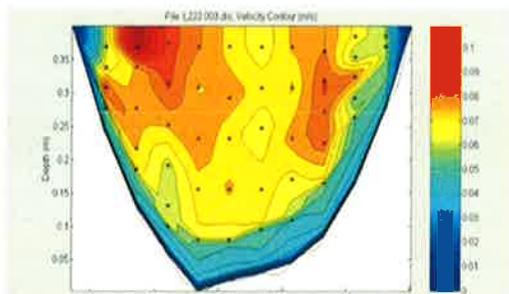
a high-resolution pressure sensor to define water level that is then used to compute channel cross-sectional area (via a user entered cross-sectional survey).

The four velocity profiling beams measure the horizontal and vertical distribution of velocities in the channel - in the end the IQ provides accurate flow data that you can make decisions on. There are two versions of the IQ, a standard version and a **SonTek-IQ Plus** version.

The IQ is a bottom mounted system or otherwise known as an “up-looker”. The IQ collects the horizontal and vertical distribution of water velocity as well as water level data

to determine flow. After talking extensively with water managers in the water industry, SonTek determined that having reliable and dependable flow data from the field is important for decision making. Existing technologies provide data, but the data have limitations due to the accuracy that can create problems.

For example, is an Irrigation District providing the farmer the right amount of water? Not enough water means an unhappy farmer; while too much water means that the Irrigation District could have sold that water elsewhere and made more money. Bottom line is that water is a valuable resource and the IQ can give you data that you can make sound decisions on.



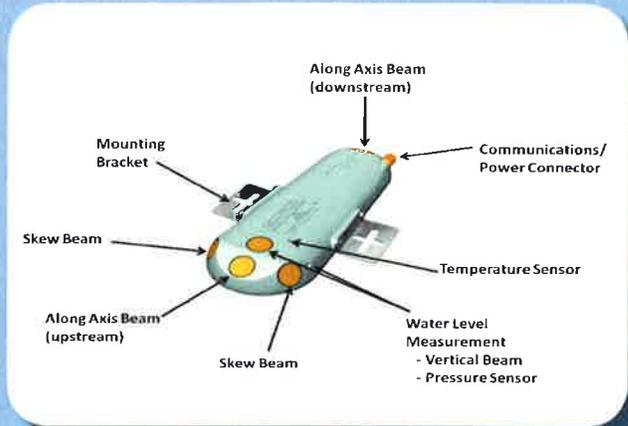
Here is an example of a FlowTracker measurement and corresponding isovel map – data from these measurements and hundreds more were used to define beam geometries and flow algorithms. In the end, the IQ is a that collects data that you can make decisions on.

	Operating Range (m)	Velocity Output	Software
IQ	0.08 - 1.5 m	SmartPulse ^{HD} Average Velocity	Standard data display, no data reprocessing
IQ Plus	0.08 - 5.0m	SmartPulse ^{HD} Velocity Profiles (cell sizes as small as 2 cm)	Advanced data display and data reprocessing

The SonTek-IQ software package is the starting point for interfacing with the instrument. The “SmartPage” has built-in icons that guide users through the configuration steps

SonTek-IQ Attributes:

- ◆ Two along-axis velocity profiling beams (25° off the vertical axis)
 - Measures vertical stratification of channel velocities
- ◆ Two skew velocity profiling beams (60° off the vertical axis and horizontal axis)
 - Measures the horizontal distribution of channel velocities
- ◆ Intelligent adaptive sampling via SmartPulse^{HD}
 - Dynamic selection and optimization of the acoustic pulsing scheme based on water depth, flow velocity and turbulence
- ◆ Robust water level
 - Combines data from vertical beam and integrated pressure sensor



- ◆ High resolution temperature sensor
- ◆ Communicates via RS-232, SDI-12 and Modbus
- ◆ Mounting brackets allow for a quick and easy installation
- ◆ External power (7- 15 VDC) required
- ◆ 4 GB internal recorder provides data storage for years

to collect the best possible data. After configuring the IQ, data collection and downloading is easy. Simply connect to the system to download data files – the software organizes data files like a database; files can be sorted by Site name, File name, IQ Serial number and Operator name, allowing users to find and use data quickly and easily. The organized structure of icons at the top of the screen provides users quick an easy option for creating graphs and viewing tabular data. Creating reports are easy – graphs generated by the IQ software can be copied and saved and then pasted or inserted into any document. Want to run some statistics on the data?

You can do that too, with just one click.

