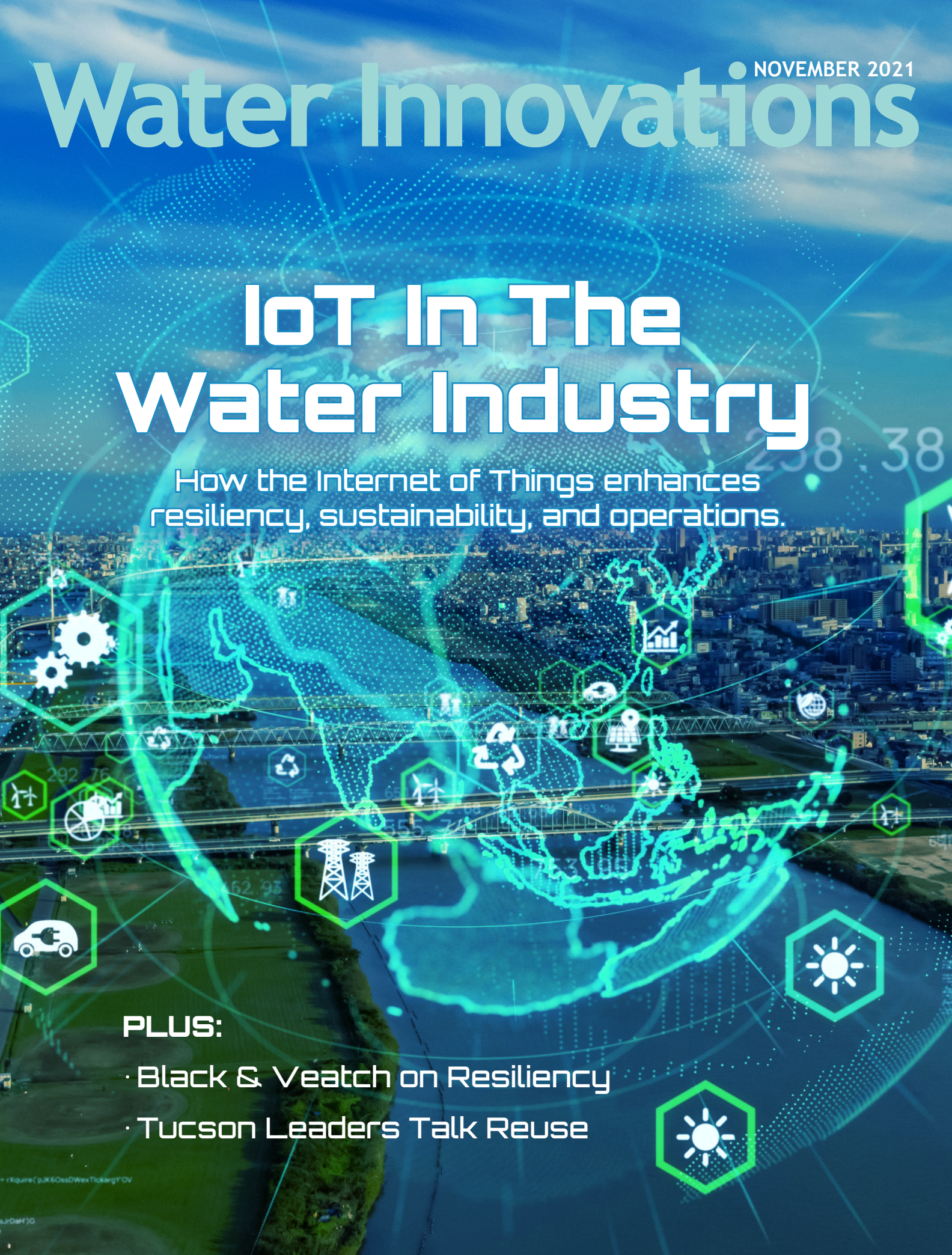
Water Innovations
NOVEMBER 2021

IoT In The Water Industry

How the Internet of Things enhances resiliency, sustainability, and operations.



PLUS:

- Black & Veatch on Resiliency
- Tucson Leaders Talk Reuse

TABLE OF CONTENTS

NOVEMBER 2021

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Advertiser Index

EDITOR'S LETTER

By Kevin Westerling
Chief Editor, editor@wateronline.com

Solving Water Scarcity With Reuse — **The Tale Of Tucson**

Two water leaders from Tucson, AZ, reveal how big cities can thrive in the desert, even amid historic drought.

Water-scarcity issues are all too familiar for many people throughout the world, but Americans have largely been spared the daily worry of getting what we need from the spigot. However, that peace of mind — the privilege of plentiful water — is being challenged in the U.S., particularly in the West, due to persistent drought.

While average citizens likely don't concern themselves until restrictions on water use are ordered, city officials and water managers must think much further ahead. It is their job to ensure the sustainability of supply for decades to come, if not longer, even as the climate warms, droughts linger, and people continue to flock to dry, sun-drenched locales.

This is the quandary for Timothy Thomure, John Kmiec, and many more of their ilk — those who keep the spigots flowing for both citizens and industry, so that services run and needs are met, and so that Americans can keep their peace of mind, but hopefully in a mindful, resource-conscious way.

Thomure is assistant city manager for the City of Tucson, while Kmiec is deputy director at Tucson Water, and together, they tackled the following questions about the state of water in Arizona and what state officials have done to improve it. Their insight is especially important because of their success, given that it can be a model for others. Read on to learn Tucson's remedy for water shortages — a multifaceted approach that includes reuse, conservation, public engagement, and policy enactment — which should also become the way of the West and perhaps the best way forward for all of us sooner or later.

Tucson is known as a leader of U.S. cities for reclaiming water. How did that come to be?

With the advent of the Arizona Groundwater Management of 1980, Tucson became dedicated to using renewable supplies like recycled water. By 1983, Tucson constructed a tertiary treatment plant for the advanced treatment of secondary effluent received from Pima County. At the same time, Tucson began the pilot aquifer recharge program for effluent, later to become full-scale. Aquifer recharge using surface-spreading basins provided the required tertiary treatment necessary by the ADEQ [Arizona Department of Environmental Quality]. The Tucson reclaimed water system, using directly filtered water and recovered, recharged groundwater from aquifer storage of effluent, allowed the city to quickly convert irrigation uses, like turf for parks and golf courses, to the renewable supply of reclaimed water. City-funded expansion throughout the 1980s and 1990s converted most high non-potable uses throughout the community to a renewable, reclaimed water supply. By removing large volumes of water from the potable water system through the creation of this other distribution system, Tucson Water was able to manage its water supplies for drinking water in a more efficient way.

