

ENVIRONMENTAL monitor

fall 2011

Application and technology news for environmental professionals

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Welcome...

In this issue of Environmental Monitor, we canvass the Great Lakes region to look at a variety of water-quality monitoring projects. These featured systems provide remote continuous monitoring, allowing more data to be collected faster. And whether the goal is to prevent thermal pollution, ensure the sanctity of a fragile ecosystem, or just make sure the water is safe to swim in, we showcase the technology and projects that get the job done. For more information on monitoring systems, contact a Fondriest applications engineer. We're always happy to answer questions and brainstorm new solutions.

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Clean Beaches, Safe Water

By Alexandra Hazlett

A new predictive model could change the way beach contamination is monitored

Imagine spending the day at the beach and learning afterward that you were swimming in water contaminated with high bacteria levels. This nasty surprise is all too plausible in many beaches around the country, including the Great Lakes.

Swimming in contaminated water is probably more unsettling than actually dangerous, but it can make people sick. The Great Lakes support billion-dollar tourism and outdoor recreation industries, so officials are vigilant about monitoring water quality to make sure that the water is safe.

Ensuring the water quality of lakes and beaches is a never-ending task that falls into two categories. Firstly, contamination should be avoided if possible and remedied when it occurs. Secondly, it is critical that beach managers around the country be able to identify when contamination has occurred so that water recreation can be restricted or banned.

Achieving this later goal is surprisingly complicated. Absent seeing contamination happen, the only way to know that it has occurred is to test the water for the presence of bacteria. Scientists generally test for strains

of E. coli that are common in animal waste. These non-threatening strains of the bacteria, which also live in human intestines, can indicate the presence of fecal matter in the water. When the number of colony-forming units (CFUs) reaches a federally-determined threshold, the water is no longer considered safe to swim in, said Richard Whitman, research ecologist and station chief of the Lake Michigan Ecological Research Station in Porter, Indiana.

"We call [E. coli] a fecal indicator bacteria...They indicate the presence of waste, and that waste can carry pathogens," Whitman said.

However, measuring even this relatively straightforward parameter can be difficult. Direct testing of E. coli is expensive and time consuming. Water samples from the relevant lakes and streams must be sent off for testing, which can take 24 hours. By the time a result is returned and the water closed to swimming, people have probably been in it all day.

Even this wouldn't be such a problem if E. coli levels remained stable over several days. Then, Monday's result would still be good for Tuesday, and even Wednesday,

making closure decisions appropriate. Unfortunately, the Chicago Park District (CPD) has found that their water samples show that E. coli levels are inconsistent - high one day and low the next.

"By the time we posted a ban, the water was OK again, and we didn't have a ban when the water was bad," said Cathy Breitenbach, director of Lakefront Operations for the CPD. "Our current system is only correct when high [bacteria] levels last for more than a day."

A Novel Solution

So how then to measure E. coli in a timely and cost effective manner? The answer: Don't.

E. coli themselves are an indicator of fecal contamination, not direct evidence. Many factors can cause their presence - migratory birds, other wildlife, and even latent bacteria presence in sand can all cause the tests to spike. The E. coli in the water could themselves be reproducing and driving up the measurements. But there are several environmental factors that have been shown to influence the levels of E. coli in the water.

In collaboration with the United States Geological Survey, the CPD is creating an alternative model to predict E. coli levels by looking at other variables that can be measured instantly. These include wind speed and direction, wave height, turbidity (cloudiness of the water), rainfall, and barometric pressure. All of the above variables fluctuate with E. coli counts, but are much easier to measure. Using an equation that takes into account these statistics, Whitman and his team can estimate the E. coli counts in real time. CPD will continue to take water measurements to confirm the validity of the model. Funding for the project comes from the Great Lakes Restoration Initiative, a federal program managed by the US Environmental Protection Agency that aims to maintain and improve the health of the Great Lakes.

The measurements are obtained by way of buoys deployed at five of the 25 beaches under CPD's purview. Along with three land-based weather stations, NexSens data loggers attached to the buoys take hourly measurements and use cellular telemetry to publish the data to a website. The data from the buoys and weather stations has also been useful beyond the modeling project. Lifeguards access the data to check the water temperature, Breitenbach said. Beachgoers can also check the water-quality indicators before they head out to a beach where they might not be able to swim. The National Oceanic and Atmospheric Administration has also expressed interest in the data, according to Breitenbach.



A monitoring buoy anchored off Oak Street Beach, one of several that were deployed in June.

"For us [CPD], it's about protecting water quality, but if I'm taking my kids to the beach, I want to know what the weather's like," she said.

So far, the new predictive approach correctly explains approximately 40 to 60 percent of E. coli water test results. While this may seem low, it's actually about four times as accurate as traditional models. Whitman said highly correlative results are rare in the realm of biological science as there are usually a multitude of uncontrollable factors that can affect results.

"It's a very complicated and interactive phenomenon that's going on there," he said.

Ultimately, the goal is for the predictive model to supplant traditional E. coli monitoring for informing management decisions about restricting swimming, though samples would still be taken to corroborate the model's results.

One drawback of this approach is that it needs to be adjusted for each unique location.

"Some beaches are very influenced by the architecture of that particular beach," said Breitenbach, adding that different beaches are also vulnerable to different pollution sources.

