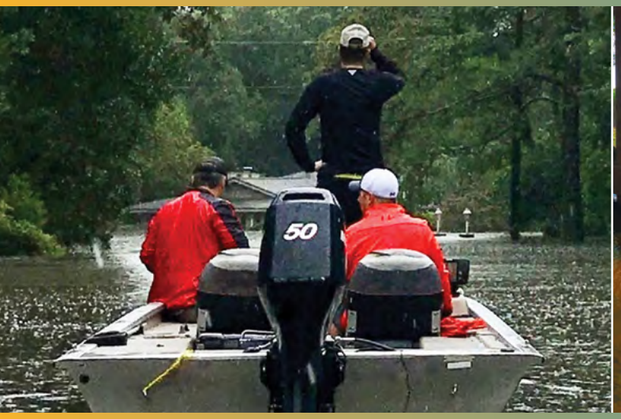
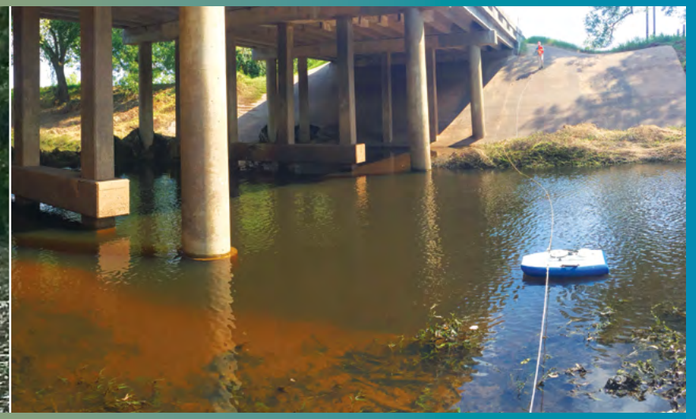
CASE STUDY: CONTINUOUS MONITORING

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 flow measurement stations 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 Brazoria County—both located about an hour and a half south and southeast of Houston.

For more on Environmental Institute of Houston:
EIH.UHCL.edu

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 capacitive touch buttons so that wet or 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 **Storm 3 datalogger** and a **GOES statellite transmitter**, gage level in feet is delivered every hour to EIH's team. GOES was used because cellular reception can be unreliable at these remote sites.

According to Oakley, the team needed to do preliminary work so that ultimately the Amazon's stage data could be used to complete loading calculations. Instantaneous discharge measurements were made using two of SonTek's leading technologies: a **SonTek *Flow Tracker*** and **SonTek M9 RiverSurveyor**. These were used to develop a flow 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 elevations are shown along with the gage 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. "Yet, 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… furniture and mattresses…everything from their home, out along the street… 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."

RESOURCE FOR RESIDENTS

EIH has developed a page on the university website to allow landowners in the area to see real-time gauge height and discharge measurements for nearby waterways. This is greatly facilitated by their upgrade from YSI's legacy Storm Central website to **HydroSphere**, the cloud-based platform that facilitates public viewing of real-time data via a public URL that can be shared by EIH.

"There are 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 gage 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