

# ENVIRONMENTAL monitor

spring 2011 Application and technology news for environmental professionals

## Piecing it together



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**LakeScientist.com** aims to promote a greater consciousness about the pressing issues facing lakes and other freshwaters. The site was founded with the belief that research and education are critical to conserving the planet's water resources. It offers an educational "Learn About Lakes" database as well as relevant news articles.



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# In the Depths of Lake Huron, Secrets of an Ancient Sea

**Massive lake-bottom sinkholes support strange benthic ecosystems**

*With a nine-meter-long Boston Whaler for scale, the Middle Island Sinkhole is open to Lake Huron.*



*(Aerial Image Credit: Scott Kendall and Bopi Biddanda / Grand Valley State University)*

Sprawled across portions of Lake Huron's seafloor is a microbiogeochemical mystery with deep prehistoric ties.

In Lake Huron near Alpena, Mich., time, groundwater, and bedrock geology (limestone, dolomite, and evaporite) have combined to produce several karst formations in the form of sinkholes and cracks located on the lake floor. Here, dissolved components of the 400-million-year-old Paleozoic bedrock concentrated in the groundwater are venting through the submerged sinkholes onto the lake floor. Hundreds of millions of years ago, the bedrock was a seafloor, and it still contains deposits from the ancient sea's sulfur and salt, according to Bopi Biddanda from the Annis Water Resources Institute at Grand Valley State University in Muskegon, Mich.

Since the venting groundwater is anoxic and rich in ions (e.g., sulfates and chlorides), it is denser and forms a layer bathing the lake floor; freshwater communities common to the well-oxygenated Great Lakes cannot survive here. Instead, a carpet of microbial mats metabolize the sulfates to sulfides and cyanobacteria photosynthesize the sulfides back to sulfates. Sinkhole microbes are efficiently recycling the sulfur from the venting groundwater, according to GVSU researcher Scott Kendall. On the lake floor's surface, microbial mats use available sunlight. Deeper into the sinkholes, though, microorganisms must survive using only chemical means, called chemosynthesis.

In some sinkholes, rich, textured, and vibrantly purple benthic microbial mats cover what are sometimes

football field-sized areas of the lake bottom. These bizarre ecosystems thrive as little as 66 feet below the surface. Such "extremophile" organisms and the environments in which they live had previously only been discovered in deep-sea hydrothermal vents, cold seeps, and permanently frozen Antarctic lakes. The Lake Huron sinkholes present a unique opportunity to understand the impact of groundwater intrusion into freshwater habitats.

Biddanda and Kendall are part of a research team that has been studying the sinkhole ecosystems since 2003, which also includes Steve Ruberg from the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory. The team believes these microorganism-dominated sinkholes provide a snapshot of our distant past. They are investigating the origins of these ancient groundwater minerals, trying to specify precisely how long ago they were deposited and how rapidly they are flowing into the lake. They also hope to map the gradient of water quality from this prehistoric cauldron of salts and gases inside the sinkholes to the oxygen-rich freshwater above.

A group of archaeologists and explorers from NOAA's Thunder Bay National Marine Sanctuary in Alpena and Institute for Exploration in Mystic, Conn. found evidence of the sinkholes by accident in 2001 while studying shipwrecks located offshore from Alpena. They noticed water quality measurements showed unusually high levels of conductivity and called in Biddanda and Ruberg, who discovered the source of the anomaly.

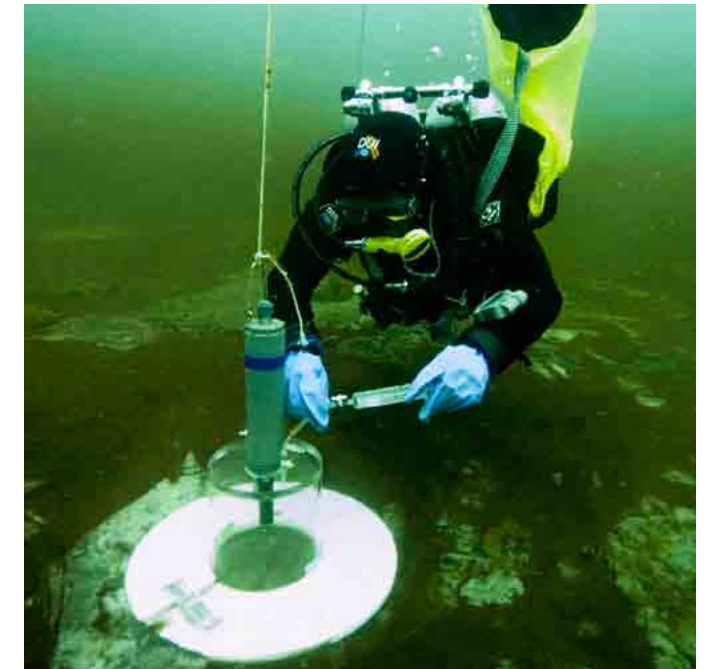
The research team has since utilized divers, ROVs, and a wide variety of sensors and water quality sondes to assess the conditions around, specifically, three submerged sinkholes in the TBNMS. The El Cajon sinkhole, located in Misery Bay, is a small, shallow (one-meter-deep), near-shore spring that receives full sunlight. Then there is the deeper (23-meter-deep) Middle Island sinkhole, which experiences only five percent surface irradiance and spreads across a massive one-hectare area of the lake bottom. Thirdly, a deeper and darker "Isolated Sinkhole" lies in 93 meters of water.

Sensor equipment provided by Fondriest Environmental played a major role in collecting data to characterize these newly discovered ecosystems. YSI 6600 and 6920 multi-parameter sondes collected discreet and continuous time-series data on the water quality of the groundwater and overlying lake water in the sinkholes. Six YSI 6920 sondes were mounted within custom benthic chambers to evaluate microbial mat metabolism by measuring temperature, conductivity, dissolved oxygen, pH, and ORP over 2-3 days. Concurrently, a NexSens SDL500 data logger equipped with a LICOR LI-193 Spherical Quantum Sensor was used to measure PAR. Also, YSI 6600 sondes were used to obtain conductivity measurements at small depth intervals to determine the thickness of the groundwater layer and measure characteristics of the chemocline.

