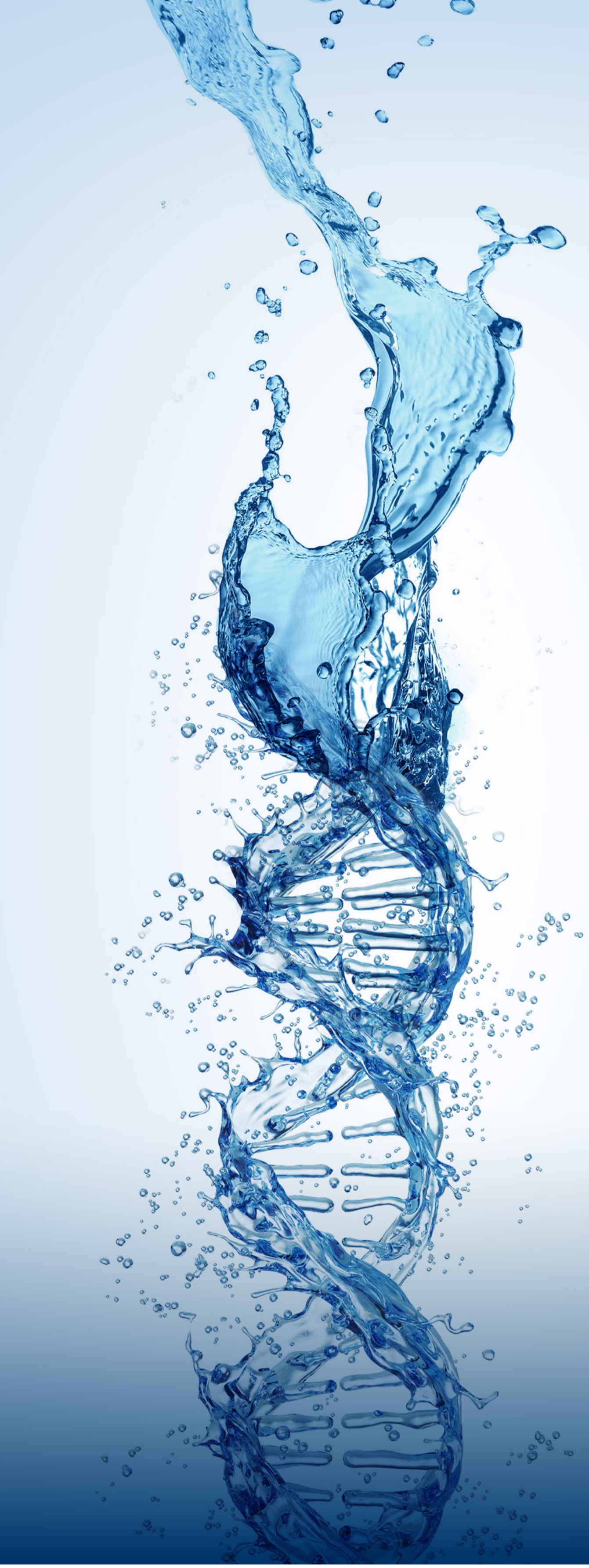

Water Innovations
MAY 2025
The Role Of AI In Reducing Water Contamination



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FROM THE EDITOR

By Kevin Westerling
Chief Editor, editor@wateronline.com

Building Back Better?

Every four years, America gets a fresh reminder of where we stand as a nation, for better or worse. What have we reaped this time around?

We're doing better at the top, but that's not saying much. After all, we only went from a C- to a C.

I'm talking, of course, about the *Report Card for America's Infrastructure* from the American Society of Civil Engineers (ASCE), which assessed our overall infrastructure — encompassing 18 categories — and determined just slight improvement from 2021 to 2025.

Many categories in ASCE's report relate to the water industry, such as dams (graded D+ in 2025), inland waters (C-), levees (D+), and ports (B), but I'd like to focus on three vitally important categories for *Water Online* and *Water Innovations* readers: drinking water, wastewater, and stormwater.

For this crucial trifecta, we remain unchanged from four years ago. And like that other pulse check of our nation, keeping the status quo can be viewed positively or negatively — the devil is in the details.