However, in the long run, a buoy-based, real-time monitoring system will provide faster results that are less labor intensive than manual sampling. If the model proves its worth, Breitenbach said, it could be put into use next summer. ■

Understanding the impact of HYDRO-FRACKING

By Audrey Rabalais

The Clarion River, once believed to be the most polluted river in Pennsylvania, is well on its way to a full recovery. While many are asking if hydro-fracking will impact the recovery, officials are setting up real-time water quality stations to find out.

With nearby natural gas drilling in the Marcellus Shale and other industrial runoff, two organizations in Elk County, Penn., have teamed up to monitor the area's water. The Elk County Conservation District (ECCD) and the Iron Furnace chapter of Trout Unlimited, a coldwater conservation group, have put grant awards from the Colcom Foundation and the Stackpole-Hall Foundation toward establishing real-time water quality monitoring stations at 16 locations in sub-watersheds of the West Branch of the Susquehanna River, and the Clarion and Allegheny Rivers in and around Allegheny National Forest.

The Clarion River is the only river that runs through Elk County, and at one time was so badly polluted it could be lit on fire. In the last 40 years, the river has been cleaned and community members have developed a sense of responsibility and pride for their water. Now, concerns for drinking water, aquatic recreation and the aquatic habitat that supports high-quality fisheries throughout Western Pennsylvania have been raised by the increased natural gas drilling seen across the much of Pennsylvania. It is the hope of the ECCD and Trout Unlimited that the new monitoring project will help protect these valued waters.

Protection of public drinking water is the project's priority. Residents have already begun gathering baseline measurements of water quality before major drilling begins in the area. That information will complement real-time water quality data gathered by NexSens satellite telemetry systems. The almost instantaneous water-quality warnings these systems provide will help the team respond to pollution events.

"We have to be proactive in watching over our waters. With this system, we can protect drinking water quality before a pollution event becomes a problem," explained Kim Bonfardine, Watershed Specialist at ECCD.

Gas drilling in the Marcellus Shale frequently relies on a technique called hydraulic fracturing, in which high volumes of water and chemicals are injected into the shale formation to release natural gas. This brings with it the risk that the fracturing fluids, or the natural gas itself, could enter and contaminate underground aquifers and/or surface waterways. The monitoring system allows natural gas drilling to take place and will alert if there is a pollution event.

Iridium Satellite Telemetry

The design of the Iridium satellite network allows data to be routed anywhere in the world. When the system transmits data, it connects to the satellite overhead and data is relayed through the network to the appropriate Internet gateway. NexSens systems automate this process so real-time data is ultimately displayed in a graphical user interface.



The sites will be equipped with NexSens mast-mounted data loggers that use Iridium satellite telemetry to transmit data without relying on cellular networks. A 20-watt solar power kit continually recharges the systems, offering lasting performance without the need for battery changes.

Each data logger will connect to a multi-parameter water quality sonde, which is equipped to measure temperature, conductivity, pH, dissolved oxygen, and turbidity. This state-of-the-art equipment is designed for long-term deployments in both fresh and saltwater. It includes self-cleaning sensors to extend deployments. Calibration parameters are logged in an internal file for quality assurance.

Public awareness, a key element of the project, is facilitated with an online datacenter. Visitors can see charts and gauges, the locations of the watershed monitoring sites, and the latest measurements. The data is automatically collected from the loggers at four-hour intervals and transmitted via satellite telemetry to a computer running NexSens iChart software.

Project officials are basing their approach on the Susquehanna River Basin Commission's water-quality monitoring project. The eastern third of Elk County is located in the Susquehanna River Basin, which covers most of central and eastern Pennsylvania and parts of southern New York. The remaining two-thirds of the county are what the ECCD and Trout Unlimited are concerned about. Bruce Dickson, a member of Iron Furnace Trout Unlimited, said that the lack of similar monitoring projects in the Allegheny National Forest area means water use goes unregulated.

"There's so much public land up here, and there's really no advocacy for it," Dickson said. "We're in a situation where our water withdrawal and disposal isn't regulated

under one tent like it is with the SRBC. It's kind of a free-for-all."

Dickson said Trout Unlimited is also working with watersheds in Forest and McKean counties so that more of the water resources in Allegheny National Forest are monitored. Some streams in the area are plagued by acidic water, which comes from coal mining drainage and acid rain. The soils on the Allegheny Plateau are sandstone-based and have lost much of their buffering capacity after years of exposure to acid precipitation. The acidic water inhibits fish and macroinvertebrate reproduction. Many people visit the area to fish for its native trout; however, sensitive freshwater fish could be threatened if conditions do not improve.

"They're typically small populations, because the stream's productivity is not there due to the long-term effects of acidification," Dickson said.

To increase community awareness, Bonfardine works with area schools to teach students about local flora, fauna, and water quality. Some high school teachers have already expressed interest in the Web portal. They can incorporate data produced by the Elk County Monitoring Project into their lesson plans. Students will be able to take an active part in monitoring water quality by simply watching for spikes in parameters while in the classroom. Bonfardine also works with middle and high school students by taking them to acid mine drainage sights, acid precipitation sites, and to local streams for chemical analysis and macroinvertebrate identification.

"I think getting kids interested in the quality of the stream, whether there's pollution or not, is a very important thing," Bonfardine said. "I want them to develop a sense of stewardship where they feel responsible for the streams in their communities." ■

ESTUARIES

System-wide Monitoring

By Audrey Rabalais

Maintaining a delicate balance in these fragile ecosystems

Throughout human history, people have always wanted to be where the rivers meet the sea. The mix of freshwater and saltwater species surrounded by a variety of terrestrial environments makes estuaries hubs of rich biodiversity.