Can you describe the treatment path from wastewater to reuse?

Secondary effluent is received from the Pima County Agua Nueva facility. Traditionally, that water is either directly tertiary treated or placed in surface-spreading basins for aquifer recharge. In more recent times, the city and other water providers have been receiving aquifer recharge credit for water recharged through the Santa Cruz River. The recovered water — tertiary effluent, whether received directly from the wastewater plant or recovered from the aquifer — is then disinfected, tested for quality, and delivered as Class A water to the reclaimed water system for distribution.

How much of Tucson's water comes from reclamation, and where is it utilized?

In recent years, the reclaimed water system accounts for 10 to 14 percent of Tucson Water's total water demand. Primary customers include golf courses, schools, parks, transportation corridors, and single-family residential use.

Has Tucson ever considered going from indirect to direct potable reuse?

Tucson Water was a primary leader in the last few years in proving that direct potable reuse can be done in Arizona through a partnership in a demonstration project. We successfully lobbied to have the state prohibition on potable reuse removed from statute. Now, communities across the state are considering direct potable reuse as an option. Though direct potable reuse is not necessary for Tucson in the near future, we know it can be considered an option if the decision to go that direction is made.

To what degree do these programs require public outreach and participation?

At Tucson Water, sustainability through water conservation is a large part of our outreach. Bringing information to customers on the value of conservation and providing rebate programs for appliances and water harvesting have helped Tucson Water's overall

per capita water use to decline significantly over the decades. People don't conserve, or become sustainable, magically. Outreach on the value of water, how the urban water cycle works, and the energy-water nexus are all important for people to understand the true value of water. Once they do understand, an ethic of conservation is created. For example, Tucson Water customers in 2021 use about the same amount of water annually as they did in the early 1990s, but with more than 200,000 people in growth.

What other plans, if any, does Tucson have to bolster its water supply?

Tucson Water has several water-resource inputs it can use in the future: continued full-use CAP [Central Arizona Project] water, effluent entitlements, groundwater rights, remediated groundwater, and stormwater-capture programs.

Do you see the stress factors — population growth, drought/climate change, etc. — getting worse in the future, and how do you stay ahead of the challenge?

The first part of the answer is "yes and no." The preponderance of climate science indicates that Tucson will continue to get warmer, although projections of total precipitation are mixed as to whether it will increase or decrease in our area and are much more uncertain. Regarding population growth, Tucson has decoupled increasing water demand from population growth over the past two decades. It is no longer a direct stressor to water supply, although it is often considered as such.

Tucson stays ahead of water-supply challenges by supporting community water conservation programs, investing in water system efficiency, storing water for the future, enacting water efficiency codes and standards for new development, innovating in water reuse, deploying new technologies, developing new supplies such as rain and stormwater, and entering into strategic partnerships.

Tucson has also worked on mitigation strategies with significant public outreach. Two that come to mind are the mayor's Tucson Million Trees initiative and the Green Stormwater Infrastructure program. [Find more information here.]

With an eye toward the future, Mayor Regina Romero and city council voted to pass differential water rates recently. This is a policy decision that, among other things, is designed to encourage conservation by charging a higher rate for water to higher users of this valuable resource.

Additionally, Tucson's Citizens' Water Advisory Committee (CWAC) is reviewing and updating local ordinances, such as the Commercial Rainwater Harvesting Ordinance and the Residential Gray Water Ordinance.

What lessons can other water-stressed cities learn from Tucson's experience?

Continuous community involvement on "how water works" within their community is key. When people know how their water is brought to them, they respect the process and value the resource more.

Education, conservation, and local ordinances and policies make a difference. ■

Water Innovations

101 Gibraltar Road, Suite 100
Horsham, PA 19044
PH: (215) 675-1800
FX: (814) 899-5587
Email: info@wateronline.com
Website: www.wateronline.com

CHIEF EDITOR
Kevin Westerling
(215) 675-1800 ext. 120
kwesterling@vertmarkets.com

PUBLISHER
Travis Kennedy
(215) 675-1800 ext. 122
tkennedy@vertmarkets.com

PRODUCT MANAGER
Bill King
(215) 675-1800 ext. 100
bking@vertmarkets.com

MANAGING EDITOR
Karen White
(814) 897-9000 ext. 316
kwhite@vertmarkets.com

PRODUCTION DIRECTOR
Lynn Netkowicz
(814) 897-9000 ext. 205
lnetkowicz@vertmarkets.com

CREATIVE DIRECTOR
William Pompilii
(215) 675-1800 ext. 145
bpompilii@vertmarkets.com

PRODUCTION MANAGER
Susan Day
(215) 675-1800 ext. 101
sday@vertmarkets.com

DIRECTOR OF AUDIENCE DEVELOPMENT
Martin Zapolski
(814) 897-9000 ext. 337
mzapolski@vertmarkets.com

DIRECTOR OF ONLINE DEVELOPMENT
Art Glenn
aglenn@vertmarkets.com

Eprints and NXTprints
The YGS Group (800) 290-5460
VertMarketsReprints@theYGSgroup.com
www.theYGSgroup.com

Finding New Ways Through

The president of Black & Veatch's water business reveals the findings of the company's annual water survey and report, offering a snapshot of where we stand and insight on what is needed.

By Cindy Wallis-Lage

When the flow of water is restricted, it eventually finds new pathways. The same can be said of the water industry over the course of the past year.

Our *2021 Strategic Directions: Water Report*, released in August, examines the issues and trends affecting the water sector. A top takeaway in this year's report — based on a survey of more than 200 stakeholders in water, wastewater, and stormwater combined with expert analysis — is that mounting challenges also provided opportunities for improvement. As an industry, we found new ways to keep water clean and flowing productively.

Adaptation And Resilience

Survey respondents confirmed that aging infrastructure is still the most challenging issue, but justifying capital improvements and rate requirements, achieving or maintaining resilient systems, and managing capital costs are also key issues. The COVID-19 pandemic exacerbated concerns about aging assets and funding, cutting into revenues and cash flows. Two-thirds of survey respondents reported that the outbreak had at least a moderate impact on day-to-day operations, with smaller systems feeling a bigger impact.