The data from the sondes, along with lab analysis of diver-collected samples, show the venting groundwater exhibits chemistry that significantly differs from the lake's typical freshwater environment. The groundwater, characterized as water with conductivity ten times greater than lake water, has a lower temperature (7-9 vs. 4-25 degrees Celsius), lower pH (~7.1 vs. 8.3), higher specific conductivity (~2.3 vs. 0.3 mS/cm), and lower concentrations of dissolved oxygen (0-2 vs. 5-11 mg/L) and nitrate than Lake Huron water. High conductivity of venting groundwater is attributed to concentrations of dissolved sulfate (1,000 mg/L), carbonate, and chloride ions.

The unique ecosystem is dominated by an ancient form of purple-pigmented cyanobacteria composed of independent layers of phototrophic, chemotrophic, and heterotrophic microorganisms. Biddanda, Ruberg, and their team suspect the cyanobacteria originate either from dormant spores stored within the ancient underground deposits or are colonized from the similar strains already present in other sinkholes of the Great Lakes.

Along the purple carpet, finger-like protrusions occur that sometimes exceed a foot in height. The fingers are formed from purple cyanobacteria mats and rise up due to trapped gases produced by microbes in the carbon-



*At the Middle Island Sinkhole, Thunder Bay National Marine Sanctuary diver Joe Hoyt sets up a respiration chamber experiment over benthic microbial mats using a YSI multi-parameter sonde. (Underwater Image Credit: Tane Casserley / NOAA-TBNMS.)*

rich sediment below. DNA analysis conducted by University of Wisconsin-Stout molecular biologist Stephen Nold and University of Michigan geobiologist Greg Dick determined that the purple mat is mostly composed of *Phormidium autumnale*, a photosynthetic cyanobacterium found in the bottom of permanently ice-covered Antarctic lakes, and has sulfide physiologies suggestive of fossil microbial mats in the anoxic, sulfur-rich seas of early Earth, respectively.

Researchers are also finding that sinkholes are "sinks" for carbon. Studies of sinkhole sediment cores by University of Wisconsin-Milwaukee biogeochemist Val Klump have revealed that sinkholes are active sites of intense carbon burial. The hypothesis is that rapid sequestration and preservation of carbon in sinkhole sediments is favored by a combination of intense microbial productivity and the prevailing anoxic conditions.

The Lake Huron sinkhole research, funded by the National Science Foundation and NOAA's Office of Ocean Exploration, aims to discover how such unique ecosystems can form in the Great Lakes. The research, Biddanda said, may also uncover undiscovered organisms and biochemical processes — leading not only to the conservation of these unique habitats in the Great Lakes but also expanding our understanding of the diversity of life on Earth. To learn more, visit <http://bit.ly/gvsusinkholes>.

# Predicting WILDFIRES

*Real-time weather monitoring network helps San Diego officials detect Santa Ana conditions*

*Multi-parameter weather sensors and video cameras positioned in numerous remote locations around San Diego help researchers and first responders predict and monitor wildfires.*



## About the Researcher

*Hans-Werner Braun is a research scientist at the San Diego Supercomputer Center and principal investigator of the High Performance Wireless Research and Education Network, funded by the National Science Foundation.*

California wildfires can be devastating to local communities — damaging property and threatening safety. Residents of areas frequented by these violent and deadly infernos know that a rise in temperature, drop in humidity, and arrival of destructive Santa Ana winds signal that a forest fire is likely.

Recognizing that weather is the driving force behind most wildfires, researchers and first responders in San Diego utilize a sophisticated network of weather monitoring stations to detect potential wildfire conditions.

The High Performance Wireless Research and Education Network, a National Science Foundation-funded project, provides the communication backbone for these weather stations. Researchers at the University of California, San Diego, led by Hans-Werner Braun, are developing it. Braun is a research scientist at UCSD's San Diego Supercomputer Center and principal investigator of the HPWREN.

The non-commercial, wide-area wireless network connects university campuses as well as a number of difficult-to-reach areas in remote environments. It is formed using Internet routers on mountaintops, interconnected via wireless links. In addition to first responder activities, it is used for collaborative cyber infrastructure on research and education — aiding projects such as monitoring supernovas in distant solar systems and studying wolf behavior in the desert.

"The collection of real-time data is one of the most valued aspects of scientific research, and that is what this network delivers," Braun said. "Such data allows for increased knowledge and understanding of an array of scientific concepts, from heavily impacted ecological systems on Earth to the tracking of transient astronomical events in the universe."

Using the high-speed HPWREN, weather data from remote locations can also be gathered and calculated in real time, providing near instant detection of Santa Ana conditions. Fondriest Environmental has supplied Vaisala WXT520

multi-parameter weather sensors to collect real-time data at several monitoring sites. These solid-state sensors were initially chosen several years ago to replace cup and vane anemometers, which had suffered mechanical failures.

The WXT520 was selected because it is a comprehensive and compact weather measurement device with direct digital output. It measures six essential weather parameters, including wind speed and direction, liquid precipitation, barometric pressure, air temperature, and relative humidity.

The WXT520s are part of a larger system that measures additional parameters. Sensor data is continuously processed to monitor for Santa Ana environmental conditions.

If fuel moisture drops below 7 percent, or if the relative humidity drops below 25 percent, and the wind direction is between 10 and 110 degrees at a speed above 25 miles per hour, automated real-time alerts are sent to public safety personnel via pager messages and email. Mobilization of firefighting resources — from aircraft to fire crews — can then begin in response to the fire risk.

The HPWREN benefits first responder activities in other aspects, too. It is a vital wireless connection for various Incident Command Posts and other firefighting centers, facilitating rapid coordination. Monitoring stations are also equipped with video cameras that provide live feeds, helping first responders spot and track wildfires once they've ignited.

Weather and video data from these stations are used significantly by local agencies, and it's forwarded to the National Oceanic and Atmospheric Administration and National Weather Service. To learn more about the HPWREN, visit [hpwren.ucsd.edu](http://hpwren.ucsd.edu).

