Stormwater Solutions
TAKE CONTROL WITH YSI
Why Monitor Stormwater?

Combined Sewers and MS4s
Stormwater is often carried through municipal separate storm sewer systems (MS4s) or a combined sewer designed to carry both wastewater and stormwater. Municipalities maintain stormwater management programs for NPDES permits to guard against combined sewer overflows and pollutant discharges.

Oil & Gas Stormwater
Clean Water Act section 402(l) defines requirements for non-exempt Oil and Gas activities such as those at refineries, where stormwater discharges must be tracked. Cooperate with local, state, and federal agencies by generating traceable and uninterrupted data streams for NPDES reporting and compliance.

Road Flooding
Extreme weather events are driving flash flooding in many communities, making roadways unpassable and dangerous. Monitoring installations can inform alert systems of flooded roadways, and can do double duty to aid in NPDES permit reporting.

Construction Waste
Make monitoring part of your stormwater pollution prevention plan (SWPP) for maintaining a Construction General Permit (CGP). Sediment, debris, and chemicals in loose soil can be detected with water quality sensors, and adding flow sensors enables the calculation of discharges and loads.

Road Salt and Deicers
Airports can balance FAA requirements for deicing with Airport Deicing Effluent Guidelines that require some airports to maintain NPDES permits as part of the EPA’s Industrial Stormwater program. Road salts from urban activities can likewise pollute rivers and streams, especially during melt-off.

Erosion and Sedimentation
One of the EPA’s main concerns related to climate change, erosion and sedimentation can be tracked with water quality and water flow sensors. Detect plumes from acute events to understand dynamics that contribute to eutrophication, hypoxia, and harmful algal blooms.
You can’t control the weather, but managing stormwater’s impacts on your city or watershed starts with reliable monitoring.

With an ever-changing climate and growing concerns about environmental impacts, our customers are increasingly asking for help in the design of stormwater monitoring solutions. Here we introduce a range of YSI solutions through real-world examples, highlighting key technologies and services. There is a stormwater solution for any budget and need; please let us know what we can design for you!

YSI’s Integrated Systems & Services Team
937-767-7241
info@YSI.com
YSI.com
Types of Stormwater Solutions

On the following pages we share case studies that demonstrate three types of systems YSI has delivered for customers: Event Monitoring, Continuous Monitoring, and Flood Monitoring. For each stormwater solution featured, YSI helped customers walk through five system features shown on the facing page. These drive system complexity, the level of YSI’s involvement in your overall program, and of course the price of your stormwater monitoring solution. In all cases, the same quality and customer service people have come to expect of YSI's instruments are delivered through YSI’s Integrated Systems & Services, where we help customers design, build, install, and maintain their customized solutions.

What Stormwater Solution can we design for you?

<table>
<thead>
<tr>
<th>Features of a Stormwater Solution</th>
<th>Situational Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define the program scope and objectives • Perform site assessments • Plan staffing and training</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Features of a Stormwater Solution</th>
<th>Sensor Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define monitoring parameters • Set up a sampling regimen • Consider sensor maintenance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Features of a Stormwater Solution</th>
<th>Logging &amp; Telemetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map sensor-to-end user route for raw data • Identify data backup and security points • Define alerts and escalation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Features of a Stormwater Solution</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derive power budget from sensors, logging &amp; telemetry • Plan redundant or rechargeable power</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Features of a Stormwater Solution</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarify data stakeholders and their access • Select data visualization platform • Define data analytics and communication plan</td>
<td></td>
</tr>
</tbody>
</table>

Event Monitoring
- Portable, easy-to-deploy, go-where-the-storm is system
- Key is flexibility—easily relocated, easily upgraded, easily reconfigured
- Full telemetry and alert systems are available
- Highly cost-conscious options are available

Continuous Monitoring
- Fixed monitoring stations at critical sites, often in a network of sites
- Multiple sensors, often with autosamplers and met stations included
- YSI can also build critical infrastructure to support and protect systems
- Optional installation of conduits, platforms, and other critical infrastructure

Flood Monitoring
- Early flood warning alerts based on both monitored and modeled data
- Bridge and Road submergence monitoring capabilities
- Flood mapping at the parcel or roadway for risk assessment
- Automated “High Water” street sign flashing based on real time water levels
A Proactive Approach to NPDES

NPDES PERMITTING FOR OIL & GAS

A unique portable Stormwater Monitoring System was recently built by YSI for a refinery in North Texas. A contractor had been hired by the refinery to help them monitor stormwater discharges into tributaries that feed a large and heavily utilized river system, so that they would stay in compliance with their NPDES permit.

The National Pollutant Discharge Elimination System (NPDES) was designed to regulate point source pollution in waters of the United States. It is administered by the Environmental Protection Agency (EPA) in accordance with the 1972 Clean Water Act (CWA). The EPA authorizes individual states to issue NPDES permits on its behalf. Permits are required for pollutant discharges into U.S. waters, and place limits on an organization’s discharges. Industries throughout the U.S. navigate policy and the NPDES very carefully because while most violations have manageable consequences for the violating organization, the consequences for the environment are serious or recurring violations can disrupt entire industries.