Concerns about disasters related to climate change are driving decisions about how to make assets resilient against droughts, floods, wildfires, and system shocks such as February's deep freeze in Texas that disrupted water services to millions. But by and large, survey respondents' focus remains on meeting required standards and keeping systems running. Larger water utilities listed resiliency as their third-highest priority, behind water quality and matters that involve asset management or replacement.

Sustainability can help drive resilience. Renewable energy (49 percent) and water-loss mitigation (nearly 44 percent) top the list of sustainability strategies among respondents asked to select all applicable options, followed by new/alternative water supplies (32 percent).

Wastewater utilities historically have been stewards for the environment, and environmental protection continues to be a guiding principle, even as new ways of doing so emerge. The water industry is heading in the right direction with a multifaceted approach to reduce the number, environmental footprint, and cost of inputs, with triple-bottom-line benefits for communities as a reward.

Rising interest in analytics and other technologies that facilitate decisions and remote operation are helping communities change the way they work, optimize assets, and prioritize system investments.

Despite the additional burden on an already underfunded industry, water utilities adapted remarkably well. Rising interest in analytics and other technologies that facilitate decisions and remote operation are helping communities change the way they work, optimize assets, and prioritize system investments.

Reinvention And Innovation

The water industry hasn't always been nimble or quick to adopt new technologies. Escalating challenges and the rapid reinvention necessitated by COVID-19 have accelerated the need for innovation. Report authors concur that the industry is on the right path, with some industry stakeholders farther down the path than others.

The survey shows that water industry leaders strive to spark innovation through multiple means. More than half of respondents' organizations promote innovation through open lines of internal communication, empowering employees to make decisions, and folding innovation into their strategic plans (Figure 1). Innovation is also encouraged in other ways.

Figure 1

Bold new strategies. The report holds up the Hampton Roads Sanitation District's Sustainable Water Initiative for Tomorrow (SWIFT) program as an example of thinking big and looking ahead. The program, which seeks to eventually inject 120 MGD of treated wastewater into a shrinking aquifer to replenish it and lessen what's released into rivers, shows that bold ideas can indeed take root in a sector traditionally slow to change.

Another example of innovative thinking showcased in the report is a sediment-diversion project. By letting sediment-rich water pass through a levee, the project will rebuild wetlands eroded by hurricanes and rising sea levels. This and other nature-based solutions help mitigate environmental issues associated with development and other human activity.

The Pure Water San Diego program, which will provide more than 40 percent of San Diego's water supply locally by the end of 2035 and reduce ocean discharges, additionally exemplifies how communities are charting new, more sustainable courses.

When planning tomorrow's infrastructure, strategic focus on opportunities to integrate water and other resources into a broader circular economy merits consideration. For example, co-locating a water resource recovery facility next to a manufacturing facility that needs cooling water can be mutually beneficial. Taking the concept a step further, co-locating a facility next to a factory that produces packing chips could yield renewable natural gas as an output from the treatment facility and an input for industrial production.

Working smarter. Leveraging digital technology offers the opportunity to harness data precisely, leading to enhanced capabilities in tracking consumption, optimizing performance, driving efficiencies and customer engagement, and prioritizing investments.

As the survey shows, water, wastewater, and stormwater utilities appear to be increasing their engagement with digital and electronic management approaches. Utilities found that their data management was perhaps not as robust as they thought during the operational challenges posed by COVID-19, inspiring them to improve their use of information. They are becoming more comfortable using data from online sensors, with nearly nine out of 10 respondents somewhat or very confident in the accuracy of their sensor-derived data. Meanwhile, 65 percent categorized their overall data management practices as strong and getting stronger but not fully integrated. In a separate question, half the respondents reported they are collecting lots of data but aren't capitalizing fully on their power. (Figure 2). Comfort with digital technology is increasing, but siloed data still preclude a clear picture of asset health and investment in many cases.

The merit of remote water-utility work during the pandemic was a revelation for many, and remote work necessitated greater use of technology. More than two-thirds of respondents (68 percent) cited the pandemic for stimulating their use of technology for remote work by professionals. In addition, roughly three in 10 linked the outbreak to more consideration of technology for better customer engagement and/or more remote operation and automation (Figure 3).

When planning tomorrow's infrastructure, strategic focus on opportunities to integrate water and other resources into a broader circular economy merits consideration.

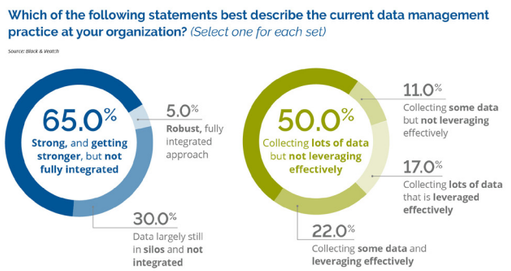

Figure 2

Figure 3

In February, a reminder that increased use of remote-access technology carries risks as well as rewards surfaced in Florida. ABC News reported, citing a memo by federal investigators, that an older version of Windows and a vulnerable network allowed a hacker to access a Florida water treatment plant's computer system. Authorities said the hacker used a remote-access program shared by workers at a plant in Oldsmar to try to taint the city's water supply with a caustic chemical. Fortunately, a plant manager noticed and thwarted the tampering intent before any major damage could occur. Evaluating cybersecurity is even more important with increased remote operations and management of water systems, which can be easy prey for hackers because the computer infrastructure of local governments tends to be underfunded and IT departments are already stretched thin.

Infrastretching. Utilities are managing to stretch their funding by investing in existing assets. "Process intensification" can maximize the performance of existing process facilities, which helps utilities improve efficiency, avoid costly new construction, and lower their carbon footprints. As one example, advances in biofilm technology have facilitated intensification of biological processes.

Continued Transformation And Collaboration

Another key message in the report is that there's more to do, and it's time to do it. Report authors recommend:

- Investing in systems.
- Leveraging new and anticipated sources of funding.
- Planning in an integrated, holistic manner with a "One Water" mindset.
- Working with community leaders to prioritize water as a way to revitalize and equitably build sustainable communities of the future.
- Collaborating with partners both within and outside the water industry.

Utilities have several options for funding capital projects. Various programs and partnership opportunities provide communities with flexible, low-cost financing to address their highest-priority water quality infrastructure projects. Approximately one in four respondents said their organizations have investigated public-private partnerships for capital project funding. Less than 10 percent have explored community-based partnerships, although interest in such partnerships appears to be rising.