Water users will come to the conclusion quickly that the SonTek-IQ was designed and built with the end user in mind. From installation and integration to configuration for data collection to downloading and data processing, the IQ is remarkably easy to use. In addition, water managers around the world will appreciate the accuracy of the IQ; finally an easy to use and affordable flow monitoring solution that provides flow data that can be used for decision making.



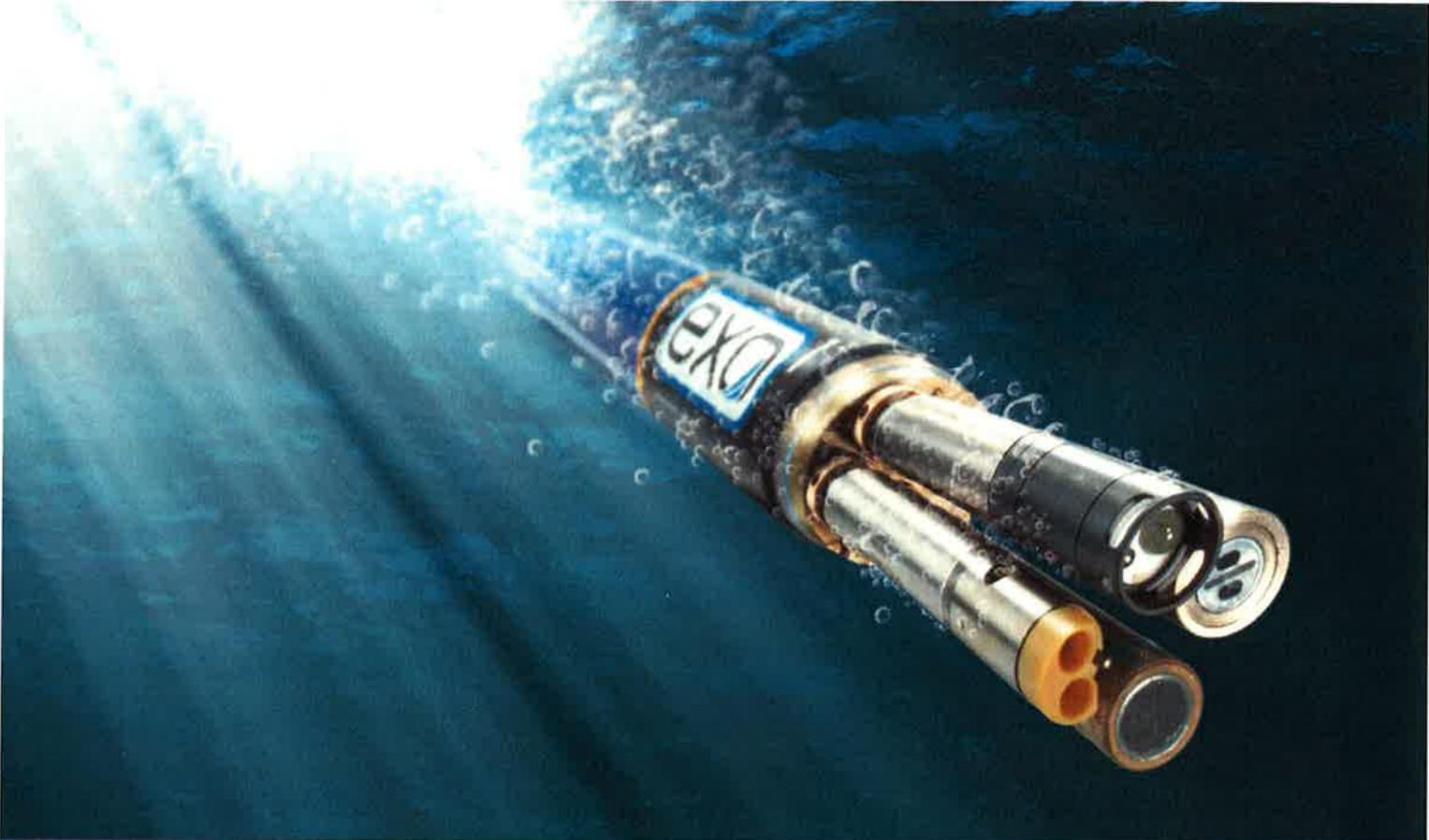
IQ Software SmartPulse



Example of the SonTek-IQ installation in a small canal.