The National Pollutant Discharge Elimination System (NPDES) was designed to regulate point source pollution in waters of the United States. It is administered by the Environmental Protection Agency (EPA) in accordance with the 1972 Clean Water Act (CWA). The EPA authorizes individual states to issue NPDES permits on its behalf. Permits are required for pollutant discharges into U.S. waters, and place limits on an organization’s discharges. Industries throughout the U.S. navigate policy and the NPDES very carefully because while most violations have manageable consequences for the violating organization, the consequences for the environment are serious or recurring violations can disrupt entire industries.

The system that was designed by YSI was on an Event Monitoring blueprint, though the actual monitoring plan might be described as semi-continuous. Event Monitoring solutions are portable—they can be rapidly deployed only as needed, and easily relocated to adapt to changing circumstances. The refinery client anticipated that the systems would be deployed during seasons when the most rainfall might be expected, and possibly recovered during the dry, intensely hot parts of the year in Texas. The actual systems themselves might change, as well. In fact the deployment sites required a portable solution because they would stay in compliance with their NPDES permit. The National Pollutant Discharge Elimination System (NPDES) was designed to regulate point source pollution in waters of the United States. It is administered by the Environmental Protection Agency (EPA) in accordance with the 1972 Clean Water Act (CWA). The EPA authorizes individual states to issue NPDES permits on its behalf. Permits are required for pollutant discharges into U.S. waters, and place limits on an organization’s discharges. Industries throughout the U.S. navigate policy and the NPDES very carefully because while most violations have manageable consequences for the violating organization, the consequences for the environment are serious or recurring violations can disrupt entire industries.

A PORTABLE SOLUTION

The client’s requirements were met with a system that leveraged one of YSI’s most widely used stormwater sensors: the Storm 3. This all-in-one flow, total volume, level, and velocity sensor is precisely made for ease of use. This IQ comes equipped with custom flow algorithms, carefully designed and tested to ensure the data being delivered. The IQ has 4 independent velocity beams for accurately mapping the cross-sectional velocity profile throughout the water column. This allows for very high-accuracy flow data which is instantly obtainable without velocity indexing in natural channels.

The IQ was connected to a Storm 3 datalogger that would store and transmit data to YSI’s HydroSphere, enabling refinery personnel to access their data on desktops and mobile devices, anytime, anywhere. The Storm 3 was ideal because it is so easy to use—it doesn’t require complex programming and it seamlessly transmits data into HydroSphere. The datalogger can communicate through many types of telemetry, including cellular, satellite, and spread spectrum radio modems. A nearby cell tower made cellular communication the best option for these sites.

HydroSphere was also an important choice from the perspective of simplicity, and in this case the contractor would set up and maintain the HydroSphere account, and go to team at the refinery full visibility of the data. Importantly it enabled the refinery to set up alerts and notifications. The site were remote—weather events there might not even be experienced by the team that lived in an urban center about an hour away. In the case of large water levels, alerts should be sent to any team member, either from the contractor’s roster or at the refinery, via text or email. Sites in a state of alert would also limit site visits so the system needed to be highly durable in the Texas heat, and data telemetry was a must-have. Finally, ease of use was critical because the equipment operators were experts in oil refining, but not necessarily in water monitoring technologies. They would work with a private contractor to handle their data and reporting requirements.

That contractor recommended a YSI solution because of their previous experience with YSI, and the three parties (the refinery, the contractor, and YSI’s Integrated Systems and Services) worked together to adapt an Event Monitoring System for this project.

A CHALLENGING SCENARIO

The refinery in Texas wanted to take a proactive stance on their NPDES stormwater permit, both to say in compliance with EPA regulations, and to protect the beautiful natural resource that everyone in the region, including the refinery’s own employees, enjoyed.

The system that was designed by YSI was on an Event Monitoring blueprint, though the actual monitoring plan might be described as semi-continuous. Event Monitoring solutions are portable—they can be rapidly deployed only as needed, and easily relocated to adapt to changing circumstances. The refinery client anticipated that the systems would be deployed during seasons when the most rainfall might be expected, and possibly recovered during the dry, intensely hot parts of the year in Texas. The actual sites themselves might change, as well. In fact the deployment sites required a portable solution because they would stay in compliance with their NPDES permit.

Discharges include stormwater runoff. There is a specific NPDES Stormwater Program that regulates stormwater discharges from municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. Large industrial sites can function like cities: they are filled with impervious surfaces so that heavy rainfall leads to runoff that can carry industrial chemicals and wastes into nearby waterways. One of the most heavily regulated industries under the NPDES Stormwater Program is the Oil and Gas Industry, to which Section 401(l)(2) of the CWA is entirely devoted.

CASE STUDY: EVENT MONITORING

A PORTABLE SOLUTION

The client’s requirements were met with a system that leveraged one of YSI’s most widely used stormwater sensors: the Storm 3. This all-in-one flow, total volume, level, and velocity sensor is precisely made for ease of use. This IQ comes equipped with custom flow algorithms, carefully designed and tested to ensure the data being delivered. The IQ has 4 independent velocity beams for accurately mapping the cross-sectional velocity profile throughout the water column. This allows for very high-accuracy flow data which is instantly obtainable without velocity indexing in natural channels.