Food production offers another chance to be collaborative. The survey revealed that many utilities have an eye on agricultural reuse, second only to industrial reuse. Water and agriculture interests overlap, suggesting an opportunity for collaborative pursuit of mutually beneficial strategies and solutions. Commonalities include hydroponics as well as effective management and recovery of water and nutrient resources. Some utilities are already working with growers to recover and treat water for agricultural use. Everyone can benefit if utilities examine agricultural needs and seek new ways to capitalize on shifting priorities, new concepts, and high-tech capital infusion. The water sector has a crucial role in feeding the world, too.

The effects of the lingering pandemic, priorities of the current administration, and ongoing efforts by many organizations have helped promote the value of water, the importance of integrated resource management, and the need for innovation. There's more to be done in these areas and others, and this is no time to slow the transformation of an industry already forging a new path forward. ■

About The Author

Cindy Wallis-Lage is president of Black & Veatch's water business, leading the company's efforts to address water infrastructure needs around the world. A longtime global champion for water resources, she promotes the value of water and the importance of resilience to help communities achieve social, economic, and environmental sustainability goals. A member of the Black & Veatch Board of Directors since 2012, she also serves on the Board of Directors for the U.S. Water Alliance and on the Leadership Council for Water For People.

EXTREME WEATHER, DROUGHTS, AND THE IMPACT ON OUR WATER SUPPLY

Drinking water is obviously affected by the persistent drought plaguing the U.S. — but not just in terms of its supply. Learn the other effects, including degraded water quality, and how to combat them.

By Rick Andrew

Climate change and human-induced droughts are wreaking havoc on life as we know it.

Droughts are prolonged periods of dry weather caused by a lack of precipitation, resulting in extreme water shortages for activities, populations, and ecological systems. They can also be defined as an extended imbalance between precipitation and evaporation. Droughts are also caused by human activity such as outdated water management processes, increased demand, over-farming, and more.

Nearly a century ago, President Franklin D. Roosevelt and America faced the negative ramifications of droughts during the unprecedented "Dust Bowl" of the 1930s. The Dust Bowl was a six-year long dust storm and drought that permanently damaged the Great Plains' ecology, agriculture, and water systems. It also relocated nearly 2.5 million Americans who depended on farming and public water sources for survival.

From a federal response standpoint, President Roosevelt created the blueprint for how world leaders should respond to environmental catastrophes, especially those that negatively impact our water supply. His blueprint is still referenced by federal and local governments as well as environmental and water professionals.

Sadly, we are still experiencing the negative effects of droughts in 2021, and our response blueprint needs to be modernized for the unique challenges of today.

According to the U.S. EPA, 20 to 70 percent of the U.S. land area experienced conditions that were abnormally dry from 2000 to 2020. Moreover, according to the NOAA National Centers for Environmental Information (NCEI), damages from droughts have cost the U.S. $249.7 billion from 1980 to 2019.

For these reasons, a private and public sector unified approach is needed to better equip federal and local governments with the resources needed to respond to droughts. Also, consumers and water professionals should be educated on how they can conserve water through daily behavioral changes and by investing in devices that conserve and efficiently use water.

Negative Impacts Of Droughts

Droughts, in addition to warming temperatures, can result in water supply chain disruptions and interruptions in home life. Unlike other catastrophic disasters, droughts do not appear suddenly but develop over time. They are also becoming increasingly hard to predict because the water supply data from past years are not reliable due to climate change's steadily altering the level of water in areas. Other negative implications of droughts include:

- *Water Supply Shortages*

Droughts can decrease the water supply in impacted areas, such as what we are seeing in Arizona and other southwestern states. This creates significant challenges for farmers, power companies that rely on hydroelectric power, and water companies that may experience increased maintenance and repair fees. If gone unaddressed, this could ultimately result in water restrictions being implemented on homes and businesses.

- *Degradation of Water Quality*

Evaporation of water can cause the concentration of total dissolved solids (TDS) in the water to increase, which impairs water quality. Increases in TDS can harm the aquatic ecosystem, make the water corrosive, and cause the taste of the water to decline.

- *Increased Wildfires*

Droughts, in tandem with higher temperatures, are a recipe for wildfires because of dry soils and increased evaporation. The toxic chemicals and smoke stemming from the fires and the materials used to extinguish them are then released into water systems. This results in increased water contamination during a time when the water supply is already low.

- *Negative Health Outcomes*

Droughts can also result in long-term negative public health outcomes. The number of cases of respiratory illnesses and diseases typically increases during droughts due to the decline in water quality and supply. Those who do not have the means to relocate from drought-prone areas will ultimately have shorter life spans than those who do not live in these areas.

How To Prepare And Respond

There is still time to turn the dial back on climate change and human-induced droughts. We cannot afford to ignore the clear signs that climate change and human behavior are causing droughts. If we do, irreparable damage will be inflicted on our water and agricultural systems as well as our communities.

To improve the public's understanding of drought best practices, we should:

- *Communicate Water Conservation Methods to Consumers*

Water professionals should spark conversations with consumers during droughts on how best to conserve water. Methods such as reduced showers, checking for leaky pipes, and investing in drain flow restrictors have been proven to be effective in reducing water usage.

- *Prepare Emergency Kits*

Local governments should educate the public on how to best prepare for droughts. This could include storing an appropriate level of bottled water in case of emergencies and stocking up on food that does not require much water to prepare. Moreover, for those who may be struggling financially and/or are housing insecure, local government should publicize the locations of cooling centers and bottled water distribution to prevent heat-related illnesses.

- *Promote Water Conservation and Efficient Devices*

Water professionals should promote devices, such as toilets, sinks, showers, and landscaping fixtures, that conserve and efficiently use water. Investing in these devices can ensure that water supplies are being used responsibly without consumers even being aware of the change.

- *Look to Certified Water Filters*

For those who fear that their water may have been contaminated during a drought, it is recommended that you read your water quality report to see what contaminants are listed. You should then focus on purchasing a water treatment system that is third-party certified by an organization such as NSF International. NSF and other third-party certification organizations ensure that treatment systems are safe to use with drinking water and won't leak, and that the manufacturer's claims are indeed true. Be sure to check that the water treatment device that you purchase is approved to treat the contaminants that are listed in your water quality report.

Moving Forward

Time is of the essence. We have witnessed enough economic, environmental, and human wreckage from droughts caused by warming temperatures to know that they are a significant threat to human life.