SonTek/YSI, founded in 1992 and advancing environmental science in over 100 countries, manufactures affordable, reliable acoustic Doppler instruments for water velocity measurement in oceans, rivers, lakes, harbors, estuaries, and laboratories. SonTek, and SonTek-IQ are trademarks of YSI Inc., Yellow Springs, OH, USA. The SonTek-IQ is made in the USA. Specifications are subject to change without notice. This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 2008-33610-19458. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

Appendix B
YSI – EXO – 2 Water Quality Sonde



EXO

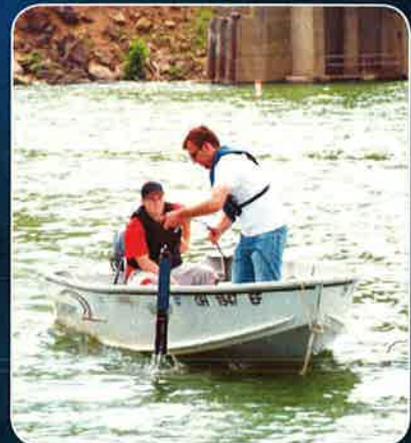
ADVANCED WATER QUALITY MONITORING PLATFORM



a xylem brand

Breaking the sonde barrier.

EXO represents the intersection of the Environment and Observation and a new generation of monitoring technology.



Features You'll Find Only with YSI:



Smart QC
Automatically checks for faults and errors to ensure successful deployments



Auto-recognition
and set-up of all sensors with background data routing



Cable-free Operation
through the use of wireless communications



Biofouling Protection
with copper-alloy components and anti-fouling wipers



Assisted Calibration
Graphical KOR software speeds the calibration process while reducing reagent consumption



Titanium Sensors
with wet-mateable, hermaphroditic connectors

A smart, field-ready water monitoring platform. EXO offers a wide range of capabilities to those dedicated to monitoring natural aquatic environments such as oceans, estuaries, rivers, lakes, and ground water.

Inside the EXO platform you'll find innovations resulting in greater ruggedness, increased accuracy and improved ease-of-use in the collection and transmission of water quality data—cost-effective now and adaptable for the future.

Like you, our engineers and scientists have spent years in the field, deploying and using the products we make. That passion for producing the most advanced and reliable monitoring equipment is how we break the sonde barrier.

Water quality monitoring that's field-ready

With a highly efficient power management platform, robust construction, and a chemistry-free anti-fouling system, EXO allows accurate data collection for up to 90 days between service intervals.



Surface Water & Ground Water Monitoring

Capturing accurate data in freshwater environments is easy with EXO.

Out of the box, EXO is ready to go with:

- Pre-installed sensors for easy set-up of factory-configured systems
- Wireless communication reduces number of field cables
- Onboard diagnostics mitigate set-up and configuration errors

Calibrates multiple sensors simultaneously, typically in 15 minutes; no cables required



Quick and Easy Calibration

Complete calibration in less than 15 minutes using EXO's suite of smart sensors and intuitive KOR interface software. Sondes can now be turned around and redeployed in the timespan of a typical sample interval.

Go Wireless

Set up, calibrate, and deploy your instrument without a single cable. No more trips to the field and discovering you don't have the right cables. The wireless handheld and sonde are the perfect pair.

Reduce Biofouling

There's no escaping biofouling in underwater measurements. To keep it from interfering with data, EXO uses copper-alloy parts and anti-fouling wipers to prolong deployments and improve data accuracy.

Smart Controls for Quality Data

Guided calibration and sensor feedback make EXO an extremely reliable water monitoring platform. Guided prompts and internal calibration logs not only speed up the calibration, but reduce the opportunity for errors.

Smart Probes. Smart Ports.

Never worry a bad probe will compromise your data. Active port monitoring automatically detects sensors and, if damage to a sensor occurs, can shut down that port to prevent damage to the sonde or other sensors.

Smart Sonde

Onboard monitoring systems automatically scan for configuration errors, monitor memory status, and verify sensor operation. Numerous onboard tests ensure successful deployments.

www.EXOwater.com

Expandable design that's network-ready

EXO's welded titanium sensors and high-impact body is built for high pressure and depths to 820 feet (250 meters)

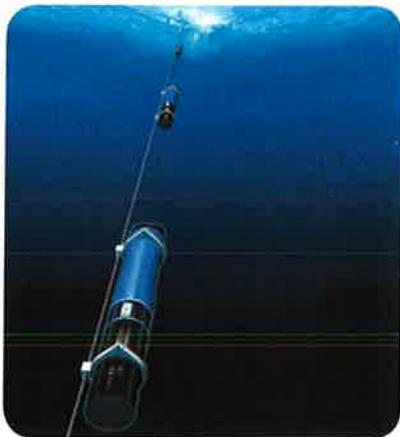


Estuary & Ocean Monitoring: High-quality multisensor suite in small and durable package