The IQ was connected to a Storm 3 datalogger that would store and transmit data to YSI’s HydroSphere, enabling refinery personnel to access their data on desktops and mobile devices, anytime, anywhere. The Storm 3 was ideal because it is so easy to use—it doesn’t require complex programming and it seamlessly transmits data into HydroSphere. The datalogger can communicate through many types of telemetry, including cellular, satellite, and spread spectrum radio modems. A nearby cell tower made cellular communication the best option for these sites.

HydroSphere was also an important choice from the perspective of simplicity, and in this case the contractor would set up and maintain the HydroSphere account, and go to team at the refinery full visibility of the data. Importantly it enabled the refinery to set up alerts and notifications. The site were remote—weather events there might not even be experienced by the team that lived in an urban center about an hour away. In the case of large water levels, alerts should be sent to any team member, either from the contractor’s roster or at the refinery, via text or email. Sites in a state of alert would also limit site visits so the system needed to be highly durable in the Texas heat, and data telemetry was a must-have. Finally, ease of use was critical because the equipment operators were experts in oil refining, but not necessarily in water monitoring technologies. They would work with a private contractor to handle their data and reporting requirements.

That contractor recommended a YSI solution because of their previous experience with YSI, and the three parties (the refinery, the contractor, and YSI’s Integrated Systems and Services) worked together to adapt an Event Monitoring System for this project.

A CHALLENGING SCENARIO

The refinery in Texas wanted to take a proactive stance on their NPDES stormwater permit, both to say in compliance with EPA regulations, and to protect the beautiful natural resource that everyone in the region, including the refinery’s own employees, enjoyed.

The system that was designed by YSI was on an Event Monitoring blueprint, though the actual monitoring plan might be described as semi-continuous. Event Monitoring solutions are portable—they can be rapidly deployed only as needed, and easily relocated to adapt to changing circumstances. The refinery client anticipated that the systems would be deployed during seasons when the most rainfall might be expected, and possibly recovered during the dry, intensely hot parts of the year in Texas. The actual sites themselves might change, as well. In fact the deployment sites required a portable solution because they would stay in compliance with their NPDES permit.
Event Monitoring

Situational Analysis
Objective was to support NPDES stormwater permit • Highly remote sites, no local power, cell towers nearby • Inexperienced staff to be trained in sensor deployment and maintenance, with support from contractor.

Logging & Telemetry
Data transmitted via cellular modem to HydroSphere for 24/7 visibility • Redundant logging of data in both the SonTek IQ and the Storm 3 data logger • Alerts transmitted via text, based on water level.

Power
12-volt battery with a solar panel and regulator for recharging • Solar recharging and battery voltage monitoring through HydroSphere.

Data Analysis
HydroSphere account administrator was private contractor; refinery personnel set up with data technician or view-only access • Data reports auto-exported by contractor as .csv files for further analyses.

Sensor Payload
Water level and flow via SonTek IQ • Manual sampling as needed • Site visits to keep sensor free of debris

Ideal for stormwater monitoring, the SonTek IQ starts with a custom flow algorithm derived from hundreds of field measurements. Four velocity beams profile water velocity along both the length and width of the channel, to ensure best possible coverage and most accurate representation of the velocity field. The built-in pressure sensor and vertical acoustic beam work in tandem to measure water level. All stainless steel hardware makes the IQ even more capable in difficult environments and in stormwater. Simply input the channel geometry using the intuitive software to start getting data right away. SonTek.com/Sontek-IQ

Specifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity Measurement</td>
<td></td>
</tr>
<tr>
<td>Velocity Range</td>
<td>±5 m/s (16 ft/s)</td>
</tr>
<tr>
<td>Resolution</td>
<td>±0.001 m/s² (0.0003 ft/s²)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±1% of measured velocity, ±0.5 cm/s (0.2 in/s)</td>
</tr>
<tr>
<td>Water Level</td>
<td></td>
</tr>
<tr>
<td>Vertical Beam Range</td>
<td>0.05 - 1.5 m (0.2 - 5.0 ft) (Standard)</td>
</tr>
<tr>
<td></td>
<td>0.05 - 5.0 m (0.2 - 16.0 ft) (Plus/Pipe)</td>
</tr>
<tr>
<td>Water Level Accuracy</td>
<td>0.1% of measured depth or ±0.003 m (0.01 ft), whichever is greater</td>
</tr>
<tr>
<td>Pressure Sensor Range</td>
<td>30 m (98 ft; 42 psi)</td>
</tr>
<tr>
<td>Pressure Sensor Accuracy</td>
<td>0.1% of full scale</td>
</tr>
</tbody>
</table>

Key Features
- Fully self-contained, all-in-one design
- Proprietary flow algorithms for irrigation canals, natural streams and pipes
- Uses SonTek’s exclusive SmartPulseHD adaptive sampling
- Self-calibrating water level using vertical acoustic beam and pressure
Automatic Samplers

Don’t send your personnel into a dangerous storm or flooding scenario to collect samples. By using an automatic sampler, you can collect discrete or composite samples based upon user-defined triggers: gauge height, a water quality threshold, or even a simple time-based collection program. YSI has two autosampler families to choose from: the Global Water WS700 series and the YSI ProSample series.