For these reasons, a unified approach is needed between the public and private sectors to ensure that consumers know how droughts can impact their water supply. The onus is on federal and local governments, as well as water professionals, to be public health champions and ensure this information is accessible to all.

If we come together and commit to this cause, we can make certain that we are prepared for what tomorrow may bring. If we do not, we stand to lose a once-in-a-generation opportunity to turn the dial back on the significant progress made thus far. ■

About The Author

Rick Andrew, MBA, is the Director of Global Business Development, Water Systems for NSF International in North America. Rick has 30 years of experience in preserving and maintaining clean drinking water and is responsible for NSF's global sales and structuring of water-related programs. He joined NSF in 1999.

THE FUTURE OF WASTEWATER

Why Has The U.S. Been So Slow To Adopt AI Tools?

Wastewater analytics are already being used around the world to monitor contamination, optimize treatment processes, and catch environmental scofflaws. So why has the U.S. been so slow to adopt these technologies?

By Caco Gilead Baibich

Artificial intelligence (AI) and machine learning have revolutionized our lives, but some sectors have been slower to adopt smart solutions than others. Despite AI systems underpinning everything from power grid regulation to Google's search tools, water and wastewater services have only recently embraced data-driven technologies.

Finally, after years of lagging behind other industries, the wastewater sector is making up for lost time, and smart systems are taking off in Europe and the Middle East.

Adoption in the U.S., however, has been comparatively slow.

Wastewater treatment plant (WWTP) managers still show up at work not knowing what a city's pipes will deliver that day. A surge of street runoff? Industrial pollution? With little insight into what's coming, managers can't optimize treatment processes. This creates an opportunity for infrastructure damage and the discharge of harmful materials.

Sure, managers know to expect surges of household water from flushing on weekday mornings and Super Bowl halftimes. They even know that dumps of used commercial kitchen grease happen late at night or on weekends when water inspectors are off duty. But even the best predictions and forecasts are still only estimations.

AI-driven technologies are detecting toxic materials long before they reach plants, allowing authorities to identify those responsible for contamination and increase process efficiency.

It doesn't have to be this way. Other industrialized nations are already using accurate, round-the-clock data that alert WWTPs to contamination events, including the time the pollution will arrive at their plants. Cities such as Haifa, Israel, have positioned network-enabled, data-gathering units inside sewer networks to help users trace pollution or sound an alert when conditions change unexpectedly.

Flooded vaulted sewer tunnel

Industrial and factory wastewater discharge

AI-driven technologies are detecting toxic materials long before they reach plants, allowing authorities to identify those responsible for contamination and increase process efficiency. In Italy, for example, AI helped Hera SpA, of Bologna, Italy, spot polluters while also cutting WWTP operating expenditures by 25 percent.

But in the U.S., surges of contaminated wastewater continue to regularly surprise, and even overwhelm, WWTPs.

While there are some such projects in the early stages of operation in the U.S., there's a long way to go for this country to catch up with the rest of the developed world.

In just one example, sewage regularly floods beaches around Los Angeles,[1] causing extended closures. Compare that to Haifa, where officials have installed live data reporting through 750 miles of pipes, supporting AI pollution modeling and enabling a 75 percent drop in beach closures.

What's Holding U.S. Utilities Back?

There are several barriers holding up progress in the U.S.

Concerns about data privacy and security apply to wastewater AI, just as they do with all other industries. AI-gathered data must be regulated, verified, and validated, adding complexity to managers' already heavy responsibilities.

Water utilities have traditionally been conservative institutions, resistant to change. For decades, their focus has been on stability rather than taking a chance on new technologies — even ones that could improve performance over time.

Finally, upgrading with new sensors, monitors, and tracking capabilities costs utilities time and money. Utility managers need to know that the capital investments will pay off.

But multiple factors mean it's getting harder for U.S. companies to turn a blind eye to AI technology's benefits.

The Biden administration has increased its focus on enforcing environmental regulations, with sharp penalties likely coming for companies that don't abide by them. It has also signaled its intent to boost investments in wastewater infrastructure[2] improvements.

The coronavirus pandemic showed how using sensors and AI analytics can allow epidemiologists to model and map outbreaks of COVID-19, helping authorities limit their spread.

Droughts throughout the U.S. have forced municipalities to find new ways to turn wastewater back into clean, potable water just to keep up with demand.

AI is finally being seen as a way to aid inspectors and regulators. Under current U.S. rules, industrial discharge is monitored on regular, predictable days. If a factory knows it will be tested for pollution on, say, every third Tuesday of the month, it can adjust effluent to dodge detection of hot loads. But a properly functioning, always-on AI system makes it nearly impossible to game the system.

Yet the U.S. is still dragging its feet, with consequences that can be costly. According to the American Society of Civil Engineers (ASCE), utilities spent more than $3 billion in 2019 to replace pipelines. The expenditure will only rise. Currently, 15 percent of the nation's wastewater treatment plants have reached or exceeded[3] their design capabilities, according to ASCE. Yet cities that embrace machine learning and AI technology, such as El Paso, Texas,[4] can circumvent many of those problems entirely, while increasing efficiencies and cost savings.

With the price of inaction mounting each day and the tools to improve America's wastewater infrastructure in smart, sustainable ways increasingly available, now's the time to do what we can to secure our water future. ■