In harsh conditions, EXO is a practical alternative to traditional CTDs with:

- The ability to integrate seamlessly with marine monitoring systems
- Quick and easy re-configuration and calibration
- Large suite of high-performance sensors, which eliminates individual cables and connectors

Combine traditional CTD sensing with additional sensors in a compact device which readily integrates with remote monitoring platforms



Compact and Accurate

The EXO platform offers a completely new approach—highly accurate, quick-response sensors in a small, easy-to-deploy and easy-to-maintain package. Gone are large and complicated sensor arrangements requiring complex integration.

Smart Probes

All EXO sensors have onboard memory and processing, allowing users to easily calibrate and configure sensors at one location and distribute to various field sites.

Measurable Sensor Performance

A new metrology system specifically for EXO offers improved accuracy of conductivity and temperature sensors to better address oceanographic challenges.

Monitor without Interruption

EXO's patented reinforced structure, welded Titanium tubes, improved power management, and stable sensor performance allow you to gather data for long periods of time and with fewer interruptions, even in the toughest conditions.

Smart Ports

Wet-mateable connectors allow for swaps in wet conditions, while the smart ports shut down any excessive current draws to prevent damage.

Self-Routing Sensors

Automatic routing enables a string of sondes to pass messages to individual probes. Anytime the configuration changes, the system automatically recognizes it. A "kick" allows any device to send alerts back up the chain.

www.EXOwater.com

Enhance Data Collection with these EXO Components

EXO Handheld

The EXO handheld provides an extremely durable, portable, weather-proof interface to the EXO sondes. The handheld uses a mobile version of the KOR interface software.

Additional standard features:

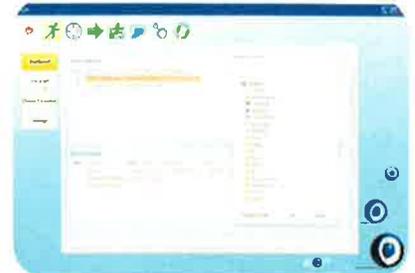
- GPS
- Temperature-compensated barometer
- Backlit alphanumeric keypad
- Microphone/speaker
- Wet-mate wireless connector
- Bluetooth communication
- Color LED screen
- 2 GB of storage
- Rechargeable battery capable



Interface with the EXO Sonde using the EXO Handheld Display

KOR Interface Software

The KOR Software offers users the capability to easily manage, visualize, and organize large amounts of field data. KOR also provides an interface to the EXO products for fast calibration, configuration, QA/QC or data collection.



- New calibration processes for long-term monitoring
- Graphical user interface for quick data analysis
- Multiple languages

Multiple Data Output Options

Sonde output is readable by YSI handheld instruments, interface software, and data telemetry modules. In addition to the cable (standard), these communication interfaces are also available:

DCP Signal Output Adapter

Wires into the end of the YSI field cable via flying leads and converts signal to RS-232 or SDI-12 for datalogger applications.



DCP Signal Output Adapter

USB Adapter

Allows connections between an EXO sonde and a PC.