**“The collection of real-time data is one of the most valued aspects of scientific research, and that is what this network delivers.”**

# Tracking 'Fracking'

*Commission monitors shale drilling in Susquehanna River Basin with real-time water quality network*

The water quality dangers posed by hydraulic fracturing, or "fracking," have been of increasing national concern in recent years as natural gas drilling has surged.

Hydraulic fracturing uses the high-pressure injection of millions of gallons of water, sand, and numerous chemicals to fracture rock formations and release the gas deposits within. It makes accessing natural gas deposits thousands of feet underground economical, but it is associated with numerous environmental concerns.

While industry officials say the process is safe, many conservation groups argue that the chemicals used in the fracking fluid, as well as the displaced natural gas, could be contaminating freshwater resources in areas near the drilling. There have been numerous reports of contaminated water, carcinogens in waterways, and even diesel fuel mixed with fracking fluid.

This is especially a concern in Pennsylvania's portion of the Marcellus Shale, where there has been a boom in drilling over recent years that has threatened the water quality of the region. A notable example is the town of Dimock, Penn.,

deemed by some the poster child of natural gas drilling gone wrong after reports of exploding water wells and tainted water supplies.

The Marcellus Shale extends throughout much of the Appalachian Basin, from Tennessee to New York. This sedimentary rock holds significant natural gas reserves, and the recent increase in drilling in the area has many worried about how it is affecting water quality in the Susquehanna River Basin.

At the same time, water resource demands throughout the basin are on the rise, making it even more imperative to be able to detect rapid changes in water quality.

In light of the ongoing environmental threat posed by natural gas drilling, an organization called the Susquehanna River Basin Commission proposed in late 2009 the creation of a comprehensive water quality monitoring network that would eventually cover much of the basin.

The SRBC already operated a monitoring system for the Susquehanna River itself. However, the commission aimed

to expand the network to continuously monitor and report the conditions of smaller rivers and streams located in the basin, especially in areas experiencing increasing water demands. The commission targeted watersheds with areas typically ranging from 30 to 60 square miles.

Now with more than 40 monitoring stations, the water quality program provides a broad set of data detailing conditions in the basin. The stations wirelessly transmit water quality data to a project computer that then uploads it in real time to the SRBC website. All stations are linked to a single, powerful network that provides vital information about the impact of natural gas drilling and other threats to the quality of water in the region.

The commission chose NexSens Technology to provide the data logging and remote telemetry solution for the network. Each water quality monitoring station includes either a NexSens 3100-iSIC or 6100-iSIC data logger. The 3100-iSIC features a built-in cellular modem, allowing it to transfer data to the project computer over the Internet using a cellular data plan. The 6100-iSIC uses Iridium satellite telemetry, making it suitable for areas in the network that have little or no cellular reception.

All data is easily accessible on a public Web portal generated by NexSens WQData. In addition to making data accessible from any Web browser, this online service allows it to be processed into statistical summaries, graphs, and tables for easy analysis. The Web interface also includes a user-friendly map that displays real-time data from all monitoring sites.

Water quality data may be viewed by officials, scientists, and the public to watch their local rivers and streams for the threat of natural gas pollution as well as any other irregularities in the water. The network is even capable of providing early warnings to environmental officials, helping them to locate the source of water quality issues quickly and respond appropriately.

The first phase of installation began in early 2010 and involved the addition of 30 remote water quality monitoring stations in the northwestern part of the basin, including the border between Pennsylvania and New York where gas drilling was most active. Additionally, some stations were placed in areas where no drilling activities were planned, providing needed control data. A significant portion of the funding came from a \$750,000 contribution made by the natural gas company East Resources Inc., based in Warrendale, Penn.

At the end of the same year, work began to expand the monitoring network with 25 additional stations. Ten of

them were placed within New York's portion of the shale and funded by the New York State Energy Research and Development Authority.

Water data is monitored using YSI multi-parameter sondes. Parameters measured include water temperature, conductivity, pH, dissolved oxygen, and turbidity. Data is recorded as frequently as once every five minutes.

Conductivity is especially important, as it correlates with natural gas activity. The conductivity of water containing spilled fracking fluid is typically 200 times greater than normal measurements, according to the SRBC, because of the brine solution used. This makes conductivity a significant indicator of pollution from drilling activities.

Each sonde also includes a built-in depth sensor to help determine the volume of water flow. All data measured by the sondes are collected by the NexSens data loggers and then transmitted to the project computer, which runs NexSens iChart software. iChart interprets all incoming data and posts to the Web in real time.

Continued additions to the network are planned for this year, and the SRBC expects to have a total of 50 stations installed in Pennsylvania and New York by June.

The SRBC was formed in 1970 by the federal government and the states of New York, Pennsylvania, and Maryland with the mandate to protect and manage the water resources of the Susquehanna River Basin.



*An SRBC field technician installs a deployment pipe, in which a YSI multi-parameter sonde will be securely housed.*

# Piecing it together

## University research park seeks to understand fragile wetlands

It's been likened to putting together an enormous jigsaw puzzle. Or trying to glue a broken vase back together. Perhaps most vividly, "It's like taking a hamburger and trying to put it back on a cow," as University of Wisconsin ecologist Joy Zedler described wetland restorations many years ago.

These metaphors all make the point that restoring or recreating the world's fragile wetlands is a much more daunting task than preserving them in the first place. However, in many cases, there no longer exists the luxury of the latter.

Since 1900, more than half of the world's wetlands have vanished, mostly because of drainage and human development efforts.

Wetlands are vital natural filters for water, removing nitrogen, phosphorus, and carbon, and they serve important water removal and retention functions. They also provide a diverse habitat for fish, wildlife, plant life, waterfowl, waterbirds, shorebirds, and songbirds.

Recognizing the immense value of wetlands and the need to preserve them, scientists at The Ohio State University's Olentangy River Wetland Research Park are leading an effort to understand how wetlands function.

Researchers at the wetland park hope the data gathered will help determine how to restore damaged wetlands as well as create new ones.