However, if a change in any of the contributing environments occurs, the delicate balance of the area can be thrown off, affecting thousands of species that depend on these brackish waters. Catfish, shrimp, crabs, oysters and clams, among other species, all depend on healthy estuaries. The National Estuarine Research Reserve System (NERRS) is working to maintain these areas so that community members can continue to enjoy them while gaining a deeper understanding of delicate estuary ecosystems.

The National Oceanic and Atmospheric Administration (NOAA) has teamed up with the 22 coastal states that participate in NERRS. Founded in 1972, NERRS is a network of reserve sites that promote stewardship, education and preservation of estuaries. NOAA ensures funding and standardizes equipment and management practices, said Ralph Garono, the reserve manager for the Lake Superior Reserve in Superior, Wis. The 28 research reserves are

managed daily by local agencies and organizations that receive funding and direction from NOAA. Each reserve is accessible to community members and those who may wish to use estuaries as education resources. The estuaries also function as a living laboratory for researchers.

Standard real-time monitoring probes in each reserve transmit data every 15 to 30 minutes, which is then made available online. Most reserves also take monthly grab samples to evaluate biochemical oxygen demand, nitrate and nitrite concentrations, and bacteria. The Centralized Data Management Office (CDMO) aggregates data from all the reserves and provides quality assurance and control. This centralized control ensures that all data is collected and distributed uniformly throughout NERRS. The CDMO synthesizes data into reports that can be viewed on the NERRS website.

Each NERRS reserve uses a three-pronged System-Wide Monitoring Program (SWMP) to determine how human and natural events affect estuary ecosystems. The program surveys short-term fluctuations in water quality, biological populations, and watershed and habitat health. The water-quality focus includes abiotic conditions such as dissolved

oxygen, pH, sediments, organic contaminants, and tidal range. Because estuaries are at the intersection of two bodies of water, measuring and monitoring them can be complicated.

"Nutrients may come in [to the estuary] in one form and transition into a completely different form that may not be available for organisms," Garono said.

The second prong, biological monitoring, surveys species in the area as well as invasive and rare organisms that could be bio-indicators of a change in the environment. Researchers also look at population characteristics and habitats. Landscape is the third focus. This includes a look at how the watershed and coastal area is changing over time and how the land is being used.

According to NERRS, SWMP is a key component of the new Integrated Ocean Observing System, an information source that provides oceanic and coastal data for environmental protection purposes and some industrial uses. Data collected from NERRS reserves is used for weather forecasts, and by fisheries and transportation services.

The NERRS program also provides education and employment opportunities for the local communities it serves. Through its Graduate Research Fellowship Program, reserves hire graduate students to monitor the coastal areas while gaining valuable experience in their field of study. NERRS attracts high-quality researchers by providing a stipend as well as state-of-the-art equipment. Local schools often utilize the data to teach students about estuaries and environmental stewardship. Public outreach is also available through adult estuary training and materials that are provided to city councils and coastal planners.

"The purpose is not only to do the research but make sure it gets transferred to different user groups," Garono said.

The information is pertinent to coastal areas where many community members come to live simply because of the view from a shoreside home. Many are not aware of the delicate ecosystem in their backyards and how their activities can contribute to the long-term health of the estuary. NERRS data reflects the changes that may be caused by the abundance of human activity in the fragile coastal areas.

"We must forge science in people's minds so they understand the consequences of their actions," Garono said. ■

Freshwater Estuary Monitoring at Old Woman Creek

Project Overview

Old Woman Creek State Nature Preserve and National Estuarine Research Reserve is one of the few remaining relatively natural freshwater estuaries in the Great Lakes region. On the south-central shore of Lake Erie, Old Woman Creek and lake water mix to form a unique ecosystem.

The 571-acre preserve provides critical habitat for native species and migrating birds and offers a unique opportunity to research the ecological benefits provided by these fragile estuarine systems.

To assist in the understanding and preservation of the estuary, an automated water monitoring system was installed at Old Woman Creek Nature Preserve. The system is part of a long-term data set collected at National Estuarine Research Reserves around the country.

System Description

Two water quality monitoring stations were deployed: one where Old Woman Creek enters the preserve and another near the mouth of the estuary. At both stations, NexSens radio data loggers and multi-parameter sondes with temperature, conductivity, salinity, dissolved oxygen, pH, depth, and turbidity sensors were installed.

At each site, water quality and hydrology data is collected and transmitted via license-free spread spectrum radio to a base receiver located at the Old Woman Creek visitor center. A computer connects to the radio receiver, and uploads data to an online datacenter at WQData.com. This data is used in environmental education as well as restoration and resource management decisions.



Old Woman Creek empties into Lake Erie.

Pursuing Ecology's 'Digital Revolution'

By Steve Fondriest

Securely deploying a sensor is only half the battle these days. Many environmental monitoring projects now make data available to scientists, researchers, government agencies and in some cases the general public in near real-time. In the past, this would have been a daunting task, but new technology allows even novice computer users to share environmental project data via the Internet.

While the US Geological Survey, NOAA and others federal agencies have been transmitting and sharing environmental data for years, many non-government projects continue to rely on remote data acquisition and periodic site visits for data retrieval. Under optimal conditions, these systems can work very well. However, hazards associated with weather, marine environments and harsh field conditions often lead to lost or erroneous data and significant delays waiting for collection. An automated system can eliminate these inconveniences and provide a constant stream of reliable data.