Here's the breakdown:

- **Drinking Water:** Maintained a grade of C-. This indicates that while there's no significant deterioration, the infrastructure shows general signs of aging and requires attention. There are still notable deficiencies that increase vulnerability. Key concerns include the presence of over 9 million lead service lines, significant water loss (equivalent to more than 50 million Olympic-sized swimming pools annually), and an estimated $625 billion needed over the next 20 years to bring the systems to a state of good repair. Despite the Infrastructure Investment and Jobs Act (IIJA) allocating funds, earmarks have reduced the capitalization grants available to states.
- **Wastewater:** Remained at a grade of D+. This signifies that the infrastructure is in fair to poor condition and, in some instances, approaching the end of its service life. Failures are becoming more common. Although the number of sanitary sewer overflows has decreased, the renewal and replacement rate for large capital projects has declined. There's a significant annual funding gap of $99 billion for wastewater and stormwater, with only about 30% of the needs currently met.
- **Stormwater:** Continued with a grade of D. This is one of the lowest grades, indicating a system largely in poor condition and at risk of failure. The length of impaired rivers and streams has increased significantly, partly due to the strain on stormwater systems from aging infrastructure and increasing rainfall intensities linked to climate change. While more utilities are developing maintenance plans, revenue from increasing stormwater fees isn't keeping pace with the growing costs.

Here's what this stagnation implies:

- **Continued Underinvestment:** The consistent grades suggest that, while the IIJA has begun to inject much-needed funds, the level of investment may still be insufficient to significantly move the needle on the deep-seated issues within these sectors. The funding gaps reported in both years remain substantial.
- **Aging Infrastructure Persists:** The grades reflect the ongoing reality of aging pipes, treatment plants, and other crucial components that are reaching or exceeding their design lives. The lack of improvement indicates that the pace of repair and replacement is not yet adequate to improve the overall condition. For drinking water, the millions of lead service lines continue to be a major concern.
- **Missed Opportunities for Improvement:** While other infrastructure sectors saw grade improvements, the water sectors did not. This suggests that the specific challenges and funding priorities within drinking water, wastewater, and stormwater may require more targeted and potentially increased attention and investment.

The consistent C-, D+, and D grades for drinking water, wastewater, and stormwater, respectively, serve as a stark reminder that sustained and potentially increased investment, coupled with strategic planning and innovative solutions, are crucial to sustaining our nation's water infrastructure — and improving these middling to poor ASCE grades.

As we do in these cycles, we will be looking back in four years to see how we did. Fingers crossed. ■

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CERCLA and PFAS: What's The Liability For Water And Wastewater Utilities?

Federal rules aim to target those liable but may miss the mark. Utilities can redirect the effort — and costs — to those truly responsible for PFAS contamination.

By Ken Sansone

Effective for nearly a year, the designation of two common per- and polyfluoroalkyl substances (PFAS) as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) stands to impact public works operations such as water and wastewater treatment facilities, municipal landfills, and airports. Also known as Superfund, CERCLA was enacted in 1980 to protect public health, clean water, and the environment by mandating remediation of environmental contaminants.

CERCLA authorizes the U.S. EPA to identify and investigate site contamination, order site cleanups, recover cleanup costs from potentially responsible parties, and require responsible parties to report releases into the environment. For pollution involving the two specific PFAS named in the June 2024 designation — PFOS and PFOA — this regulation creates Superfund liability for owners and operators of sites where there have been releases of these substances, exposing those agencies to the risk of citizen cost recovery suits for any environmental impacts.

When a contaminant is designated as a CERCLA hazardous substance, it creates liabilities and responsibilities for entities that — either actively or passively — release such contaminants into the environment. This creates troubling implications especially for public agencies, which could be held responsible for the high costs of remediation of a contaminant that they neither manufactured nor introduced. Even more concerning, CERCLA liability is retroactive; therefore, entities can be held liable for PFAS released into the environment years or even decades ago. Since PFAS ("forever chemicals") persist in the environment for extensive periods of time, agencies could be forced to remediate sites affected by long-ago contamination.

CERCLA claims against water and wastewater utilities historically have been rare, but because of the scope of PFAS contamination in both drinking water supplies and wastewater streams, there's reason for concern. The cost and impact of PFAS contamination and its remediation expense could rival that of asbestos and lead.