Key Features
- Easy-to-use controller
- Automatic backflush clears strainer and hose
- High portability with wheeled case and handle
- Rugged construction for harsh environments

3 Reasons To Use An Autosampler

High sample volume accuracy with proprietary pump
Up to 12 user-defined programs
Up to 24 discrete samples, or 1 x 26L sample

Key Features
- High sample volume accuracy with proprietary pump
- Up to 12 user-defined programs
- Up to 24 discrete samples, or 1 x 26L sample
- Double-walled, insulated, ruggedized housing

GWI WS700 Series

The GWI WS700 autosamplers come in a rugged, rainproof and lockable wheeled transport case for ease of deployment. Samplers self-clean to clear debris from the strainer, and collect samples on programmed triggers or a timer. The GWI autosamplers are available with a Stormwater Kit that includes a GWI rain sensor, flow sensor and auto-drain rain gauge all in one package, and refrigerated models are also available. ➤ YSI.com/ws755

Specifications
- Pump: Peristaltic
- Max Lift: 6 m
- Rate: 1000 mL/min at 4 ft head
- Samples: Single or dual-bottle models (one or two pumps)
- Composite or discrete sampling modes
- Samples ranging from 50 mL to 2 L in composite mode, up to 3 L for discrete
- Weight: 9-15 kg
- Inputs: 250mS minimum pulse width switch closure or 4-24VDC
- Power: Rechargeable 5Ah gel cell
- Certifications: CE

YSI ProSample Series

The ProSample is YSI’s premium high-accuracy autosampler. ProSample models collect based on time, analog signal, digital pulse, and/or measurement from an SDI-12 sensor like YSI’s EXO sondes. The ProSample P is ideal for Continuous Monitoring, and the lighter PM for Event Monitoring. Each sampler can store up to 12 user-defined programs for quick deployment, and can hold ice for keeping samples cool. ➤ YSI.com/ProSample

Specifications
- Pump: Peristaltic
- Max Lift: 8.5 m
- Rate: >0.61 m/s at suction height up to 7 m with 10 mm ID hose
- Samples: Single or multi-bottle models
- Composite or discrete sampling modes
- ProSample P Bottles: Polyethylene: 24 x 1 L, 8 x 2 L, 4 x 4 L, 1 x 26 L
- Glass: 24 x 350 mL, 12 x 950 mL, 8 x 2 L
- ProSample PM Bottle: Polyethylene: 1 x 10 L
- Weight: 9-15 kg
- Inputs: Analog 0/4-20 mA, Digital SDI-12
- Power: 12 V/7.2 Ah lead storage, leak proof 115 V or 230 V operation by means of battery charger
- Certifications: CE, ISO 5667-010, EN16479

12 13
CASE STUDY: CONTINUOUS MONITORING

Gauging a Hurricane in Real Time

FROM SCIENCE TO SAFETY

There are 16,000 miles of waterways within the Houston-Galveston region of Texas, USA. These waterways provide an estimated 80% of the region’s drinking water, however more than 80% of monitored waterways don’t meet state water quality standards.

In 1991, the Texas Commission on Environmental Quality (TCEQ) passed the Texas Clean Rivers Program—a program focused on conducting water quality monitoring, at the watershed level, within each river basin.

As part of the ongoing program, the Houston-Galveston Area council (H-GAC) serves as the regional water quality partner for the TCEQ. They contracted the Environmental Institute of Houston (EIH) to install and maintain two continuous monitoring locations in the San Jacinto Brazos and the Brazos-Colorado Coastal Basins. These sites were selected on Caney Creek in Matagorda County and Oyster Creek in Brazos-Colorado Coastal Basins. These sites were selected of Houston (EIH) to install and maintain two continuous for the TCEQ. They contracted the Environmental Institute (EIH) serves as the regional water quality partner (H-GAC) to conduct water quality monitoring, at the watershed level, within each river basin.

REAL-TIME DATA FOR REAL-WORLD MONITORING

Jenny Oakley is an Environmental Scientist for the EIH and leads the research team that installed the stations at both locations in February 2017, and who is responsible for the maintenance and operation on an ongoing basis. They worked very closely with YSI’s partner in Texas, Randy Rushin and his company Water Monitoring Solutions.

Rushin suggested the Amazon bubbler for water level monitoring. This low-power system is ideal for a battery-powered station, and the display with anti-sun glare technology is great for working in the Texas sun. The Amazon is also easily set up with the menu-driven display, and has separate touch buttons so that even muddy fingers won’t damage the electronics. The rugged aluminum housing would also protect the electronics and especially the air compressor from water intrusion. The orifice line passes through a desiccant canister on its way into the water where stage would be monitored. The bubbler measures stage height every 15 min of every day. Via a SonTek M9 RiverSurveyor and a SonTek Flow Tracker using two of SonTek’s leading technologies: a rating curve based upon a stage-discharge relationship. Basic stream morphology data were collected, and elevation relative to the bubbler was measured for bank full (first terrace) and flood stage (second terrace). These observations are shown along with the gauge height data to illustrate the water level relative to these two stage markers.

HURRICANE HARVEY HITS

In August 2017, Hurricane Harvey made landfall on the Texas coast. This record-shattering storm battered southeastern Texas for several days, before moving inland, causing billions of dollars in damage and catastrophic flooding that impacted thousands.