This is a particularly pressing concern in Ohio, which has lost more than 90 percent of its wetlands in the last 200 years, according to the U.S. Geological Survey. The state's wetlands have shrunk from about 5 million acres to less than 500,000. In fact, Ohio's wetlands have experienced the worst diminishment compared to any other state.

The Olentangy River is a tributary of the Scioto River in Ohio. It is positioned within a 30-minute drive for more than 1.5 million Ohio residents. Despite rapid housing and business development around the Columbus area, the Olentangy River has actually seen an improvement in water quality, as it was

*Constructed 20 years ago from an abandoned urban floodplain, The Ohio State University's 50-acre Olentangy River Wetland Research Park offers a unique opportunity for studying wetlands and rivers.*

upgraded to an exceptional warm water habitat by the Ohio Environmental Protection Agency.

Constructed 20 years ago from abandoned land, the 50-acre wetland park draws water from the Olentangy and features thousands of feet of boardwalk that offer students and researchers access without disruption to the marsh. A deep-water billabong marsh and a bottomland forest also border the Olentangy River.

Finally, the park harbors two constructed 2.5-acre marshes with a river water delivery system, one that was artificially planted with wetland vegetation in 1994 and the other left to colonize naturally.

Interestingly, recent data from the park reveals that both wetlands, despite their disparate beginnings, now have equally diverse plant life and are equally effective at retaining contaminants.

To aid in the park's mission to understand and preserve wetlands, the Heffner Wetland Research and Education Building was built in 2002. During construction, three additional wetlands were created nearby, including one that receives and retains stormwater runoff from the building.

The facility is managed and operated by wetland scientist Dr. William Mitsch. Researchers studying the park's wetlands have benefited from a wealth of real-time data collected at various locations.

Mitsch and his staff have worked closely with NexSens Technology over the years to design and install the wetland monitoring system, which utilizes multiple instruments from numerous vendors to provide comprehensive data on conditions in the wetlands.

The requirements for the system included water level, quality, and flow monitoring at strategic locations throughout the wetland research park; a real-time connection to the monitoring devices; and software to manage the data.

To monitor water quality, the team installed several YSI 6600 multi-parameter sondes, which can be deployed for weeks without recalibration. The sondes measure a variety of water parameters, including temperature, conductivity, pH, ORP, dissolved oxygen, turbidity, and chlorophyll.

NexSens AccuStage sensors were selected for water level monitoring. The AccuStage is a self-contained pressure transducer that provides high performance and accuracy over a wide range of operating conditions.

NexSens data loggers with real-time spread-spectrum radio telemetry transmit data from the environmental sensors to a PC in the research building.

Mitsch said the most beneficial aspect of the NexSens real-time monitoring network is the ability to monitor live data from within the facility.

"It is the ecological analog of seeing the score of a game as it is happening as opposed to reading about it the next day," he said.

In the research building, a computer running NexSens iChart software saves the data and displays current conditions from around the wetlands on large HDTV displays, which Mitsch said are viewed by thousands of visitors annually.

The real-time system also allows for rapid response to sudden changes in conditions in the wetlands.

"We know immediately if there are interesting hydrologic, chemical, or biological events, such as floods, clogged outflows, or pollution," he said. "Then we can alert our research or management team to take adaptive action."

Since the wetland research facility is considered the only one of its kind, a key objective is to share the data gathered on wetland science and ecological engineering with experts worldwide.

The wetland park is continuing to pursue collaborative projects both throughout the state and across the globe. To assist with the dissemination of data, iChart automatically produces reports and posts them to a page on OSU's website. The page gives researchers anywhere access to recent sensor readings, helping advance crucial research on how to maintain, restore, and rebuild the world's wetlands.



*Real-time data from the wetlands is displayed on HDTV displays, which are viewed by thousands of visitors annually.*

# Pursuing Ecology's 'Digital Revolution'

With NexSens WQData, real-time environmental project information can be viewed securely on any Web browser, shared with clients or colleagues, or displayed on a public portal for all to see. Project data and the applications themselves are served from a highly secure, scalable, and reliable data center, allowing environmental projects to offload the infrastructure costs and effort it takes to maintain an on-premises solution.

Whether in a stream, on the go, or at your desk, you and your project team can be productive from anywhere using WQData. Scalable pricing plans start with a completely free basic option and are upgradeable to accommodate even large-scale enterprise systems.

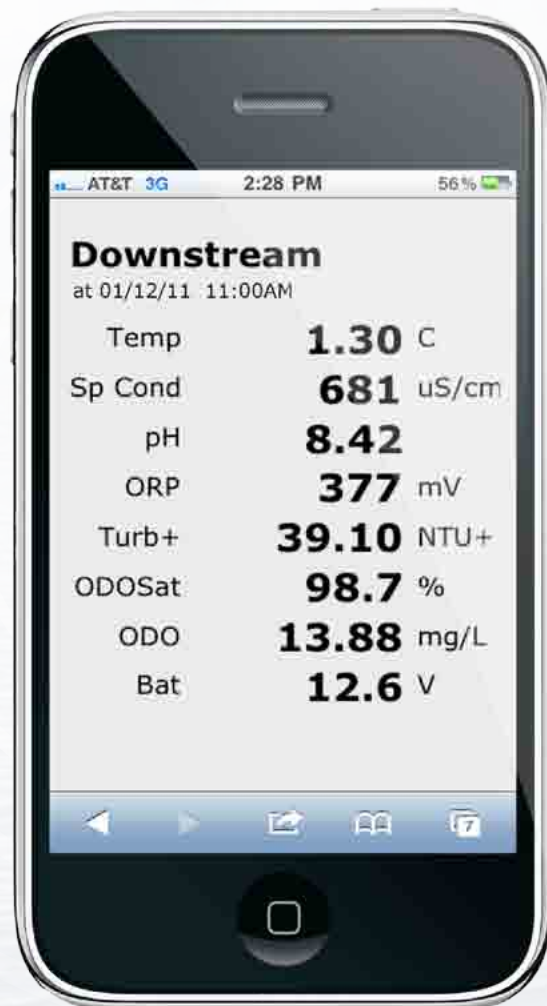
You might hear this type of technology called "software-as-a-service" or "cloud computing." This is simply a computing model in which information technology is provided as service, allowing users to access applications and share project data from the Internet without needing to maintain the supporting infrastructure.