Highlighting concerns about liability, procedural fairness, and the potential economic impacts on various industries, several industry groups have initiated legal challenges against the EPA regarding the CERCLA designation. In February 2025, the U.S. Court of Appeals for the District of Columbia Circuit granted the U.S. EPA's request for a 60-day stay that pauses this litigation, which would give the EPA and its new leadership time to reassess its approach to PFAS regulation.

The Water Systems PFAS Liability Protection Act

At the time of the designation, the EPA announced a "PFAS Enforcement Discretion and Settlement Policy," indicating it will likely not bring CERCLA actions against passive receivers like municipal water and wastewater facilities but rather focus on industrial PFAS discharge. However, even this EPA policy, which is discretionary and not guaranteed, does not exempt public agencies from lawsuits filed by other parties like private citizens or state governments.

To more formally protect public entities from PFAS liability, members of the U.S. House of Representatives introduced the Water Systems PFAS Liability Protection Act in 2024 as H.R.7944. It aims to exempt certain entities, such as water and wastewater treatment facilities, from CERCLA liability with specific regard to PFAS contamination, with the goal that polluters, not taxpayers, shoulder the burden of cleanup costs. This act provides that agencies will be protected from CERCLA liability as long as they're in compliance with "all applicable laws at the time the activity is carried out." Violations of state law requirements or permit conditions would arguably forfeit this immunity — as would acting with "gross negligence or willful misconduct."

This bill did not advance out of committee review before the end of the 2024 legislative session, but in February of this year, the bipartisan bill was reintroduced as H.R.1267 and is currently under consideration by the House Committees on Energy and Commerce, and Transportation and Infrastructure.

Multiple trade groups that represent public works organizations have expressed support for this bill, including the American Water Works Association (AWWA), National Association of Clean Water Agencies (NACWA), National Rural Water Association (NRWA), American Public Power Association (APPA), and the Water Environment Federation (WEF). There is some concern, however, that this legislation may embolden polluters, who could indirectly benefit from the overall reduction in PFAS lawsuits and the power of litigation to hold responsible parties accountable.

How PFAS Contamination Is Creating Expenses For Water And Wastewater Utilities

Drinking water utilities are currently working toward a June 2029 deadline for complying with Maximum Contaminant Levels (MCLs) finalized by the EPA last year, which target six specific PFAS compounds. These compliance actions are generating significant expenses for utilities, including those related to testing, monitoring, treating, and communicating with the public. And while the CERCLA designation is separate from the drinking water MCLs, water treatment plants could experience repercussions from CERCLA. With a "hazardous substance" designation in place for PFAS, water treatment plants might have to dispose of PFAS-laden spent filtration media differently and with greater expenses. Also, should a water treatment plant detect elevated levels of PFAS in its water source, the site could be added to the National Priorities List (NPL), triggering federal oversight and potential cleanup responsibilities and operational impact.

With regard to affected wastewater treatment plants (as well as municipal landfills and airports), the costs could be even more direct. These facilities are caught in the middle — unable to stop receiving PFAS from various waste streams but required to limit releases without additional funding. The EPA's designation of PFOA and PFOS as hazardous substances requires wastewater systems to report non-exempt releases of one pound or more within a 24-hour period. Also, utilities that suspect their wastewater effluent or biosolids contain PFAS may be obligated to conduct additional monitoring for releases. Even wastewater systems with releases below the reporting threshold may have liability risk from third-party lawsuits that accuse them of contributing to other agencies' PFAS cleanup costs.

Many wastewater utilities are already experiencing financial impacts caused by PFAS. In recent decades, biosolids have

With a "hazardous substance" designation in place for PFAS, water treatment plants might have to dispose of PFAS-laden spent filtration media differently and with greater expenses.

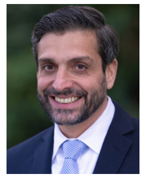
become a revenue stream for wastewater treatment plants. But in some states, PFAS-laden biosolids are being banned from land application due to PFAS contamination concerns, a turn that is both decreasing revenue and increasing disposal costs for wastewater treatment plants.

Utilities Are Using The Law To Ensure Funding

To proactively plan, many utilities are using the law to hold polluters responsible, so that neither the utilities nor the ratepayers are left holding the bag for contamination they did not cause. Utilities can recover significant costs related to PFAS cleanup by bringing legal claims against the PFAS manufacturers that caused the contamination in the first place. Without settlements or awards from these manufacturers, utilities will have to absorb the treatment costs on their own. These can run into the many millions of dollars for almost any utility operating in a state with restrictions on PFAS concentrations in its water, effluent, or sludge.