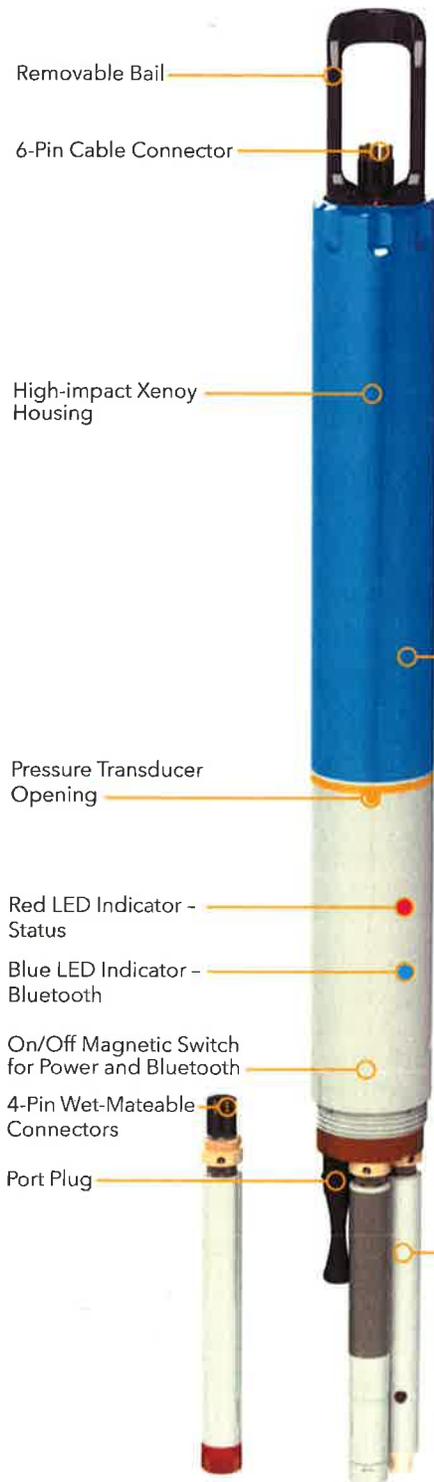
USB Adapter

Bluetooth Wireless Technology

Enables communication between a sonde and a user in the lab and pre-deployment in the field.



Sondes: EXO1 EXO2



Removable Bail

6-Pin Cable Connector

High-impact Xenoy Housing

Pressure Transducer Opening

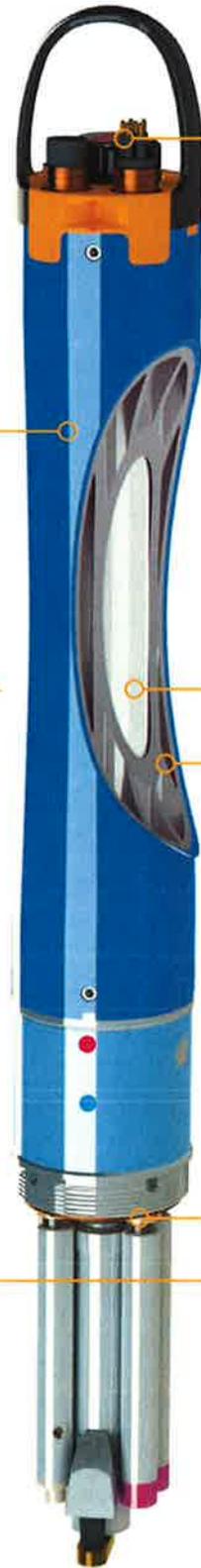
Red LED Indicator - Status

Blue LED Indicator - Bluetooth

On/Off Magnetic Switch for Power and Bluetooth

4-Pin Wet-Mateable Connectors

Port Plug



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



Wiper keeps sensors clear of biofouling

Welded Titanium Housing



EXO1 sonde contains 4 universal sensor ports

Instrument Specifications*

EXO1 Sonde		
Ports	4 sensor ports Peripheral port: 1 power communication port	
Size	Diameter: 4.70 cm (1.85 in) 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) Peripheral ports: 1 power communication port; 1 auxiliary expansion port	
Size	Diameter: 7.62 cm (3.00 in) 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 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) 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 (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		
1 Year	pH, ORP, and optical DO membranes	
2 Years	Cables, sondes (bulkheads), handheld, and the following sensors: conductivity, temperature, depth, and optical sensors	

* 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.

** Release in 2013. BGA-PE specs TBD.

Sensor Specifications*

Sensor	Range	Accuracy ⁴	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) or Phycocerythrin (PE)** (part of Total Algae sensor)	0 to 100 µg/L PC; 0 to 100 RFU	Linearity: R ² > 0.999 for serial dilution of Rhodamine WT solution from 0 to 100 µg/mL PC equivalents Detection Limit: 0.04 µg/L PC	T63<2 sec	0.01 µg/L PC; 0.01 RFU
Chloride** ¹¹	0 to 1000 mg/L ²	±15% of reading or 5 mg/L, 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 Detection Limit: 0.09 µg/L Chl	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 calibra- tion 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 Conductivity and Temperature)	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 TDS)	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

** Release in 2013. BGA-PE specs TBD.

What can Xylem do for you?

Xylem (XYL) is a leading global water technology provider, enabling customers to transport, treat, test and efficiently use water in public utility, residential and commercial building services, industrial and agricultural settings. The company does business in more than 150 countries through a number of market-leading product brands, and its 12,000 people bring broad applications expertise with a strong focus on finding local solutions to the world's most challenging water and wastewater problems.

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Appendix C
Water Tight Data Collection Enclosure with Solar Panel