At the heart of this system is the Windows-based NexSens iChart software. The program simplifies and automates the Web interface by automatically collecting data from remote monitoring stations, processing it, and exporting it to a project Web datacenter in real time.

iChart offers the industry's largest device library for integrating popular environmental sensors and systems. Simply select the manufacturer and model number from a device index. A built-in device profile eliminates complex sensor programming. Remotely deployed data loggers with radio, landline, cellular, Ethernet, and satellite telemetry provide real-time data access.

WQData does the rest. What once required contracting an expensive computer technology company has become a simple, affordable process. Best of all, you don't need to purchase new hardware to access this Web interface.

This Web-based data hosting solution is specifically designed for environmental data management, offering



WQData's mobile-friendly view makes accessing data on any smartphone convenient.

numerous data analysis tools, a map display of project areas overlaid with the most recent data, and even embeddable applets to include real-time data on outside websites.

WQData allows you and collaborators to share and access environmental monitoring project information at any time, from anywhere, using any computer or mobile device with an Internet connection. A mobile-friendly view makes accessing real-time data on any smartphone convenient, providing an excellent way to check data while in the field.

Whether  
*in a stream,  
on the go,  
or at your desk,*  
be productive from anywhere  
with **WQData.**

- ✓ *Secure, reliable Web-based datacenter*
- ✓ *View data on any computer or smartphone*
- ✓ *Scalable pricing plans, with free basic option*
- ✓ *Custom alerts via SMS or email*



**Product Spotlight:  
Water Quality**

# SUBMERSIBLE CDOM Sensor

*Turner Cyclops-7 offers advanced detection of colored dissolved organic matter*



There are many methods for determining CDOM in water, but the simplest and most cost-efficient way is to utilize in-situ fluorescence. Turner Designs has developed an in-situ Cyclops-7 CDOM fluorometer that uses ultraviolet excitation for CDOM detection. The sensor offers a unique combination of performance and size, making it attractive for freshwater, coastal, and oceanographic environments.

Colored (or chromophoric) dissolved organic matter, CDOM, often gives water a brownish or yellowish hue. CDOM naturally forms from trees and other vegetation in the landscape around water bodies but is also concentrated in water from agriculture and improper land use. It often regulates transparency to both visible light and damaging ultraviolet radiation in lakes, and it is a food source that forms the basis of aquatic food webs, providing nutrients for algae and energy for bacteria.

When the Cyclops-7 CDOM fluorometer emits UV light into the water sample, CDOM fluoresces in the same manner a black light shining on clothing produces different color light. The fluorescence is registered by a photodiode inside the sensor and outputs a measurable voltage. The voltage is proportional to the concentration of CDOM.

Cyclops-7 submersible fluorometer sensors are ideal for integration into remote data collection and telemetry platforms, such as NexSens iSIC and submersible data loggers, for long-term monitoring applications.

The rugged, stainless-steel construction is designed to withstand most environmental conditions. For stationary deployments in highly corrosive environments, titanium sensor housing is also available for increased resistance to the elements.

The Cyclops-7 sensor features a locking sleeve Impulse connector with cable options available from two feet to 50 meters. Sensor cables can be factory-connectorized with NexSens underwater connectors for integration to an SDL submersible data logger sensor port.



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Scan this with a smart phone using free software from [neoreader.com](http://neoreader.com) for online product details.  
<http://bit.ly/cyclops-cdom>

**Product Spotlight:  
Water Quality**

# USB-BASED pH Sensor

*NexSens WQ-pH is the latest in smart sensor technology*



The NexSens WQ-pH offers the latest in smart sensor technology.

The WQ-pH, part of NexSens' WQSensors series, is constructed with double-junction electrodes and is gel filled, ensuring minimal maintenance concerns throughout its long life. It is capable of direct computer interface through a six-foot integral USB cable, offering a hassle-free connection without meters, batteries, or power supplies. Data is displayed in real time directly on Windows-based PCs.

The pH sensor comes with WQSensors software, a powerful sensor interface and data collection program. After connecting the WQ-pH sensor through a USB port, users can easily calibrate, log, and analyze data from a sample using the software.

An internally stored unique ID and GLP file tracks calibration and sensor status for quality measurements. After data is collected, the sensor's unique ID is automatically recognized, and information on the most recent calibration, factory calibration, and probe status is displayed. [An integral temperature sensor is also included for displaying sample temperature.]

With WQSensors software, professional PDF reports can be generated with the click of a button, outputting

summaries, statistics, graphs, and raw data points. Advanced options allow the user to adjust graph scaling, select time intervals, and more.

A built-in science library includes an interactive periodic table of elements, tools for common environmental computations, standard mechanical and electrical reference information, and a unit conversion calculator.

Additionally, the software supports one-, two-, and three-point calibrations. Just place the sensor in a standard, click the "Calibrate" button, and enter the value of the standard. Repeat for each standard, and you're done.

The NexSens WQSensors pH Sensor provides affordable data collection capabilities with minimal maintenance requirements. Its durable construction allows for a long application life and thousands of measurements.



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<http://bit.ly/wq-ph>



**Product Spotlight:  
Weather**

# MULTI-PARAMETER Weather Station

*Lufft WS600 offers a cost-effective, maintenance-free solution for land- and buoy-based weather monitoring*



Compact and affordable, the Lufft WS600 has made it possible to purchase a single pole-mounted sensor that monitors air temperature, humidity, pressure, precipitation, and wind.

The unit is designed to reduce the maintenance requirements normally associated with traditional analog mechanical weather sensors, such as cup and vane anemometers.

The wind sensor instead uses four ultrasound sensors, which take cyclical measurements in all directions. The resulting wind speed and direction are calculated from the measured run-time sound differential. An integrated electronic compass is included to correct wind direction on moving platforms. The WS600 is tested in a high-precision wind tunnel to guarantee accuracy.