Automated real-time environmental monitoring systems are comprised of sensors, data loggers, telemetry, software and a web datacenter.

Sensors

Manufacturers are now bundling 'smart sensors' into multi-parameter devices, leveraging onboard electronics as much as possible. Vaisala's WXT520 multi-parameter weather station combines wind, precipitation, pressure, temperature, and humidity measurements into a single compact device. Other manufacturers have followed suit with similar units.

Recent advances in self-cleaning sensors and anti-fouling technologies have significantly improved the quality of data gathered by multi-parameter water quality sondes. YSI recently introduced several copper alloy anti-fouling kits for use with 6-series sondes. Tests conducted in fresh, estuarine, and marine waters across the nation have demonstrated longer deployments and improved data quality with the kits. Water quality characterization of lakes, reservoirs,

rivers and marine environments is less complicated, data reliability is much improved, and maintenance costs are also much less.

Data Loggers

The environmental data logger acts as a centralized hub for sensor connections and provides an interface for various data telemetry modules. These data acquisition systems are built to withstand harsh field conditions and are self-powered with options for solar charging. Onboard non-volatile memory accommodates months of time-stamped records.

The integration of multiple sensors from multiple vendors is often the most challenging aspect of setting up an environmental monitoring system.

While opportunistic vendors have somewhat hindered the standardization of sensor connections, many data loggers now accommodate several connection types. NexSens incorporates sensorBUS architecture into every data logger. It combines multiple industry standard interfaces on a single 8-wire bus, replacing parallel wiring found on many prevailing analog and SDI-12 systems. All connections are field hardened and fully submersible.

Telemetry

There are many benefits and significant cost savings associated with the addition of wireless communications. The most obvious may be the reduced number of trips made to remote project locations for data retrieval. Additionally, potential problems (sensor failure, bio-fouling, vandalism, ...) are readily identified and data loss is minimized. Deployment times are extended by continually verifying that high-quality data is still being collected.

Telemetry makes it possible to transfer data and send configuration information to remote project sites. Options include: land-line telephone, cellular, satellite, Wi-Fi, Ethernet, Bluetooth and VHF, UHF or spread spectrum radio.

Software

A host computer provides the interface for connection to project sites. Windows-based software is used for interfacing both locally (direct-connect) and remotely (through telemetry) to a single data logger or network of data loggers. The software simplifies and automates many of the tasks associated with acquiring, processing, analyzing, and publishing environmental data.

NexSens iChart software is based on an open architecture and designed specifically for environmental monitoring projects. It offers an easy-to-use set of tools to configure and customize monitoring projects. Drivers for various sensors are built into the device index, which simplifies setup and eliminates complex programming. Many commonly used communications settings are predefined.

The software also includes a unique Report Generator tool for building customized reports with historical data from all remote sites. Users have the option to save report templates, eliminating the need to recreate the same report. To further automate the process, reports can be posted to a website, network drive or emailed to a predefined user list.

For projects that require real-time data access from multiple locations, the software automatically posts data to a web datacenter. This feature can also be used to share the information with a broader audience.

Web Datacenter

For 24/7 instant access from any location, many environmental monitoring projects are turning to web datacenters. Data and project information are available using any Internet browser. Projects can be setup as password-protected or open access. A public portal can

be configured to selectively present information to the general public, while maintaining historical data and sensitive information for the project team. Area maps with dynamic markers identify sites and display current status with a 'mouse over' feature to view the latest readings.

Standard data processing features include recent and historical data tables, time series graphs, statistical summaries, and project-specific information. A 'Select All' feature displays common parameters for all sites. More advanced features include project photo galleries, data entry forms with dropdown lists, workforce management tools and RSS data feeds.

A web datacenter is automatically generated by the software and hosted on secure servers. Scalable plans start with a no-cost basic option and can be upgraded to accommodate even large-scale enterprise systems. A standard web applet allows users to display data on their company or agency website by simply embedding the html code into the page. Data is presented to site visitors as a quick snapshot. An 'ALL DATA' button directs the user to the project datacenter.

Continuous remote monitoring systems paired with web datacenters allow environmental projects to offload the infrastructure costs and effort it takes to maintain an on-premises solution. The arrangement frees up project personnel so they can focus on the real task at hand. ■

About NexSens:

NexSens Technology is a Dayton, Ohio-based company that specializes in the design of real-time environmental monitoring systems. NexSens data loggers, software, and web interface technology simplify the process of managing and sharing project data. For more information, visit NexSens.com

“Software simplifies and automates many of the tasks associated with acquiring, processing, analyzing, and publishing data.”

Turning the Tide

By Kelly Blumenschein

After another drowning at a beach notorious for its dangerous currents, a city came together to improve beach safety

In early October 2005, a crowd of beach-goers at Picnic Rocks Beach in Marquette, Michigan, became the audience to a tragedy. News reports recounted how dozens of people watched as two swimmers were overcome by the current while trying to swim back to shore. Onlookers called for help and a kayaker tried to reach them, all to no avail. The two teenagers, Toni Copeland and Cassiano Huckabee, both drowned.

The waters off Picnic Rocks Beach in Lake Superior have caused more than a dozen deaths in the last 30 years, according to Assistant City Manager Karl Zueger. Swimming is discouraged, and the beach is not patrolled by lifeguards, but the water is deceiving, especially in nice weather.