“Prior to [Hurricane Harvey] making landfall, both streams were in typical summer base-flow conditions. We didn’t remove any equipment because the storm appeared to be heading much further south...we weren’t expecting any major impact from the storm other than rainfall,” states Oakley. “It’s in less than four days, the region received over 127 cm (50 inches) of rain – or approximately an average year of rainfall. My home was flooded and other staff at the Institute experienced the intense flooding as well. The following week when we were able to make it back to work, but still weren’t able to reach any of our sites.”

Within 30 hours after the hurricane hit, both monitoring stations were above flood stage with Oyster Creek peaking at over 7.9 meters (26 feet) and Caney Creek above 7 meters (23 feet). The roads to the monitoring sites were flooded for weeks, but the team knew that the sites were still active.

“I had been checking the real-time data and it looked reasonable,” Oakley continues. “I felt confident in what the state of equipment would be when we got out there...I also knew what the flood stage level was, so I knew we had surpassed those thresholds by just looking at the data.”

Oakley and her team were relieved knowing the instruments at the monitoring locations were still functioning, but, unfortunately, the surrounding areas were not as lucky.

“Every single home that you drove past going to and from the [Oyster Creek] site had mountains of people’s possessions piled along the flooded streets,” she recalls. “Drywall and flooring…everything from their home, out along the streets… the entire area was severely impacted. The houses directly next to our site all had some sort of damage from the flood. At a certain point I became a little numb to it because I saw devastation in every direction.”

“Some landowners that I’ve had contact with in the direct vicinity of our monitoring stations that have a second home there, don’t live there full-time or use the land as rangeland for cattle,” Oakley explained. “I know that our data were also used by a family much further downstream to make the decision of whether or not to evacuate (during Harvey). They were watching the gauge height in real-time to decide whether it looked like the water would get very much higher. Luckily, it ended up not flooding in their area and people were able to stay in their homes, especially because traveling at that time could have been dangerous.”

The Environmental Institute of Houston continues to maintain these sites and report the gauge level data to the public. Real-time discharge data will be available to the public soon at EIH’s website—thanks to a scientist with a creative mind and genuine concern for local residents.

“This is a great resource to have our finger on the pulse of our watershed,” she added. “Especially in a situation like this where it was an extreme event and lives and property were at stake.”

For more on this project, read the full Mission: Water article: YSI.com/EIH
Continuous Monitoring

Situational Analysis
Objective was to support an active Total Maximum Daily Load Plan managed by the TCEQ at Oyster Creek. Preliminary discharge data and rating curves were prepared using a SonTek Flow Tracker or a SonTek River Surveyor. Training was minimal with easy-to-use Amazon bubbler technology.

Sensor Payload
Primary parameter of interest is stage height measured with a YSI Amazon bubbler. Loading calculations are made from stage height data and the preliminary discharge data. Data points are collected every 15 min.

Logging & Telemetry
Storm 3 Datalogger transmits data every hour via an external GOES satellite transmitter. Amazon has redundant logging should lightning or any other event knock out the datalogger.

Power
A sealed lead acid 12V/35 Ah battery with 30 watt solar panels. Battery voltage is also monitored via telemetry.

Data Analysis
Amazon data are transmitted to Xylem’s HydroSphere platform. Data can be viewed by the public and even downloaded by other researchers. Visit https://uhcl.edu and search for Oyster Creek.

Designed with simplicity in mind, the Amazon bubbler is an ideal system for long-term, water level monitoring sites. It can be used as a stand-alone system with internal data storage, or as a sensor connected to any manufacturer’s data logger. Easily configure and collect data using the browser-based graphical user interface with all standard web browsers on PCs, tablets and smart phones. It’s rugged build, and technologically advanced system makes the Amazon Bubbler an attractive solution for real-time monitoring and data collection. Visit YSI.com/Amazon

Amazon Bubbler

Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
<th>Pressure</th>
<th>Depth</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 to 15 PSI</td>
<td>0 to 21 m</td>
<td>0 to 35.15 m</td>
</tr>
<tr>
<td></td>
<td>±2.1 mm (0.007 ft)</td>
<td>±4.3 mm (0.014 ft)</td>
<td>±7.11 mm (0.02333 ft)</td>
<td></td>
</tr>
</tbody>
</table>

Key Features
- Advanced rugged and sealed design
- Intuitive menu with field-compatible display for easy setup
- High accuracy water level measurements
- Flexible inputs and outputs, including SDI-12
Featured Product
SonTek M9

The RiverSurveyor M9 is a river discharge measurement system without the traditional limitations. Small, portable and easy to use, the patented and award-winning RiverSurveyor measures in extreme flood or drought situations within a single instrument, and without changing user settings. The results speak for themselves - the RiverSurveyor M9 has revolutionized the way discharge is measured in rivers and canals. » SonTek.com/RiverSurveyor

Specifications

**Velocity Measurement**
- Profiling Range (Distance): 0.06 m to 40 m
- Profiling Range (Velocity): ±20 m/s
- Accuracy: ±0.25% of measured velocity, ±0.2 cm/s
- Resolution: 0.001 m/s
- Number of Cells: Up to 128
- Cell Size: 0.02 m to 4 m