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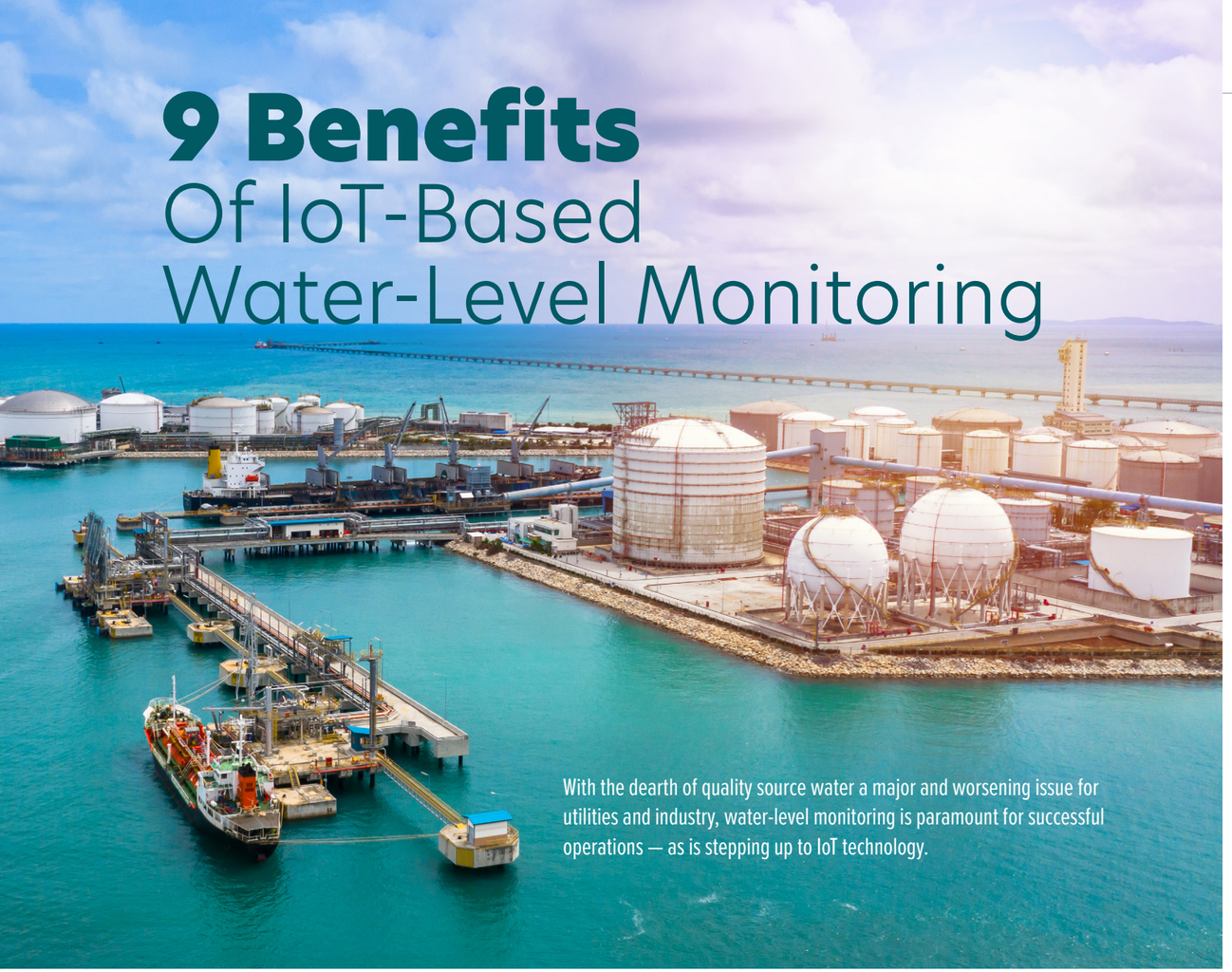
About The Author

Ricardo (Caco) Gilead Baibich is the chief technology officer of Kando (kando.eco).

9 Benefits Of IoT-Based Water-Level Monitoring



With the dearth of quality source water a major and worsening issue for utilities and industry, water-level monitoring is paramount for successful operations — as is stepping up to IoT technology.

By Sanjeev Verma

Degrading water quality, reduced water levels, water consumption patterns, and a lack of backup resources are a few challenges that water-based industries currently face, and the reckless use of water has adversely affected biodiversity and natural habitats to a point where it has become scarce across major regions. However, Internet of Things (IoT) technology provides a real-time monitoring solution for the water industry and other sectors that utilize water as their primary resource, helping to mitigate scarcity's impact.

Traditionally, operators across industries would use scales to measure water levels and record everything manually. This posed several challenges, with the foremost being inaccurate measurement, affecting inventory levels and disturbing the entire process. IoT technology is a disruptive concept that flourishes with rapid industrial acceptance in the field of level monitoring for liquid commodities.

If you are thinking of replacing your traditional and old processing system with IoT technology, doing so would reap the following benefits:

1 INFORMATIVE INSIGHTS

Installing IoT technology with your existing SCADA provides sensor-based monitoring of assets, where the sensors fetch water-level data and transmit the same on the user's dashboard. This enables prompt decision-making, allowing managers to take necessary actions on time. It thus reduces the chances of water spillage; detects unnecessary consumption patterns, thefts, and leakages; and increases the overall efficiency of the plant processing.

2 ILLUSTRATIVE HISTORICAL REPORTS

An IoT-based solution to monitor water levels provides a well-structured and systematic approach to deal with the plant's functioning. Managers get a simplified dashboard to optimize their everyday tasks, and can even operate them remotely if needed. It then presents the details through illustrative reports, while also keeping a historical record of each process and piece of equipment. This makes it a lot easier for managers to make decisions at a single glance and share them with the appropriate person when required.

3 PREVENTIVE MAINTENANCE CHECKS

The data-driven approach of IoT technology provides scheduled preventive maintenance checks for the respective equipment and assets. It also provides a set threshold value for rising water levels to avoid unnecessary water spills, thus protecting the premises against water damage. The water-level monitoring solution is well-structured and equipped with advanced-level sensors to keep a real-time watch on water levels, eliminating the chances of asset degradation through any means. It also enables automated maintenance checks of the entire system as per the business requirements.

4 INSTANT ALERTS

The sensor-based system retrieves data from water containers and supplies the information through advanced communication channels. All notifications are sent to the managers through an instant alarming system that triggers another alarm on the connected smart devices. This helps the industrial operators make informed decisions in case of leakages so that they can manage adequate supplies across particular regions. Industries can use this data to ensure better business productivity, improved brand recognition, and quality services.

5 SEAMLESS COMMUNICATION

One can easily simplify the data management process by installing an IoT setup with water storage containers. IoT technology provides great opportunities for businesses to scale up their progress in effective ways. A smart water-level monitoring solution helps water authorities buckle up at times of risks like floods, rising river water levels, etc. It further offers seamless integration and communication within the authorities through interconnected devices, ensuring productive inputs and informed decision-making.

6 COST REDUCTION

IoT technology is currently being used in abundance across industries. Integrating it at water authorities gives a new edge to the entire processing of the water supply network. This counts for significant cost savings as the technology prompts the use of sensor devices and gateway connectivity to run maintenance schedules on time and reduce process downtime.