Temperature is measured using a highly accurate NTC resistor, while humidity is measured using a capacitive humidity sensor. Both are located in a ventilated radiation shield to reduce the effects of solar radiation.

Absolute air pressure is measured using a built-in MEMS sensor. The relative air pressure referenced to sea level is calculated using the barometric formula with the aid of the local altitude, which is user-configurable on the equipment.

Field-proven radar technology is used to measure precipitation. The precipitation sensor works with a 24-GHz Doppler radar, which measures the drop speed of individual drops of rain and snow. Precipitation quantity and intensity are calculated from the correlation between drop size and speed; the difference in drop speed determines the type of precipitation.

All sensors in the WS600 are completely protected from the elements, and the unit can be integrated into any building control system. Lufft's entire WS series of compact weather stations are now compatible with most any programmable logic controller that communicates via MODBUS data stream. They can also be configured via ASCII digital language, SDI-12, UMB, NMEA, or analog.



**Learn more**  
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**Product Spotlight:  
Survey**

# SIDE-SCAN Sonar

*Plug-and-play, towable StarFish 990F delivers the sharpest resolution of any StarFish system*



The recently released StarFish 990F is the latest and most advanced model in Tritech International's line of Starfish side-scan sonars.

Designed for extreme high-resolution surveys, the 990F has a 35-meter range capability on each channel, providing 70 meters of total swathe coverage. It is the smallest towed side-scan sonar available, measuring just 15 inches in length.

The 990F has the same compact, three-fin, hydrodynamic build that made the original so popular. This design ensures stability for the system's images while being towed, regardless of boat movement or speed.

The new model's capabilities have been enhanced through the application of Compressed High Intensity Radar Pulse (CHIRP) and digital-signal-processing (DSP) techniques. The 990F uses high-frequency 1-MHz acoustic chirped pulses with a 0.3-degree horizontal beam width to produce the most defined and clear images out of any StarFish system.

This capability makes the 990F ideal for surveys in ports and harbors, academic research, inland waterways such as rivers and canals, and search and recovery operations.



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# Dredging the Ottawa

## **Turbidity monitoring buoys support safe dredging in Great Lakes AOC**

The Ottawa River in northwest Ohio has long been considered one of the state's most polluted waterways. For years, it has received runoff and discharges from several landfills, industrial facilities, and combined sewers that overflow after heavy rains.

Despite efforts over the last 10 years to contain some of these pollution sources (e.g., capping landfills, cleaning industrial sites, and reducing sewer overflows), the river was until recently burdened by toxic chemicals that endangered humans and the local aquatic ecosystem. Sediment in the river was contaminated with a combination of polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and heavy metals (primarily lead).

The Ottawa carried these pollutants directly into Lake Erie's Maumee Bay. In fact, the river has historically been one of the lake's leading sources of PCBs, which have prompted a number of state advisories against eating certain fish from both the river and bay.

After years of political entanglement, however, a massive dredging cleanup of the river was implemented during the 2010 construction season. Officials chose to run the dredging operation 24 hours a day, six days a week. Maintaining aquatic health during the project was a key priority. The dredging site was carefully monitored using real-time data buoys that measured sediment re-suspension levels to ensure they did not exceed specified limits.

### **Protecting Lake Erie**

The project removed approximately 240,000 cubic yards of contaminated sediment from a 5.5-mile stretch of the river near downtown Toledo, making it one of the most significant cleanups in Great Lakes history. It was modeled after the 2006-07 cleanup of the Ashtabula River in northeast Ohio.

Because of the river's impact on Lake Erie, the U.S. Environmental Protection Agency funded half of the \$47 million cost of the operation under the Great Lakes

*A NexSens MB-300 data buoy with cellular telemetry monitors turbidity on the Ottawa River during dredging operations to ensure there are no issues with sediment re-suspension. Data buoys were positioned at a background up-stream location and downstream of each active dredge for the duration of the project.*

Legacy Act. The other half was paid by an organization called the Ottawa River Group, which includes seven local businesses that had historically contributed to the river's pollution.

Toxic chemical discharges entering the Great Lakes have been reduced in the last 30 years, according to the EPA, but contaminants linger in the sediment of many waterways because of urban sprawl and industrial activity, as is the case in the Ottawa.

Signed into law in 2002, the Great Lakes Legacy Act provides funding to clean up the "legacy" of contaminated sediment in areas of concern (AOCs) that feed into the Great Lakes. The Legacy Act aims to facilitate cleanups at the 31 of 43 Great Lakes AOC sites located wholly or partially within U.S. borders. The Ottawa River is part of the Maumee River AOC.

### **Sediment Removal and Treatment**

The dredging operation used four hydraulic cutterhead

dredges and five booster pumps over the project footprint. Only two dredges operated at a time to sustain production goals, while the other two were on standby awaiting confirmation sampling results. This approach exceeded minimum up-time requirements, allowing operations to run 24 hours a day, six days a week, for roughly six months.

The City of Toledo provided space in its municipal landfill for disposal of most of the dredged sediment. Water-soaked sediment was pumped through pipelines to enormous mesh dewatering bags (geotubes) in the landfill, where water was strained from the sediment. The water was cleaned at an on-site treatment plant prior to discharge back into the river. The majority of the sediment will remain in the geotubes within the city's landfill, contained within a secure liner system. Roughly 14,000 cubic yards of the sediment, however, had elevated PCB concentrations that required it to be sent to a special landfill in Michigan that is licensed to handle such waste.

### **Re-Suspension Monitoring**

The environmental consulting firm Natural Resource Technology of Pewaukee, Wisc. was contracted to assist the dredging contractor, J.F. Brennan Company of La Crosse, Wisc. with management of the contaminated sediments during the dredging project. Among the firm's responsibilities was ensuring that the levels of sediment re-suspended into the water column did not exceed specified ranges. Too much sediment re-suspension (measured as turbidity) can severely reduce water quality and transport contaminated sediment, posing a threat to cleanup objectives and aquatic health.