The current at Picnic Rocks Beach is called a long shore current, a unique subset of rip currents that run parallel to shore rather than perpendicular. Rip currents, also known as rip tides, occur as a result of the interaction between several factors, including: wave height, direction, other waves, currents and changes in water levels. These factors create an uneven distribution and buildup of water along the coastline, which propels the water back out to sea at high velocities. Water speed is considered moderate around one mph; rip tides generate currents of two to five mph. At these speeds, a rip current can pull even the strongest swimmers away from shore or into a hazardous area.

In light of these dangers, the town has been working to increase the alertness and preparedness of beach visitors, but it was in the wake of the deaths of Copeland and Huckabee that a plan began to take shape.

Friends of Copeland, Craig Wiseman and Scott McLain, engineering students at Northern Michigan University, created a proposal for a water velocity monitoring system at Picnic Rocks Beach. Using the report as their senior project, the two students outlined a detailed strategy for monitoring the water and making the data available to beach goers, emergency response personnel and the National Oceanic and Atmospheric Administration, among others.

Drownings from rip currents are not unique to Picnic Rocks Beach. During the summer of 2010 alone, 30 people died in the Great Lakes and more than 30 were rescued from dangerous swimming conditions caused by these currents. Nationally, rip currents are estimated to kill over 100 people each year and account for 80% of beach rescues.

After seeking out partners to provide the desired monitoring technology and locating grant funding from the Great Lakes Observing System (GLOS) to support their project, the team chose to monitor water safety at Picnic Rocks Beach using a Doppler current meter and a cellular telemetry system. Measurements from the current meter are stored in the data logger and then transmitted by cellular telemetry to a host

computer. Software processes and posts the data to the WQData website where it can be viewed from any web browser. Zueger commented that the equipment helped improve the city's understanding of the currents, and built a strong foundation for what has grown into a city-wide project. Citizens of Marquette can now look online at the beach safety forecasts before they visit the shoreline.

The project developed by the team is a novel step for rip current safety in the Great Lakes, Zueger said.

"This type of research and deploying this type of equipment on a Great Lake like we have is a pilot study - it hasn't occurred in other coastal communities." He noted that people are now paying attention to beach safety when they may not have in the past.

The culture of the Marquette community has been the key factor behind these changes, Zueger said. In light of these developments, Marquette has been honored with the Michigan Municipal League's (MML) Region 7 Community Excellence Award (CEA), and will have an opportunity to win the highest CEA honor for the state at the MML convention this October.

The city, schools, and supporting groups in Marquette have played important roles as the project has progressed. A new ordinance allows the city to close the beaches during times of bad weather and a flag system has been put in place to alert the public of the beach's status. A website streaming real-time data is frequented by beach goers and local hotels even place a safety card on the pillows of patrons to educate them of the importance of beach safety.

"We've found that although [the beach is] pristine, there are dangerous aspects of it," Zueger said. "It's our responsibility to get a better understanding of that and share it with the public." ■

**Product Spotlight:
Weather**

HYDREON RG-11 Optical Rain Gauge

Reliable, cost-effective precipitation measurement with a wide variety of applications



The Hydreon Optical Rain Gauge is a reliable and cost-effective choice for precipitation measurement, outputting both rain accumulation and intensity. The sensor package is about the size of a tennis ball and completely sealed from the environment. A built-in mounting arm allows for convenient mounting to weather station masts, buildings, and other infrastructure.

The RG-11 senses water hitting its outside surface using beams of infrared light, modeling the principle used in automotive rain-sensing windshield wiper controls. The optical gauge bounces the infrared beams within the sensor lens, and as rain drops hit the surface, the infrared light escapes through. Changes in the intensity of the infrared beams during rainfall are directly correlated with the size of the rain drop. The system automatically compensates for condensation and very small drops; it can detect rain drops less than a half millimeter in size!

The Optical Rain Gauge has multiple settings, including the "tipping bucket mode." By counting each individual droplet and noting its size, the optical gauge correlates the data to that of a tipping bucket. In many applications, the RG-11 may be directly wired in to replace a tipping bucket.

The RG-11 also has a function referred to as "it's raining" mode, used to trigger applications that must be notified immediately once rainfall begins or precipitation hits a specific threshold. This is ideal for wet weather notification systems or for triggering samplers and other monitoring instruments. A built-in DIP switch allows the user to switch to the mode of operation best suited for the applicaton.

The optical sensing technology overcomes many of the shortcomings of conventional tipping bucket rain gauges. The sensor works in mobile environments, there is no collecting funnel to clog with leaves, and the round shape makes it essentially self-cleaning. While the sensor is not as accurate as a tipping bucket rain gauge, the low cost (\$99) and compact size of the RG-11 makes it ideal for wet weather notification systems or remote rain gauges where periodic maintenance is not possible.■



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**Product Spotlight:
Water Level**

SOLINST LEVELLOGGER Edge - **NEW**

Water level & temperature logger with an 'edge'



Solinst recently announced the newest addition to its Levellogger series: the Levellogger Edge, a water level and temperature sensor with an 'edge' over previous models.

The stainless steel Levellogger Edge features a Hastelloy pressure transducer and titanium-based PVD coating for increased corrosion resistance. The Edge can withstand more than twice the normal pressure without causing damage to the logger. With a wider temperature-compensated pressure range and improved thermal response time, the Levellogger Edge can be deployed in temperatures ranging from -10 to 50 C.