**Depth Measurement**
- Range: 0.20 m to 80 m
- Accuracy: 1%
- Resolution: 0.001 m

Key Features
- Multi-Band - Multiple acoustic frequencies
- Uses SonTek’s exclusive SmartPulse adaptive sampling
- High precision vessel tracking and depth measurement without GPS requirement
- All discharge computations are done internally; no lost data from communication drop outs

The SonTek deluxe wading rod, features a sturdy grip and bubble level

Intuitive workflow and rich graphics to view beam check or QC plots directly, get real-time plots of parameters, view a discharge summary, edit data, and more

Temperature/Depth Sensor: 8-beam Janus (4 x 1 MHz, 4 x 3 MHz) and 1 Vertical Beam (0.5 MHz)

Internal Solid State Compass with Inclinometer

Wet Mate Connector

18 19

Featured Product
SonTek FlowTracker2®

The FlowTracker2 (FT2) handheld Acoustic Doppler Velocimeter (ADV®) has all the technology you have grown to know and trust with the original FlowTracker, but now comes with functional, modernized features (Bluetooth, GPS and large color screen, to name only a few) based on the evaluation and feedback from hydrologists, researchers and scientists who have made the FlowTracker their instrument of choice. » SonTek.com/FlowTracker2

Specifications

**Velocity Measurement**
- Range: ±0.001 to 4.0 m/s (0.003 to 13 ft/s)
- Resolution: 0.0001 m/s (0.0003 ft/s)
- Accuracy: ±1% of measured velocity ± 0.25 cm/s (0.01 in/s)

**Depth Measurement**
- Range: 0 to 10 m (0 to 32.81 ft)
- Accuracy: ±0.1% of FS (temperature compensated over full operating range)
- Resolution: 0.001 m (0.003 ft)

Key Features
- Embedded GPS for georeferencing with automatic or manual fixes
- Improved ADV acoustics: faster pinging, lower noise and better standard error
- Probes and handhelds are interchangeable - flexibility within agency teams and when sending equipment for service
- Set up and save templates

Intuitive workflow and rich graphics to view beam check or QC plots directly, get real-time plots of parameters, view a discharge summary, edit data, and more

Battery compartment is easy to access in the field - no tools required!

Intuitive workflow and rich graphics to view beam check or QC plots directly, get real-time plots of parameters, view a discharge summary, edit data, and more

Battery compartment is easy to access in the field - no tools required!
HydroSphere™ is a scalable collaborative data visualization platform for outdoor water monitoring. It has a simple user interface that allows users to view sensor data and quickly make data-based decisions. Sensor data can be viewed in different formats, downloaded, analyzed with many types of tools. HydroSphere allows you to build networks of monitoring sites, and you can even create public websites for visualization of curated data.

**Simple**
- Data is available anywhere, anytime, on any web-enabled device
- Menu-driven setup of sites
- Simple data-backfill for when transmissions from the field are interrupted
- Easy connection to your telemetry-enabled device

**Smart**
- 99.9+% availability rating of the platform
- Advanced alarm settings combine multiple parameter option
- Alarm escalation involving multiple users
- Define the content for automated reports
- Export reports when, how, and to whomever you define

**Secure**
- Hosted on Amazon’s AWS data center
- 24/7 system monitoring
- State-of-the-art security controls on the applications, servers, and networks
- Protection of personalized login credentials

For more on HydroSphere: YSI.com/HydroSphere
Closing the Flood Gates in Terrebonne Parish, Louisiana

PROTECTING TERREBONNE PARISH FROM HURRICANES

With 987 square miles (2,556 km²) of land and 1,079 square miles (2,795 km²) of lakes and waterways, Terrebonne Parish in Louisiana is actually more water than land. Though the water is the basis for a unique and cherished way of life, it also poses a serious threat to the 112,000 residents of the Parish. Terrebonne Parish is one of eight Louisiana parishes that make up the Coastal Wetlands Protection District. Overseen by the Terrebonne Levee and Conservation District, the Morganza System protects 18 to 20 feet in height. Floodgates manage canals, rivers and wetlands, there’s no more seafood, no more crawfish, no more bayous—and the sluggish outlets of rivers that are characteristic of the region—while environmental gates permit flow to wetlands. After hurricanes Katrina and Rita in 2005, and Gustav and Ike storms were blowing in. News on the gates also allows them to get back to work after storms blow through.

MONITORING ON THE MORGANZA

Rather than beginning system design with the sensors, the leading consideration for the Morganza was power and communications, because those are the first things to fail during a hurricane. The team needed a constant and reliable stream of data to not only operate the barge gates, but also to manage other aspects of the intricate water network of the region. It was decided early on, then, that the mains power available at all of the barge gates would be the primary system, but that backup batteries that were recharged with solar panels were a must-have. Battery voltage was among the “parameters” that would be continuously tracked, via the telemetry subsystems. Like mains power, cellular networks could not always be relied on in the throes of a storm or hurricane, so both cellular modems and satellite transmitters were used. Data would be transmitted every 6 minutes using these channels.

