



Today, Tomorrow, and Two Generations Ahead

Lower Colorado River Authority data delivers on-the-spot forecasts and 80-year projections

Keith Ging, senior hydrologist in the Hydromet Operations group of the Lower Colorado River Authority (LCRA), has a Texas-sized challenge. “Our main purpose is to determine how much water is flowing into streams and canals, how much water is flowing into our lakes and out of our lakes, and to make sure that data gets to the people who can use it in their decision-making,” says Ging in LCRA’s headquarters in Austin, Tex.

The stakes are high. When thunderclouds build over the state’s central Hill Country, discharge data from his team’s 60 stream gauges forms a key line of defense in the fight to keep residents of more than 30 counties safe from flash floods, which can swell a 60 cfs stream to 300,000 cfs in a matter of hours. On a day-to-day basis, it’s a vital tool for optimizing lake levels and ensuring proper water delivery to the organization’s three irrigation systems. And it’s part of LCRA’s crystal ball as the organization considers whether it can modify its storage and conveyance systems to link with the city of San Antonio while still meeting the needs of its own growing population, farmers, and the Matagorda Bay ecosystem fed by the lower Colorado.

Capturing the data is no small task. LCRA’s stream gauges and eight SonTek/YSI Argonaut®-SL canal-monitoring gauges are the backbone of the organization’s 237-station hydrological/meteorological data acquisition network. Called the Hydromet for short, the network is scattered across LCRA’s territory of 600 river miles, 18,000 square miles of drainage area, 1,100 miles of canals, and six impoundments called the Highland Lakes. Stage and flow through streams and canals, water levels at LCRA’s six dams, and weather data feed into LCRA’s headquarters via its own 900 MHz radio system.

Counting Every Drop

Hard data and solid models are increasingly important to LCRA.

“We’re trying to count every drop now, more so than we ever have in the past,” says Ging. Situated between a \$115-million-per-year recreation industry on the lakes, a \$234-million annual rice crop and a \$63-million-per-year commercial fishing industry on Matagorda Bay, LCRA’s water touches a lot of lives and a sizable chunk of the regional economy.

In November 2005, Ging’s team conducted a study of ground-water inflows into the LCRA system, part of a feasibility study exploring a proposed connection between LCRA and the city of San Antonio. For flow data at various points along the river channel, the hydrologists used SonTek/YSI FlowTracker® acoustic Doppler velocimeters mounted on wading rods.



Lower Colorado River Authority senior hydrologist Keith Ging uses a FlowTracker acoustic Doppler velocimeter to gather fast, accurate data for flow studies.

Quantifying the water that flows into the river from underground is helping LCRA’s Operations team fine-tune its releases to most efficiently maintain in-stream flow requirements and send enough fresh water into Matagorda Bay.

Fine-tuning releases for irrigation is also a big improvement. Ging’s team used acoustic Doppler flow meters (which measure both water velocity and stage) to make index velocity ratings to ascertain how much water is really flowing through the system. “By measuring both level and velocity, then indexing that velocity to the mean channel velocity, our discharge data improved dramatically,” Ging says. “We are in a variable backwater environment. Flow

from pump ratings is just a snapshot in time, but conditions are constantly changing, which requires more advanced technology, measuring velocity directly.”

An accurate tab on water in the canals is vital to meet state reporting requirements on diversions. Water diversion data can also be linked with weather data to help determine just how much water to send on its three-to-five-day journey from the lakes to the irrigation systems. Sending a full allocation down the river – then encountering rain events – means the volume of the lake releases is lost, flowing to the bay instead of feeding municipal and industrial demands along the river.

Life or Death

Counting every drop takes on special urgency when flash floods blast through LCRA's area. Staff meteorologist and hydrologists begin assessing weather data, including feeds from the Hydromet system. LCRA models predict lake levels and downstream flows, which guide decisions on emergency releases from the lakes.

Measuring flow during floods is dangerous work, and traditional methods are often inaccurate. Ging describes flow meters with 100-pound weights being pulled nearly horizontal by rushing currents. And when depth can change by four to eight feet per hour, sampling protocols that take an hour or more can yield vastly different readings between start and finish.

LCRA has added three SonTek/YSI RiverSurveyors®, trimaran-mounted, 3-D river discharge systems that use Doppler sonar to take quick discharge readings as the units transect the channel. "We're able to take measurements in conditions that we really couldn't get into with mechanical flow meters," Ging says. "The RiverSurveyor has allowed us to get some measurements we couldn't have taken in the past because of safety concerns, and others because submerged debris would have interfered with mechanical flow meters. We're looking at the whole vertical column, not just surface velocity. And we can get our measurements in 20 or 30 minutes and we're done. Safety-wise, that's a huge improvement."

Environmental Watch

The flow data collected by Ging and his team complements the work of LCRA's Environmental team, headed by senior aquatic scientist John Wedig. With four YSI 600XLM sondes and grab sample kits, the team gathers 30 to 32 pieces of information at each of more than 70 sampling sites around the lower Colorado system. Data is available to the public online at <http://waterquality.lcra.org>, and drives operational decisions at headquarters and the Hydro Operations Control Center at Buchanan Dam.