NRT selected NexSens Technology, a Dayton, Ohio-based company that specializes in real-time environmental  
*(Continued on next page)*



*NexSens Chief Technical Officer Doug Nguyen installs a submersible data logger into an MB-300 data buoy.*



Nguyen reviews deployment plans with Natural Resource Technology Environmental Engineer Andrew Millspaugh.

### Managing Data

During dredging operations, all data from the monitoring buoys was transmitted in real time to an on-site PC running NexSens iChart software. iChart served as a centralized database for all incoming data.

The software includes an "Alarm Notification" feature that could inform project members quickly if turbidity levels had exceeded a specified range.

iChart automatically sent updates to a NexSens WQData Web datacenter. The datacenter allowed personnel to review project information and real-time data online.

With this system in place, field staff was able to monitor water conditions during the project, ensuring dredging operations did not cause particle re-suspension issues. If unacceptable turbidity levels had been observed, the staff would have been able to immediately notify the dredge operators to shut down or alter operations.

### Legacy Act Progress

The Legacy Act has partially funded six sediment cleanup projects since 2004, according to the EPA, resulting in the removal of a cumulative 960,000 cubic yards of contaminated sediment. The EPA notes that these efforts have purged Great Lakes waterways of nearly 1.6 million pounds of pollutants. Despite how far the program has come, only four AOCs have been de-listed thus far, with only one being in the U.S.

Of course, there is no quick fix for remediating years of industrial pollution, but the Ottawa River project will greatly reduce the amount of harmful toxins in our waterways. With 30 U.S. AOCs still on the list, though, plenty of work remains.

*NRT specializes in environmental characterization, engineering, and remediation projects. The company is nationally recognized for managing contaminated sediments and has been selected by the EPA, U.S. Army Corps of Engineers, and National Academy of Sciences to participate in the development and peer review of various projects and documents.*

*For more information on the Ottawa River dredging project, contact NRT Principal Engineer Richard Weber at [rweber@naturalrt.com](mailto:rweber@naturalrt.com) or 262.522.1237. Furthermore, readers can visit [NexSens.com](http://NexSens.com) to learn more about NexSens Technology's turbidity monitoring systems and real-time data solutions.*

(Continued from previous page) monitoring, to design and configure a monitoring system for the project. NRT installed four NexSens buoy-based cellular data logging systems to monitor turbidity levels at a background upstream location and downstream of each active dredge.

The rugged buoy platforms are constructed of an inner core of cross-linked polyethylene foam and a tough polymer skin coating. Each buoy was equipped with a submersible data logger with cellular telemetry, solar panels, and a navigational beacon.

YSI 600 OMS (Optical Monitoring System) sondes with optical turbidity probes were suspended beneath the monitoring buoys. The turbidity probes feature a self-cleaning wiper to provide accurate measurements at a pre-specified sampling interval. Before taking a reading, the mechanical wiper would clean the sensing optics to ensure the measurement was not affected by biofouling, sediment, or debris.

# sensorBUS

**Simplify deployments by connecting numerous sensors with various interface types along a single cable bus**

Combining several popular sensor interface types into a single eight-wire bus, sensorBUS technology simplifies the deployment of environmental monitoring networks.

NexSens Technology developed sensorBUS to accommodate deployments of numerous sensors with various interface types on floating platforms. This has historically required cable assemblies for each sensor, causing issues with sensor wiring, cable tangling, and excessive cable weight.

By connecting all sensors along a single cable bus, however, the sensor string becomes easier to work with and more versatile.

The benefits of incorporating this technology in environmental monitoring projects are significant. sensorBUS requires much less space and fewer components, while offering a simple plug-and-play interface that allows environmental professionals to keep their preferred sensors or combine ones from numerous vendors.

Using a single-cable assembly, sensorBUS users can connect SDI-12, RS-485 multi-drop, and 1-wire temperature string sensors. Additionally, sensorBUS can provide both 12VDC and 5VDC power to connected probes. Each sensor is identified by a unique address or serial number, and parameter data is logged appropriately in the database.

The Serial Digital Interface at 1200 baud Protocol, or SDI-12, is capable of supporting as many as 10 sensors. The three-wire system was developed specifically for environmental monitoring applications, and the protocol governs exactly how a sensor must communicate with a data logger.

RS-485 is a multi-point communications network capable of supporting hundreds of nodes (sensors) over a few thousand feet. It offers superior performance when communicating at high data rates or over long distances.



sensorBUS' field-rugged, watertight connector and cable system is designed for harsh environments and submersible applications in fresh, brackish, or salt water. The cables are constructed of eight 22-AWG wires, including a shielded twisted pair for RS-485 signals, an overall shield, and a heavy-wall, UV-stabilized polyurethane jacket. Connectorized cable ends include a flexible strain-relief and either a plug or receptacle fitting.

Double o-rings (both gland and face seals) ensure a reliable and watertight connection. Mated connectors are rated for 200 feet of submersion. Cables are interchangeable and can be connected in series to extend lengths as needed. A complete set of accessories are available for termination, junction, and signal splitting.

