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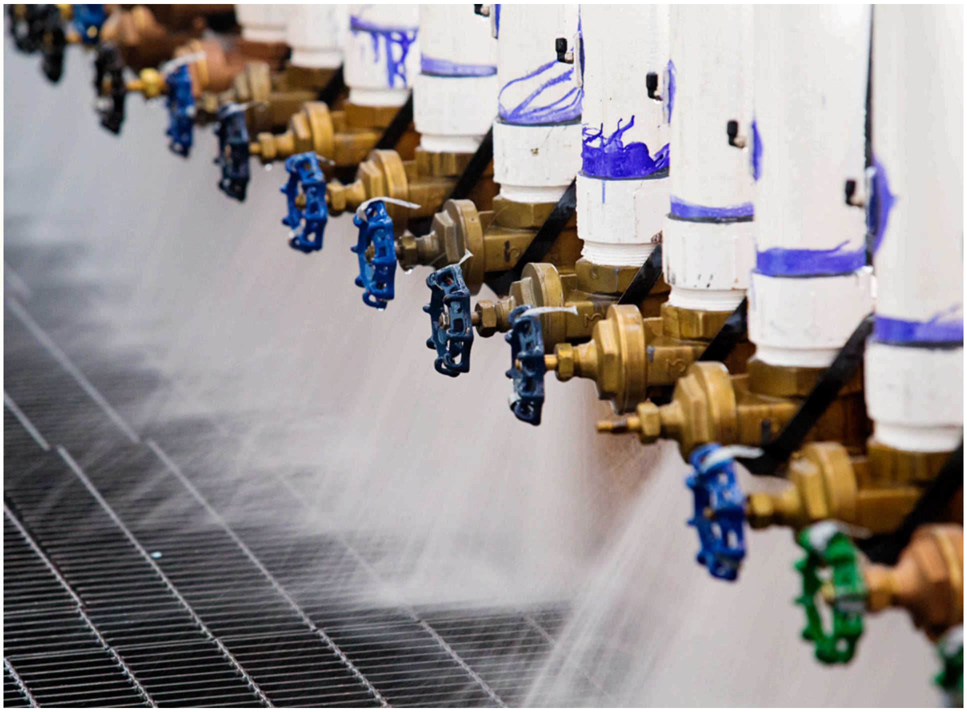
Oct. 30, 2015 – The community of Las Vegas, Nev., is acting to assure a reliable water supply by building new intake facilities at Lake Mead. After a series of drought years dropped Lake Mead levels to historic lows, the Southern Nevada Water Authority is moving forward with an ambitious project to keep the water flowing, and they're turning to the Utah Water Research Lab to help do it right.

The Las Vegas Valley gets 90 percent of its water from Lake Mead – the manmade reservoir on the Colorado River that's inching to lower and lower levels. Two existing pump stations can pull water from the lake if its level is above 1,050 feet in elevation for one pumping station and above 1,000 feet for the other. But there's a realistic chance levels could drop even further – meaning one or both of the intake pumping stations could become inoperable, and the water supply for Southern Nevada put at risk.

Community planners and water customers say that's not an option. So crews have begun work on a new $650 million Low Lake Level Pumping Station that can lift water from the lowest depths of Mead even if it drops to an unprecedented 875 feet – a parched capacity at which Hoover Dam stops releasing water downstream.

At the Utah Water Research Lab, Research Associate Professor of Civil and Environmental Engineering Steve Barfuss is working to help understand exactly how this proposed new pump station will operate. He and his crew were asked to construct a 1:9 scale physical model of the station to evaluate the hydraulics of the proposed design. The model was designed in such a way that Barfuss and his graduate students were able to accurately measure how the water will flow throughout the structure.