The telemetry components were integrated with a datalogger that also had the ports for the primary sensors in the system. YSI’s Nile radar is a leading non-contact water level sensor that was ideal for this system. The highly accurate Nile radar could track very wide swings in water level, and since it was not in the water it was not at risk of being carried off with high-energy flow, as a submersible transducer might be, and changing flows would not affect the way they might be a bubble.

Changing flows were certainly a major consideration across the entire Morganza system. Jason Kennedy of Delta Coast Consultants pointed out that an incoming tide at one monitoring station can push an outgoing flow two miles away, and notes that flood stages can vary by half a foot (15 centimeters) from one bayou to another. This爱上 multiple stations were needed to manage flooding across the entire region.

PUBLIC INTEREST

It didn’t take long for residents of Terrebonne Parish who rely on the waterways—the shrimpers and oystermen, the barge haulers, the recreational fishing enthusiasts—to ask for access to the data streaming into the levee district’s system. The district commissioned a public app, then switched to an online service at www.tlcd.org/mobile.

Visitors can click on any of the floodgates that have instruments and get an instant, up-to-date look at flood stage, wind direction and wind speed, and the status of the gate. Those who subscribe by sharing their emails and cell numbers can get alerts when the gates are closing or opening.

Kennedy says pilots on the system can use the website and alerts to adjust their routes on the Gulf Intracoastal Waterway and other channels based on gate closures — decisions that can keep them away from potentially dangerous situations.

For more on Louisiana’s Strategic Plan for Future Environments: LAsafe.LA.gov

The SonTek-SL (side-looker) is ideal for placement at multiple stations across the levees so that operators always have eyes on these systems. The SL can be easily side-mounted on bridges, canal walls, riverbanks, and yes, the infrastructure that accompanies barge gates. Operating on the acoustic Doppler principle, the SL is popular for water velocity profiling in coastal applications, because it also has a wave spectra option that calculates and outputs wave-height and period, a real-time.

Between the Nile and the SL, the team would have a good handle on the movement of water throughout the region, but anticipating what’s to come requires also keeping an eye on the weather. To Kennedy, commercial interest is just one part of what the levee system is being built to protect. “You’re protecting life and property of the people who live here,” he says. “But the other aspect is you’re protecting the culture and the environmental resources. If we were to lose these coastal wetlands, Louisiana would lose its identity. If we lose our coastal wetlands, there’s no more seafood, no more crawfish, no more Cajun culture. The communities that have been built here, that’s what they’re built on.”
Flood Monitoring

Situational Analysis
Objective was to provide advanced warning of flood-promoting events so that operators could safely and rapidly close barge gates in the Louisiana Delta. Excellent infrastructure and highly trained personnel could be leveraged for system design and data delivery.

Logging & Telemetry
Primary data transmission was via cellular modem to client’s private network. Redundant satellite transmitters to ensure operability during a storm event. Proprietary mobile app and alerts transmitted via text, email, or SMS to both operators and the public.

Power
Mains power was backed up by a 12-volt battery with a solar panel and regulator for recharging. Battery voltage was included in the transmitted data.

Data Analysis
Data are used in real-time, but building historical record improves overall management of the levee system. Data are available to the public for multiple purposes.

Sensor Payload
Water stage with Nile radar. Velocity, flow, waves with SonTek SL. R.M. Young wind speed and directional sensor. YSI tipping bucket rain gauge for rainfall.

Featured Product
Nile Radar

Designed for non-contact water level measurement, the WaterLOG Nile Series (502/504/517) combines high accuracy with an out-of-the-box measurement range of up to 70 m. The rugged, innovative design was built for extreme environmental conditions - making this series ideal for tough-to-reach sites. Its reliable interface and simple SDI-12 and RS-232 communication ensure seamless integration with current water monitoring stations. YSI.com/Nile

Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Nile 517</th>
<th>Nile 502, 504</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Range</td>
<td>up to 70 m</td>
<td>up to 40 m</td>
</tr>
<tr>
<td>Velocity Measurement</td>
<td>±5 m/s (16 ft/s)</td>
<td>±5 m/s (16 ft/s)</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.0001 m/s (0.0003 ft/s)</td>
<td>0.0001 m/s (0.0003 ft/s)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±1% of measured velocity, ±0.5 cm/s (0.2 in/s)</td>
<td>±1% of measured velocity, ±0.5 cm/s (0.2 in/s)</td>
</tr>
<tr>
<td>Water Level Accuracy</td>
<td>0.1% of measured depth or ±0.003 m (0.1 ft), whichever is greater</td>
<td>0.1% of measured depth or ±0.003 m (0.1 ft), whichever is greater</td>
</tr>
</tbody>
</table>

Key Features
• High accuracy
• Continuous operation, no warm-up or "lock on"
• Surge protection
• Multi-Echo Tracking
Whether you’re new at rain measurement technology or know the systems like the back of your hand, you’ll love the features of the SDI-12 Tipping Bucket Rain Gauge (H-3401)—such as the built-in microprocessor that automatically corrects errors. It also has a magnetic reed bucket tip sensor and an internal leveling mechanism with a ‘bulls-eye’ level to ensure high accuracy data. >> YSI.com/Rain-Gauge