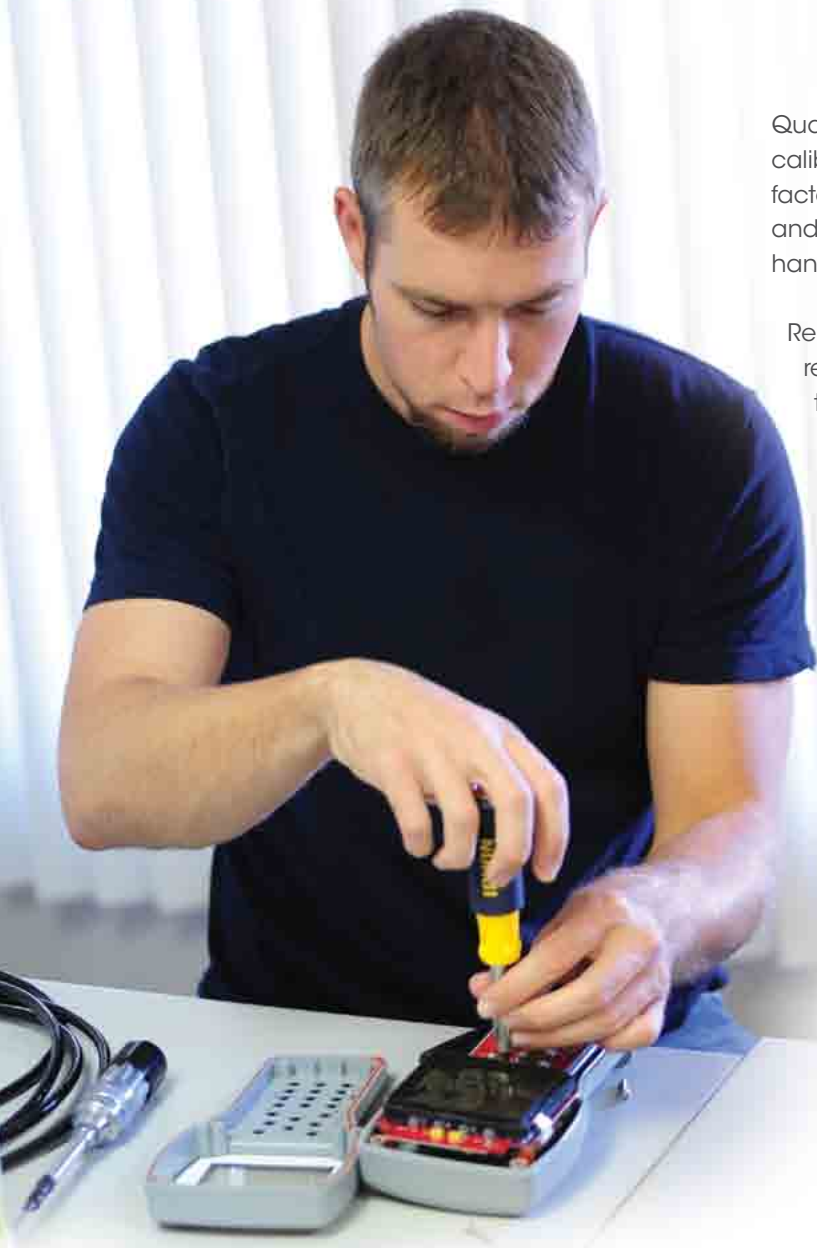
sensorBUS is especially useful for simplifying the design, setup, and operation of multi-point temperature strings, which can be constructed by simply determining the number of temperature points, connecting temperature nodes and cables together, and plugging the top cable into the data logger's sensorBUS port.

Temperature strings can be suspended from data buoys or connected to bottom-deployed data loggers and suspended by subsurface floats in the water column. Using SDI-12 or RS-485 communications, it's possible to add multi-parameter sondes, Doppler current meters, and other submersible measurement sensors to the string.

Learn more at [NexSens.com](http://NexSens.com) or call 937.426.2703 to speak with a NexSens applications engineer.



# Sensor Repair and Calibration



Quality data depends on monitoring equipment that is routinely calibrated and repaired. Fondriest Environmental offers a unique factory-certified maintenance program for YSI 6-Series sondes and displays, YSI 556 multi-parameter meters, and all other YSI handheld water quality meters.

Repair technicians will perform a free evaluation, send a repair quote via email to the point of contact, and repair the instrument based on the user's feedback. Fondriest's factory-certified repair center is staffed by trained technicians who have performed thousands of calibrations and maintenance procedures. Their experience guarantees that equipment will be efficiently and correctly repaired, allowing for the continued delivery of reliable data.

Instrument check-up, characterization, and certification are recommended on a semi-annual basis. In addition to improved data quality, the useful life of the monitoring instrument is extended with regular service.

Fondriest is pleased to offer tune-up specials on YSI 6-series sondes, YSI 556s, and all other handheld meters. Call **(888) 426-2151** or email [customercare@fondriest.com](mailto:customercare@fondriest.com) for more information.

Fondriest's service and repair center offers excellent turn-around times and low service costs on instrument repairs and annual maintenance services. Technicians can also visit the field to repair and calibrate equipment on site.

## YSI Sonde and Handheld Tune-Up Special

Fondriest Environmental is once again offering the YSI tune-up service. Upon return, your equipment will meet factory specifications and be ready for the spring monitoring season. Beat the rush and schedule service today!

**6-Series Sonde \$129**   **556 & Pro Series \$99**   **Handheld Meter \$89**

- Inspect and clean seal areas
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- Upgrade instrument firmware
- Recondition, test, and calibrate sensor
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# FONDRIEST R · E · N · T · A · L

when your  
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While it often makes sense to purchase systems outright, many short-term monitoring projects make it cost-prohibitive. Fondriest offers many real-time monitoring systems with weekly and monthly rental rates to meet project requirements.

Fondriest offers an extensive range of competitively-priced instruments for rent. Leasing on equipment for water quality testing, soil sampling, weather monitoring, and much more is available. Fondriest's rental equipment includes the latest monitoring technology, along with the field supplies needed to get the job done.



The Fondriest Preferred Rental Program simplifies and expedites the process of environmental monitoring equipment rental, offering the following benefits:

- Schedule your rental by phone or email. We'll assign an account manager to ensure you get personalized service and your equipment needs are handled professionally and quickly.
- Reserve equipment up to 30 days in advance with a signed rental agreement and credit card or purchase order; we'll hold it until your project begins.
- Shipping costs can be added to the quoted rental price, or we can ship using UPS, FedEx, or DHL shipping accounts.
- We offer flexible time frames to meet your project requirements. If you need to extend the lease, simply call or email your rental account manager.
- You won't have to tell us your rental preferences every time you reserve equipment. We keep a detailed record of your rental history.
- We keep your project shipping address and contact information on file, thus simplifying your order process.

*This personalized approach to the rental business lets you focus on the project at hand — we take care of the rest. Contact us at 888-426-2151 to learn more about how we can assist with your next monitoring project.*



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# Try **THIS** with *your* data buoy

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