Close tracking of temperature and dissolved oxygen (DO) levels

deep in the lake behind Mansfield Dam track the thermocline and signal potential problems with hypoxia. If DO falls below safe levels, Wedig can alert Operations, which can engage an aeration system on one of their hydropower turbines. The aeration system can raise DO by 2 mg/L, significantly improving water quality downstream, notes Wedig. He points out that operating the aeration system reduces the efficiency of the hydropower generators by about 10 percent, so knowing when the aeration is really needed can make a difference on the bottom line.



David Murdoch of LCRA deploys a trimaran-mounted RiverSurveyor to measure flow throughout the vertical water column. In obstructed reaches, the instrument's stationary software delivers excellent data to a simple, intuitive interface, says Murdoch's colleague, Keith Ging.



John Roberts of LCRA's Hydromet Operations group used FlowTracker acoustic Doppler velocimeters to check hydroturbine ratings near a dam.

The Environmental team's data also looks into the future. When Wedig picked up signals indicating nutrient enrichment in the Highland Lakes, LCRA began developing a water quality model. "It's the first modeling effort we've ever done for water quality," he says. "We've completed the second year of data collection, and we've collected some highly relevant storm water runoff data."

Big Study, Big Plans

LCRA's most ambitious studies to date will be key to deciding whether to proceed with an ambitious interbasin water sharing plan that would help meet future water needs in the lower Colorado basin and the San Antonio area. The plan was developed during a regional water planning process that occurs statewide in Texas every five years. Regional planning groups for the lower Colorado River basin and the city of San Antonio – now the seventh-largest city in the U.S. – both identified future water needs in their regions.

The project would capture and store excess and unused river flows in one to three new holding basins near the Gulf Coast. Intake structures would transport water from the river to the basins. A 160-mile-long water line would deliver the water to San Antonio Water System (SAWS), the city's water utility.

LCRA would deliver up to 150,000 acre-feet of water annually to SAWS for up to 70 years. The amount of water sent to SAWS gradually would decline during the last 10 years of the agreement,

after which water supplies would stay in the lower Colorado basin to meet future water needs.

The project, called the LCRA-SAWS Water Project, is under tremendous scrutiny during the six-year study period. Consultants, scientists, and technical experts are studying the project's environmental, engineering, conservation, groundwater, and socioeconomic impacts. LCRA and SAWS have agreed the project won't proceed if the six-year study period shows that costs are too high, not enough water is available, or the project doesn't meet specific legislative requirements.

San Antonio, which anticipates a 40-percent shortfall in drinking water by the time its population doubles in 2050, wants the water. Farmers in LCRA's service area want a reliable source of water to help even out weather-related swings in irrigation availability, but they'll have to fine-tune farming tactics and irrigation systems to conserve 118,000 acre feet per year to make the deal work. And environmental groups and fishermen are worried about making sure enough fresh water makes it downstream to Matagorda Bay.

Years of data have been augmented by laser-sharp focus on key elements of the system. For instance, in an intensive 72-hour component of the study, Wedig's team took salinity, temperature, DO, and pH readings at eight sites in a 350-square-mile area of Matagorda Bay. Meanwhile, Ging's team was aboard boats in the river, measuring discharge into its delta, running among six locations to keep the data flowing. Together, the teams built a comprehensive view of flow in and out of the bay – from both the river and the Gulf of Mexico – and are building a knowledge base on the effect of those flows on salinity and other quality parameters. LCRA's Matt Ables even animated the data using a Flash-driven program, bringing the numbers to life for stakeholders.

Vital Information

LCRA's comprehensive studies of the LCRA-SAWS project won't be completed until 2010 at the earliest. Before then, the lower Colorado and its Highland Lakes will surely face floods and drought. Water skiers will play on the lakes, oystermen will ply the bay, and farmers will flood their rice fields – and all will benefit from the behind-the-scenes work of Ging, Wedig and their teams at LCRA.

“The need to understand and quantify the amount of water we have available – and to understand the environmental impacts of using the water – is particularly important, and will become even more so in the future,” says Austin. “It's very important to get as much data as we can on our water resources.”

Hot Tip for Beating Biofouling

Texas' Matagorda Bay is a very productive ecosystem, which drives thriving finfish and shellfish industries. That presents challenges to aquatic scientists and hydrologists like John Wedig of LCRA, who rely on YSI sondes to gather hourly readings of salinity, temperature, pH, and dissolved oxygen at eight sites in the bay. It takes Wedig's team three days on the water to complete its monthly maintenance of the sondes, so the instruments need to stay clean and operational to deliver the required 90-plus-percent accuracy that Wedig demands.

Wedig and his team have adopted measures to keep their instruments clean, and he says they gain an invaluable week of service as a result. The YSI 600XLM sondes are deployed in perforated stainless steel pipes, open on the bottom to avoid collecting mud and muck. An irrigation sock over the end keeps organisms from entering from below. Biofouling paint on everything but the sensors discourages barnacles and algae. But the coup de grace is a Texas recipe Wedig learned from colleagues with the state – a slurry of cayenne pepper and water, brushed on over the biofouling paint to give would-be colonizers the hot foot.

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