7 EFFECTIVE ROI

IoT is the future, with many societal benefits, but it is best suited for industrial environments. It amps up the effectiveness of the plant process, resulting in better services and ROI. For instance, installing a real-time river monitoring solution will provide managers with accurate details and the status of river water levels, enabling them to make quick and informed decisions that result in effective ROI.

8 SCALABLE SOLUTION

An IoT-based water-level monitoring solution is an advanced and well-equipped system highly scalable to monitor the real-time volume of water-filled tanks. It is a full-fledged solution, comprising customizable and flexible features for ease of use. The rapid acceptance of technology in the water industry is a bold step toward progress, which makes a great impact on overall productivity.

9 MULTIPLE ALERTS

Installing a scalable IoT-based system further provides real-time alerts of water-related issues like logging, diseases, etc. It allows sufficient space for managers to make informed decisions and take necessary actions. Therefore, to never miss any alert, the solution consists of multiple alarm systems, including SMS alerts, email alerts, platform alerts, etc. These alerts are presented as real-time notifications on the users' smart devices that immediately prompt the appropriate authorities to make effective decisions regarding the river/reservoir levels.

The implementation of IoT is thus a great opportunity for water authorities and industry, providing a much-needed solution to mitigate water-related issues and offer a water supply network without any hindrances. ■

IoT is the future, with many societal benefits, but it is best suited for industrial environments.

About The Author

Sanjeev Verma is the founder and CEO of Biz4Group, based in Orlando, FL. He conceptualized the idea of Biz4 Brand and founded Biz4Group and Biz4Intellia. He has 20+ years of experience in boosting IT-based startups to success. In the past, he has worked in leadership positions with Marriott Vacations, Disney, Mastercard, State Farm, and Oracle. His company excels in developing, implementing, and monitoring digital solutions ranging from IoT solutions and products, mobile and web development, and digital marketing to full stack development and CMS solutions.

Using ARTIFICIAL INTELLIGENCE To Reduce Response Times

Public works operations and water utility personnel are now using AI-enabled insight to better serve their communities and save money.

By John Bertrand

Water utilities face the challenge of responding effectively to issues while keeping customers informed and staying on budget. Responding too slowly can result in damaged property, for which the city or utility is liable, and poor customer satisfaction. If utilities respond too quickly, they may be sending an on-call crew to respond to issues that can, and should, wait for normal resolution. That can result in thousands, if not millions, in unnecessary overtime, along with unwarranted interruptions of crew members' lives.

The Fallacy Of Human Judgment

Many utility crew members are experts in their fields. Unfortunately, they don't have time to review all incoming customer reports, nor should they be doing so. On the other hand, customers and many call center personnel do not have the knowledge to identify the crux and criticality of the issue. This is true whether calls are handled by a city administrative staff, a county call center that works with multiple cities, an emergency dispatch team, a 3-1-1 team, or a dedicated call center with any sort of employee turnover.

This challenge manifests itself in multiple ways. Consider the following scenarios.

- A customer calls in to a county dispatch office that handles calls for multiple cities after hours. The call-taker can't find the procedure for that person's city. The issue gets routed incorrectly, resulting in a delay.
- A customer calls in after hours to report a water-quality issue. The call-taker thinks it sounds like an emergency and sends it to the on-call person. This results in an automatic two hours of overtime. The issue ends up being resolved by simply running the water.
- A citizen sees water coming up through cracks in a street. They go to the city's web portal to report the issue. They choose what they think the issue is. This requires 1) that they know enough to categorize the issue correctly, and 2) that the portal has the right category for them to choose. In one real example, the citizen chose "storm drain discharge." The portal routed the report to the solid waste supervisor, delaying a response by the correct team by 30 minutes. This resulted in extra water-loss costs, as well as the social costs associated with prolonged traffic issues.

In the case of customer calls (or emails, texts, portal submissions, or social posts), AI can be used to analyze incoming data and predict category and criticality.

In each case, time is being wasted that could result in thousands of dollars of damage per incident, or overtime is being spent on issues that could have waited.

In one city in North Carolina, using an AI platform to help determine the criticality of customer-reported issues contributed to a 50 percent decrease in overtime, saving the city hundreds of thousands of dollars.

Reducing Reliance On Subjective Judgment With Technology

Call center, dispatch, city administrative staff, and others who take customer calls have to keep track of a lot of information, particularly when supporting multiple departments or cities. Providing them with simple tools to relieve some of the burden of having to remember, and make the right decision about, where and when an issue should be reported helps team members route information more accurately. This also allows them to process calls more quickly.

These tools can take two forms. The first simply embeds process rules from the service organization, whether that's a municipal water department, regional water district, or other entity responsible for the actual callout, into a platform. This platform then helps the call-taker follow the right process for that organization. These rules can include when and to whom calls should be sent, as well as automatic escalation trees.

The second set of tools is more complex. Before sending a report to a utility, the call-taker needs to understand what the core issue is to be able to route it correctly. That's where artificial intelligence and issue classification come in.

Artificial Intelligence And Issue Diagnosis

For some, artificial intelligence (AI), or "the capability of a machine to imitate intelligent human behavior,"[1] feels futuristic and maybe a little scary. In reality, mundane examples of AI exist throughout our daily lives. If you unlock your phone by looking at it, follow a recommended route on Google or Apple maps, or use Google to search for anything, you're taking advantage of AI.

AI is also already prevalent in the water utilities industry. It takes the increasingly voluminous sets of data being created through advanced metering infrastructure (AMI), SCADA, customer reports, and other sources, and turns them into actionable, and sometimes automated, steps.

In the case of customer calls (or emails, texts, portal submissions, or social posts), AI can be used to analyze incoming data and predict category and criticality. This reduces the reliance on the judgment of a nonexpert caller and helps the call-taker perform more effectively. The AI platform simply needs the caller to describe the symptoms, and then it can make the diagnosis.

An AI platform uses a set of algorithms, or rules it follows, to conduct the analysis and categorization. Those rules were developed by industry experts to reflect the decisions they would make and update dynamically as the platform encounters more data — thus the "intelligence" in "artificial intelligence."

For example, if a customer reports water coming up through cracks in the street, it would give it a high probably rating of being a water issue. If the person reported a bad odor and toilet paper visible in the water, it would categorize it with a high probability of being a sewer issue.

AI can also be used to identify duplicate reports, facilitating a coordinated response and eliminating additional unnecessary callouts. This also allows the utility to proactively address additional incoming calls with a recorded message acknowledging the issue, or to send out a text blast to the affected area.