The Edge's expanded memory capacity can hold up to 120,000 readings using the compressed linear sampling option; measurement rates can be set from 1/8 second to 99 hours. The Edge can schedule up to 30 rate- and duration-customized items with the new Schedule option. At a sampling time of 1-minute, the logger's lithium battery will last at least 10 years. The high resolution of earlier Solinst loggers is maintained a water level accuracy of 0.05% full scale.

The Levellogger Edge connects with the host computer through Solinst's new Optical Reader, increasing the speed at which data is transferred to 34,800 bps. Other

communication options include RS-232 and SDI-12 for custom or remote telemetry applications.

A streamlined version of the Levellogger software has been introduced as well, providing more sampling options such as linear- and event-based logging. A new user-friendly interface makes it easy to view and process data. Multiple files can be barometrically compensated at once. Compressed and repeat sampling, as well as a future stop option are also available.

The Edge also features a protective Faraday cage design to safeguard from power surges or electrical spikes caused by lightning. It is ideal for stormwater run-off monitoring, aquifer characterization, and stream gauging, in both short- and long-term applications. The newly-released Levellogger Edge offers reliable performance, low maintenance and high accuracy in a compact and corrosion-resistant housing.■



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**Product Spotlight:
Water Quality**

YSI OBOD Lab Kit

Reliable meter and optical oxygen probe for quick and easy lab BOD measurement



YSI's OBOD laboratory kit provides a convenient solution for accurate biochemical oxygen demand (BOD) measurements. The kit is comprised of YSI's optical BOD probe, ProODO meter, docking station, and power supply.

The optical BOD probe measures dissolved oxygen using optical luminescent technology, a method that has recently gained wider acceptance over traditional electrochemical sensors because of its increased accuracy, stability, low maintenance, and EPA approval. The sensor emits a blue light that causes the dye in the sensing element to glow red, measuring both luminescence intensity and lifetime; the signal is then compared to a highly stable reference.

The optical BOD probe is a smart sensor that retains calibration data and can be interchanged between instruments without recalibration. This self-stirring probe provides a representative sample, requires no warm-up time, and increases response times by almost 50 percent. The body fits into a standard 300mL BOD bottle and also features a guard to protect the sensing element when moving between bottles. With reduced drift and no hydrogen sulfide interference, the probe is ideal for wastewater applications.

The optical probe connects directly to the ProODO meter, which conveniently sets on a lab docking station. The dual-purpose meter can also be used as a portable field device with compatible field cables and probes. The ProODO has the ability to store 5,000 data sets, including sensor data, date, time, site and user-defined information. Compatible BOD Analyst Pro desktop software offers convenient data processing and method determination.

The costs associated with electrode maintenance and membrane changes common with traditional electrochemical probes are reduced with only an annual recommended sensor cap replacement. The reliable and serviceable YSI OBOD laboratory kit is backed by a 3-year meter and 2-year probe warranty. ■



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**Product Spotlight:
Marine**

MUSTANG SURVIVAL Inflatable PFDs

Inflatable PFDs for unpredictable circumstances when working on the water



Mustang's line of Deluxe Inflatable Personal Floatation Devices (PFDs) prepares users for unpredictable circumstances on the water. With options for manual or automatic inflation, or a combination of the two, the Mustang Inflatable PFDs provide safety for water environment professionals.

Mustang's automatic PFD option uses hydrostatic inflator technology (HIT) that automatically inflates the PFD when it is submerged in four or more inches of water. The automatic PFD is authorized for US Coast Guard use and will not inadvertently deploy due to rain, spray, or humidity. Automatic inflatables are the best choice when the user does not expect to end up in the water, but wants the confidence that the PFD will inflate in seconds if the unexpected happens.

The manual PFD includes a safety inspection window indicating inflator status. The PFD inflates when the user pulls on the activation cord. An oral tube is located on the left chest as a back-up inflation method. Manual inflatables are best for paddling, kayaking, and other activities where there is a reasonable chance of ending up in the water.

All Mustang inflatable PFD models offer a coated neoprene neck cushion and include a strobe light

holder, SOLAS reflective tape, a patented SecureZip closure system, and a safety whistle to alert rescuers in emergency situations.

Models are also available specifically for workers in need of a vest with reduced heat stress, as well as for fisherman who may require a lightweight PFD with storage pockets and a back hanging ring for their landing net. A high-visibility model is also available, made with the same materials used by police, EMS, and traffic controllers.

The Mustang PFDs require no maintenance for five years unless the PFD inflates. A look at the safety inspection window will provide the user with a necessary replacement date for the re-arm kit. ■



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Lake Michigan facility seeks NPDES permit renewal

By Audrey Rabalais



Industrial facilities throughout the country withdraw and discharge water from lakes and streams to use in cooling systems. Thermal pollution occurs when the discharged water is too hot, and then affects the surrounding aquatic ecosystems.

The scores of power plants, paper makers, chemical refineries, and other industrial facilities that use local freshwater to cool their processes are required to ensure that the water doesn't harm wildlife when it is returned to the rivers and lakes.

To prevent harm from thermal pollution, an industrial facility along Lake Michigan is conducting a study to ensure it continues returning borrowed water to the lake without jeopardizing aquatic health. AECOM, an environmental consulting firm and the facility's consultant, completed the first phase of a thermal discharge study last October in order to renew the facility's National Pollutant Discharge Elimination System (NPDES) permit.