**Specifications**

<table>
<thead>
<tr>
<th>SonTek-SL500 (3G)</th>
<th>SonTek-SL1500 (3G)</th>
<th>SonTek-SL3000 (3G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity Measurement</td>
<td>Water Level</td>
<td>Pressure Sensor Range</td>
</tr>
<tr>
<td>Range</td>
<td>±7 m/s (23 ft/s)</td>
<td>0.1 to 5.0 m (0.3 to 17 ft)</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.0001 m/s (0.0003 ft/s)</td>
<td>0.15 to 10 m (0.5 to 33 ft)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±1% of measured velocity, ±0.0005 m/s (0.015 ft/s)</td>
<td>±1% of measured velocity, ±0.001 m/s (0.003 ft/s)</td>
</tr>
</tbody>
</table>

**Key Features**

- Measures multiple parameters from one easy-to-use instrument
- Uses SonTek’s exclusive SmartPulseHD adaptive sampling
- Compact, hydrodynamic design
- Self-calibrating water level using vertical acoustic beam and pressure

**Specifications**

<table>
<thead>
<tr>
<th>H-3401</th>
<th>H-3401 52X</th>
<th>H-3401 635</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>±2%, 100 mm/hr (4 in/hr)</td>
<td>±2%, 100 mm/hr (4 in/hr)</td>
</tr>
<tr>
<td>Resolution</td>
<td>±0.1%</td>
<td>±0.25%</td>
</tr>
<tr>
<td>Funnel Aperture</td>
<td>100 mm W (8 in)</td>
<td>100 mm W (8 in)</td>
</tr>
<tr>
<td>Protocol</td>
<td>SDI-12, version 1.3</td>
<td>SDI-12, version 1.3</td>
</tr>
<tr>
<td>Electronic Operating Temperature</td>
<td>-40° to +60° C (-40° to 140° F)</td>
<td>-40° to +60° C (-40° to 140° F)</td>
</tr>
<tr>
<td>Mechanical Operating Temperature</td>
<td>-40° to +60° C (-40° to 140° F)</td>
<td>-40° to +60° C (-40° to 140° F)</td>
</tr>
</tbody>
</table>

**Key Features**

- Two removable stainless steel funnel screens
- Rustproof, power painted aluminum enclosure and cart base
- Anodized aluminum or stainless steel internal parts
- Magnetic reed bucket tip sensor
- Internal leveling mechanism with ‘bulls-eye’ level
**Featured Product**

**EXO Sonde**

EXO Multiparameter Sondes — the best-in-class platform for the highest quality data. Stormwater Solutions that employ EXO can deliver a real-time look at runoff, discharge, and plumes from point sources.

**The unmatched benefits of EXO include:**

- **Highest Data Quality**
  Onboard monitoring systems verify sensor operation

- **Industry-leading Antifouling**
  Extend deployments and sensor life with the industry’s best antifouling wiper

- **Smart Sensors**
  SmartQC™ tracks calibrations and sensor positions, and enables multi-sensor calibrations

- **Transformative optical nitrate sensor available only on the EXO**

For more on EXO Sonde: YSI.com/EXO

---

**Smart Sensor Suite**

A dynamic range of sensors for multiparameter applications

- **DO**
- **pH/ORP**
- **TAL-PC**
- **fDOM**
- **Turbidity**
- **C/T (Wiped)**

Shown: An EXO2 bulkhead with smart sensors

EXO sondes feature universal smart ports for sensor installation

**Calculated Parameters**

The following parameters are calculated from one or more sensors listed above. More information may be found in the EXO User Manual.

- Absolute Pressure
- Ammonia
- DOC Local
- DOC LocalB
- Gauge Pressure
- nLF Conductivity
- Resistivity
- Salinity
- Specific Conductivity
- Total Algae cells/mL
- Total Dissolved Solids
- Total Suspended Solids
- Vertical Position
- Water Density

**Sensors Not Shown**

- Total Algae-PE
- Rhodamine
- pH
- Non-wiped Conductivity/Temperature (C/T)
- ISEs for Ammonium, Chloride, Nitrate
After your Stormwater monitoring system is installed, the hard work begins. Let our service specialists support you.

Our experts can provide:

**Installation**
Harsh environments, remote locations, and sites accessible only by boats, airboats, helicopters, or swamp buggies won’t stop our team. YSI technicians have construction and installation experience in the field including hardware installation, civil engineering work, and complete system implementation.

**Commissioning**
We can verify that your system is working, including helping you get started with HydroSphere and training your team. Let our experts help your experts.

**Maintenance**
Maybe you need to keep the data moving, but don’t have the people to do routine maintenance of your sites. No problem—we have instrument experts that can take care of calibration, site upkeep, communication verifications, system upgrades, and data quality control. Contact us to discuss the scope of your needs!

For more on ISS Services:
[YSI.com/Services](YSI.com/Services)

Your Stormwater system and monitoring environment are unique. Talk with our hands-on application specialists to get started and enjoy years of high-quality data!

Let us help you solve your water monitoring challenges.
Contact YSI Integrated Systems & Services about your next project!

[YSI.com/Systems](YSI.com/Systems)  [YSI.com/Services](YSI.com/Services)  937-767-7241
1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We’re a global team unified in a common purpose: creating advanced technology solutions to the world’s water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com