Some Examples Of Success Using AI To Improve Response

In one city in North Carolina, using an AI platform to help determine the criticality of customer-reported issues contributed to a 50 percent decrease in overtime, saving the city hundreds of thousands of dollars.

Another city in California used the technology to reduce its response times to under an hour, a requirement of a consent decree that they could not have met otherwise. They also saw an estimated 75 percent reduction in callouts.

Several cities are using AI to quickly identify events that impact multiple people. In one, the AI platform identified an event after seven calls during a winter storm. After the event was identified, callers were greeted with a message about the service interruption. Ninety percent opted to receive text updates rather than talk to a person. Fifty percent of callers uploaded additional information, including photos, to help the team resolve the issue.

These are just a few examples of how utilities, municipalities, and counties are using technology and artificial intelligence to help their teams and better serve their customers. ■

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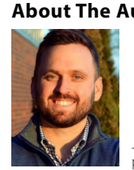
About The Author



John Bertrand, PE, is the founder and CEO of Daupler, which provides first response software for utilities and public works.

How Acoustic Leak-Sensing Devices And Data Analytics Can Save Billions Of Gallons Of Water

Failing infrastructure and water scarcity are two major issues for U.S. water utilities. One technology could help mitigate both problems.

By Rob Sibley

As historic heat waves and droughts grip the country, water scarcity has emerged as a critical challenge across the western United States. Recently, for the first time in American history, the federal government declared a water shortage at Lake Mead, a critical reservoir feeding the Colorado River. The move has triggered cuts in the water supply that will ultimately impact up to 40 million people in the Southwest.

In California, the situation is particularly dire. The issue is now an emergency, with the governor recently mandating that utilities reduce water consumption by 15 percent. As the population continues to grow and temperatures continue to rise, water scarcity will only get worse throughout the state.

By feeding data from pressure and flow sensors into analytics engines and machine-learning applications, utilities can quickly identify areas where considerable leakages exist within their territory.

To address water scarcity issues, policymakers and stakeholders typically focus on two areas: 1) urging individual consumers to cut back on water usage, and 2) building major new infrastructure, such as desalination plants and dams, to boost the water supply. But these have drawbacks. For one, relying on individuals to conserve water will only ever have a minor impact on overall consumption. Second, while major infrastructure projects do provide tremendous value in increasing the water supply, they require significant investment and take decades to complete. This is a problem that needs a shorter-term solution.

Luckily, there are much quicker and less costly ways to address water scarcity: leak detection and analytics. According to self-reported data, California water utilities are losing roughly 97.4 billion gallons of water through leakage in their distribution system. [See chart, p. 19.] Though some of that leakage may not be addressable, Itron calculates that approximately 27 billion gallons can be recovered. That would supply the needs of roughly 850,000 households. (Visit this resource and click on a utility to see its individual data.)

California utilities — and utilities throughout the U.S. — can begin to recover billions of gallons of water by leveraging Industrial Internet of Things (IIoT) technology. Acoustic leak-sensing devices and data analytics make it possible to rapidly discover and locate leaks, which are the most difficult aspects of leak mitigation and why so many leaks aren't being repaired in a timely manner. These solutions can be deployed quickly and require far smaller investments than traditional infrastructure projects, providing much-needed relief in the short term.

Throughout the U.S., there are far more small water utilities than larger ones, many of which have not yet adopted these modern IIoT solutions. Without this technology, discovering leaks is a slow and cumbersome affair, with utilities sending technicians to survey miles of pipe infrastructure and literally listen for leaks. These surveys can take months or longer to complete, all while the water losses mount.

This approach is so inefficient that leaks are normally first discovered by customers. Customers will stumble upon a small sinkhole forming in their yard or notice water trickling into their driveway. Even when a technician finds and repairs a leak, another one will often spring up elsewhere due to the altered equilibrium within the piping.

In contrast, acoustic leak-sensing devices and analytics save considerable time and labor costs. By feeding data from pressure and flow sensors into analytics engines and machine-learning applications, utilities can quickly identify areas where considerable leakages exist within their territory. The deployment of acoustic leak sensors further enhances the utility's capabilities by detecting individual leaks (pre-existing and emerging) with greater accuracy. These two methods effectively provide a daily leak survey of the utility's territory, thus enabling the optimization of utility resources by showing them where not to go. In addition, advanced analytics can be implemented to determine the priority of leak repairs and provide insights into future areas where leaks are most likely to occur.

The federal government must commit resources to help utilities adopt sensor and data analytics technology. Without help, small utilities will continue to struggle with the economics of recovering water. Digging up pipes to modernize infrastructure is costly. Unfortunately, even the investment required to deploy sensors and enable a data-based approach may be more than what an individual utility can afford.

However, with a relatively minor investment of infrastructure funds from the government, utilities would be able to deploy IIoT and analytics technology and realize their benefits within a year. Those benefits will extend for decades. The federal government must act with urgency to address and subsidize these deployments. This will incentivize utilities to effectively act on the issues they are facing and to address water loss and the broader social costs.

CARL* (Current Annual Real Losses)	UBL (Unavoidable Background Leakage)	TBL (Total Background Leakage)	CRL + CURL (Current Reported Losses + Current Unreported Losses) *Available to be addressed via Leak Sensors, IIoT, and Analytics*	TBL - UBL** (Total Background Leakage minus Unavoidable Background Leakage)
97,428,890,000	43,292,250,000	70,327,050,000	27,101,820,000	27,034,800,000

*Totals are the sum of the last fully reported year for each California utility. If 2020 data are missing or incomplete for a given utility, the latest prior year that is complete was included.

**Recovering this leakage requires physical modernization of the distribution infrastructure.

A glimpse of Southern California's drought, as Broadway Bridge spans over a dry LA River near downtown Los Angeles.

With increasing water scarcity, water losses affect everyone's quality of life. They lead to water restrictions, poor water pressure, and reduced agricultural output, among other impacts. Increasing water supply through major infrastructure projects can help, but we also must use the water we have more wisely. Mitigating addressable leakage through acoustic leak-sensing devices and data analytics is the best way to achieve the quickest ROI.

Support from the federal government could enable every utility to deploy these technologies and provide a clear ROI now and for decades in the future. Federal action could collectively save hundreds of billions of gallons of water across the country over the next 10 years and improve quality of life for millions of Americans. ■

About The Author

Rob Sibley is the vice president of global professional services delivery for Itron.

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