During a four-week field survey last fall, AECOM used field data and a numerical model to determine whether the thermal plume from the discharge point exceeded the allowed 1,000-foot mixing zone. The receiving water temperature in Lake Michigan cannot be three degrees Fahrenheit greater than existing background temperatures outside of the mixing zone. The current NPDES permit allows the facility to exceed normal

temperature limitations if it can demonstrate the discharge does not adversely affect aquatic life.

The project team set up 13 mooring locations to monitor water temperature and variance at different depths and distances from the point source. NexSens MB-100 data buoys were deployed at each location. They were equipped with SDL500C submersible data loggers with cellular telemetry and T-Node temperature strings. The data loggers transmitted readings twice daily and were powered using D-Cell alkaline batteries, said Fondriest Environmental's Paul Nieberding, who worked with AECOM on designing and deploying the monitoring system.

"We had all 13 buoy systems turned on and transmitting data when they shipped," he said. "This way, they did not need to do any programming at the site — just drop the buoys in the water."

The mooring locations ranged from shallow near-shore areas to locations 3,000 feet off shore in water about 25 feet deep. Buoys in shallow areas withstood 10-foot waves during two large storms. Fortunately, the NexSens systems were designed to withstand full submersion, Nieberding said.

"Where larger buoys would get tossed around in severe wave action, the MB-100 acts more as a bobber and can take a submersion if needed," he said.

The field data collected by the buoys was used to calibrate and validate an environmental fluid dynamics computer model. AECOM used this three-dimensional simulation of the receiving water to predict theoretically worst-case scenarios that could not be measured in the field due to limited time. The project team took a virtual look at what would happen to water temperatures during the warm summer months and cool spring months, adjusting for current and wind direction.

Once the virtual and raw data were collected and analyzed, the results showed the thermal plumes would exceed the 1,000-foot arc during theoretically worst-case scenarios. The facility will now need to move to Phase 2 of the project to prepare an updated 316(a) thermal variance demonstration when applying for their NPDES permit renewal. This will include a biological assessment of the aquatic environment affected by the effluent, a description of the important species possibly affected, and a hydrothermal assessment. The Phase 2 plan will be submitted to the regulatory agency sometime next year for approval of the variance. ■

About AECOM:

AECOM is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. For more information, contact Ben Zhang at Ben.B.Zhang@aecom.com.

System Description

AECOM's multi-point temperature monitoring buoys consisted of the NexSens MB-100 data buoy, SDL500C cellular data logger, and T-Node temperature string delivered as a pre-built system ready for deployment.

The MB-100 data buoy is designed to withstand rough waters in both surface and subsurface applications. It features an inner core of cross-linked polyethylene foam with a heavy polymer skin. The stainless steel frame secures the foam in place and serves as an attachment point for mooring line.

The SDL500C cellular data logger is a self-powered remote data logging system designed to be secured within the MB-100 data buoy. The system is configured with an internal cellular modem, along with five ports for connection to digital and analog sensors. Internal circuit boards and communication modules are shock mounted, and all access ports incorporate redundant sealing for use in harsh environments.

NexSens T-Node temperature sensors feature an integral digital sensor secured in a protective housing for temperature profiling in fresh, brackish, or seawater. For this application, the sensors were connected in-series using UW underwater cables, attached along a mooring line, and suspended vertically in the water column.



Buoys are ready for deployment in Lake Michigan.

Monitoring Lake Water Quality



Buoy systems provide easy, continuous water quality monitoring

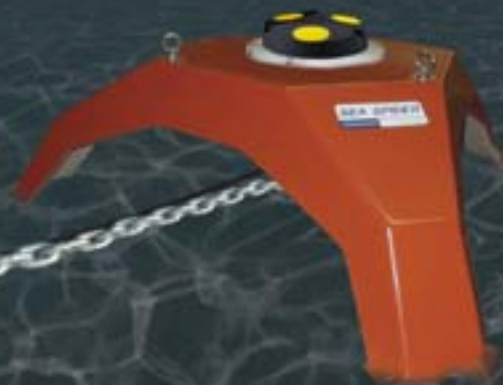
As interest in protecting water resources grows, so does the need for real-time monitoring. Periodic spot sampling provides a snapshot of the overall health of a lake, but it is often difficult or impossible to gather continuous time-series data needed to make informed decisions. Many water resource groups are turning to buoy-based monitoring systems to acquire timely water quality and other environmental data. NexSens buoys simplify setup, deployment and operation of these systems. With wireless radio-to-shore, cellular, or satellite telemetry and web-enabled publishing, water quality data is always available.

Buoy platforms range in size from 100 to 2,500 pounds of buoyancy and provide options for deployment in small lakes, deep reservoirs, bays, harbors, and coastal waters. Corrosion-resistant stainless steel and advanced polymer construction

ensure years of reliable service. Integral mooring and lifting eyes along with a full line of accessories aid in deployment and provide long-term stability in harsh conditions.

An integrated, fully submersible data logger includes five sensor ports for connection to water-quality sondes, fluorometers, nitrate sensors, temperature strings, Doppler current meters, and other measurement devices. Industry-standard RS-485, RS-232 and SDI-12 protocols and an open software architecture ensure seamless integration of preferred vendor's sensors. Fully submersible connectors, analog signal converters, and signal splitters provide a plug-and-play interface.

NexSens buoys, data loggers, and systems streamline the construction of subsurface sensor networks. Contact a Fondriest Applications Engineer for more information. ■



YSI ProODO

Optical Dissolved Oxygen Instrument is innovative, durable, & field-ready

Enhanced with optical dissolved oxygen technology, YSI's handheld ProODO meter is a cutting-edge solution to in-field data collection. Low-maintenance optical technology eliminates the need for cleaning electrodes and changing solutions.