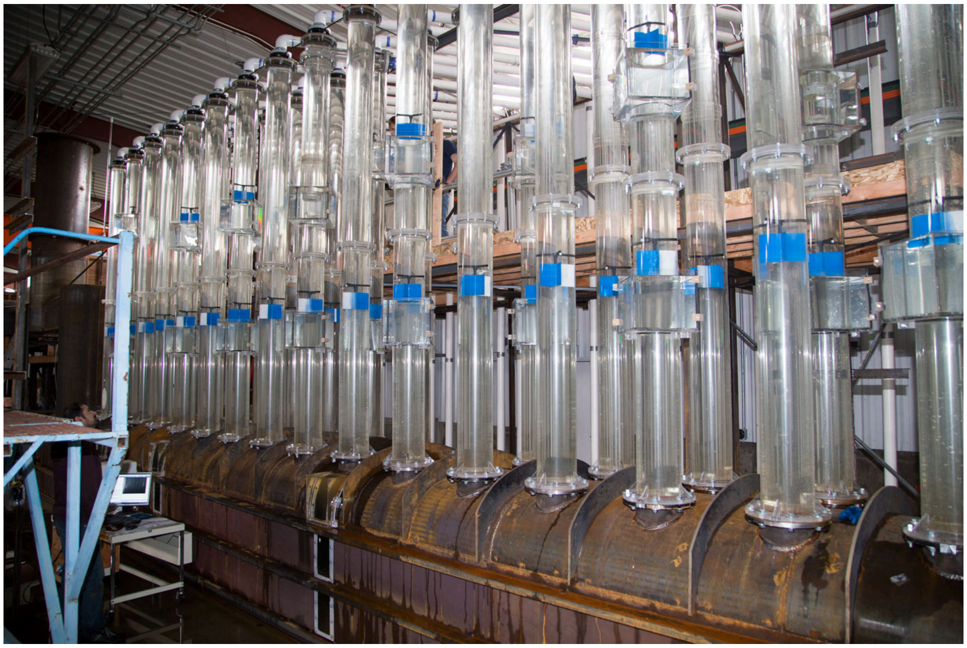


Lake water will enter the pump station through an existing tunnel system, fill a large underground forebay and then be pumped upward through 34 well shafts to the surface where it will flow to two water treatment plants. When it's built, the station will be able to pump 900 million gallons of water each day. Barfuss' mission is to examine flow conditions for the specialized submersible pumps inside the well shafts.

"What we're trying to do is protect the longevity of the pumps," he said. "You can actually destroy a pump very quickly if it's put in an extreme environment it wasn't designed for."

Engineers are designing the system to ensure that water entering the pumps flows at a consistent velocity and with very little turbulence. If the velocity of the approaching water varies or if the flow rotates significantly, the pumps won't operate as efficiently and may ultimately burn out – a risk the Southern Nevada Water Authority can't take.

"To operate the way they were designed, these pumps need to have uniform flow approaching them so that their impeller blades do not cavitate and vibrate and so they can operate at their optimal location on the pump curve," said Barfuss. "If you have weird things happening in the shaft, the pump starts vibrating, pumping costs go up and the pump wears out quicker than it would otherwise."



To measure what's happening inside the well shafts, Barfuss installed rotometers inside the model's 8-inch acrylic tubes. If the rotometer spins too quickly as water flows through it, the team will know there's too much swirl in the shaft and the design will need to be changed.

"If the water is perfectly uniform and streamlined, the rotometer won't turn," said Barfuss. "In a perfect world, the rotometer is perfectly still. In this case, the pumping station was designed well enough that we see only very small rotations – which is acceptable."

Other measurements including velocity profiles and separation zones were measured using a green laser and a specialized camera that captures enormous detail and information.

But simply pointing the camera at the acrylic tubes didn't return the clear picture Barfuss and his team were hoping for. It's a problem we're all familiar with – an object behind rounded glass or plastic looks different than the same object behind flat glass.

"It's just like viewing an object in a glass of water," said Barfuss. "The rounded tube distorts what we're trying to see in the well shaft."

To fix the problem, some of the well shafts were equipped with a section of square clear tubing. The flat surface allows the laser and camera system to capture a clear picture and give Barfuss and his research team the data they need to improve the design.

After several weeks of testing, preliminary data indicate that the design is acceptable without any significant modifications to the structure's geometry.

The project has been a seven-year-long undertaking for Barfuss. An earlier design was modified when SNWA officials recognized the possibility that Mead could drop to never-before-seen levels. Barfuss says projects like the new Lake Mead pumping station and dozens more around the world illustrate the growing need of the Utah Water Research Lab and its experts.

Engineers from all over the world come to the Water Lab for help in solving hydrologic, environmental and hydraulic water-related problems, and the professional expertise available at the UWRL keeps bringing these same people back again and again.

“In hydraulics, it’s normally about hydraulic efficiency, safety and cost,” said Barfuss. “With these physical models, we’re able to help engineers around the world design their water structures so that they operate at an optimal level, so that they are safe and so construction costs are minimized. It’s very enjoyable to be part of this engineering process.”

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