The luminescent detection method, approved by the EPA last year, allows for efficient DO readings. This "cold light" energy does not consume oxygen while sampling, meaning no stirring is needed. It also provides more accurate readings by preventing interference from gases such as hydrogen sulfide. The ProODO meter can record a DO range of 0 to 500 percent.

The digital sensor can also store calibration data internally, eliminating the need to recalibrate when probes are placed on a different instrument. Calibrations can be stored up to one year, and the memory holds up to 5,000 data sets. Data can be organized into 100 user-defined folders, so each location, date, and data type can be easily retrieved.

Built with the unpredictable outdoors in mind, the ProODO is sheathed in a rubber over-molded case tested by YSI to survive multiple one-meter drops from all angles. It is also rated to IP-67 standards, even with the battery cover off, meaning it is completely protected against dust and able to withstand immersion between 15 centimeters and one meter. It also includes cable weights that can be daisy-chained and waterproof military spec connectors with bayonet

locks. The ProODO comes with a three-year instrument warranty and a two-year cable and probe warranty.

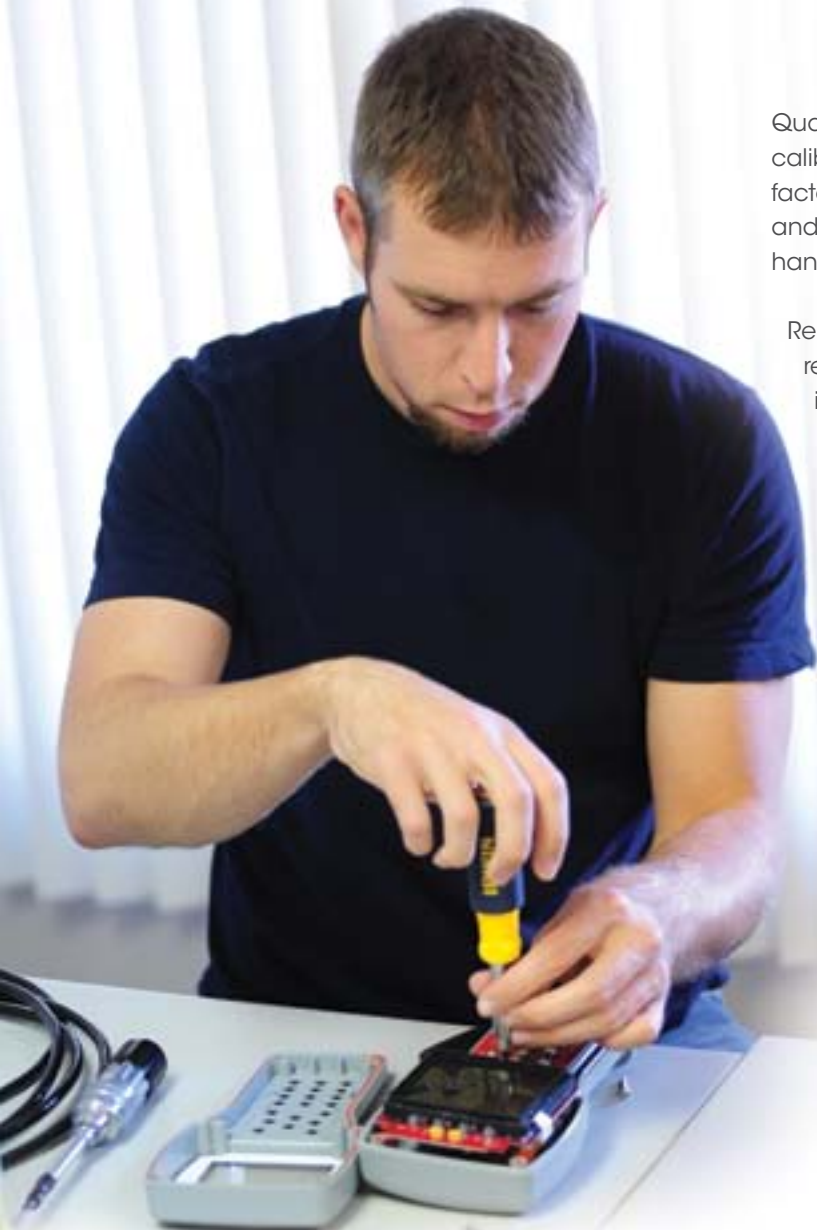
The backlit display and keypad allow for use in low-light field outings, and data can be spoken aloud in English, Spanish, German, Italian, Norwegian, Portuguese, and French. The instrument can be connected to numerous lengths of cable. A cable management kit is included for cables 4 meters and longer. The convenient instrument package also includes a tripod, belt clip, and carrying cases. Weighing just over one pound, the instrument can be easily carried long distances.

After field data is collected, it can be transferred to a computer through the USB and communication saddle. Free Data Manager software makes it easy to conduct real-time studies, configure multiple instruments and data sets, and print or export graphs. The software provides on-screen help, eliminating the need for time-consuming searches and software manuals. ■

Learn more at Fondriest.com or call 888-426-2151.



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 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!

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\$129 **\$99** **\$89**

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- Replace membranes and electrolyte
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- Upgrade instrument firmware
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FONDRIEST R · E · N · T · A · L

when your
research
demands
quality data

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.



fondriest.com/rental

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