Affected utilities, states, property owners, and other entities have filed lawsuits to hold the PFAS manufacturers accountable, with many cases consolidated into the Aqueous Film-Forming Foam (AFFF) MDL (multidistrict litigation), which coordinates similar cases filed in multiple federal district courts to streamline the legal process. So far, the AFFF MDL has been an effective cost-recovery strategy for participating drinking water systems — nearly $15 billion in settlements have been obtained from large-scale PFAS manufacturers 3M, DuPont, BASF, and Tyco for impacts to public drinking water supplies. The current settlements only apply to drinking water providers, but they illustrate the potential for significant cost recovery through litigation and serve as a valuable funding strategy tool for PFAS-impacted communities. ■

About The Author



Ken Sansone is a partner at SL Environmental Law Group PC, where he represents water suppliers and other public agencies in contamination lawsuits, including claims over PFAS, 1,2,3-trichloropropane (TCP), and perchlorate. Prior to joining SL, Sansone was an assistant attorney general for New Hampshire. He has more than 20 years of experience handling complex civil and criminal cases in federal and state trial and appellate courts. He received his law degree from New York University and his undergraduate degree, magna cum laude, from Duke University.

How To Set *Realistic* Targets To Reduce Non-Revenue Water

Data-gathering is key to goal-setting, and is achievable in 5 steps.

By Christian Bonawandt

Nearly all water utilities struggle with non-revenue water (NRW). This problem is both costly and a serious strain on what is increasingly considered a scarce resource. Reducing NRW is no simple task, partly due to the large number of ways in which it can occur. But it is achievable. The key is to gather data and set realistic targets. Setting realistic targets is important because it avoids overambitious goals that are more likely to fail and, in turn, demotivate operators, managers, and other stakeholders. To set realistic goals for NRW requires a thorough understanding of contributing factors, as well as the capabilities and constraints of the water utility.

Leveraging Data

Setting realistic targets requires leveraging data so that operators have a firm understanding of where they are starting from and what is needed to make changes. This process can be broken down into five steps.

1. Baseline Assessment. The first step is to establish a baseline that will help determine the extent of NRW and prioritize areas for improvement. Utilities should start by conducting a comprehensive assessment of the current NRW levels within the water distribution system. This includes measuring physical losses (leakage, system failures) and apparent losses (metering inaccuracies, billing errors, unauthorized consumption). Specifically, operators will need to know the total volume of water supplied to the distribution system over a specific period (e.g., monthly or annually). Next are data on water consumption patterns, such as metered and billed water consumption by customers. Finally, operators will need system-performance data, such as pressure levels, flow rates, distribution network characteristics, age and condition of infrastructure, and history of system failures.

2. Data Analysis. With the baseline data in hand, water utilities can then perform a segmentation analysis. Operators will need to look at NRW data based on different parts of the distribution network, such as zones, districts, or customer categories (commercial, residential, hospital/medical, etc.). This helps in identifying NRW hotspots and prioritizing areas for intervention. In addition, a time-series analysis could be used to pinpoint trends and patterns in NRW over time. For example, utilities may see seasonal variations, trends in consumption levels that impact NRW, and changes in NRW levels caused by interventions or external factors.

3. Performance Indicators. From there, water utilities must define key performance indicators (KPIs) related to NRW. The most common KPIs are the volume of water lost, revenue loss from NRW, and relevant water consumption patterns. These indicators will serve as benchmarks for measuring progress toward NRW reduction goals..

4. Set SMART Goals. Once KPIs are established, water utilities should set SMART goals (Specific, Measurable, Achievable, Relevant, Time-bound). These will establish realistic and achievable targets for NRW reduction. For example, a SMART goal could be to reduce NRW by 20% over the next two years by focusing on leak detection and repair programs and/or improving metering accuracy. The specific goals will depend on what data were gathered during the baseline assessment and analysis.

5. Gap Analysis. This step is used to identify the factors contributing to NRW and any potential barriers preventing its reduction. Operators may need to assess the condition of infrastructure, the effectiveness of monitoring and control systems, the accuracy of billing and metering processes, and the level of awareness and compliance among customers.

Implementing The Plan

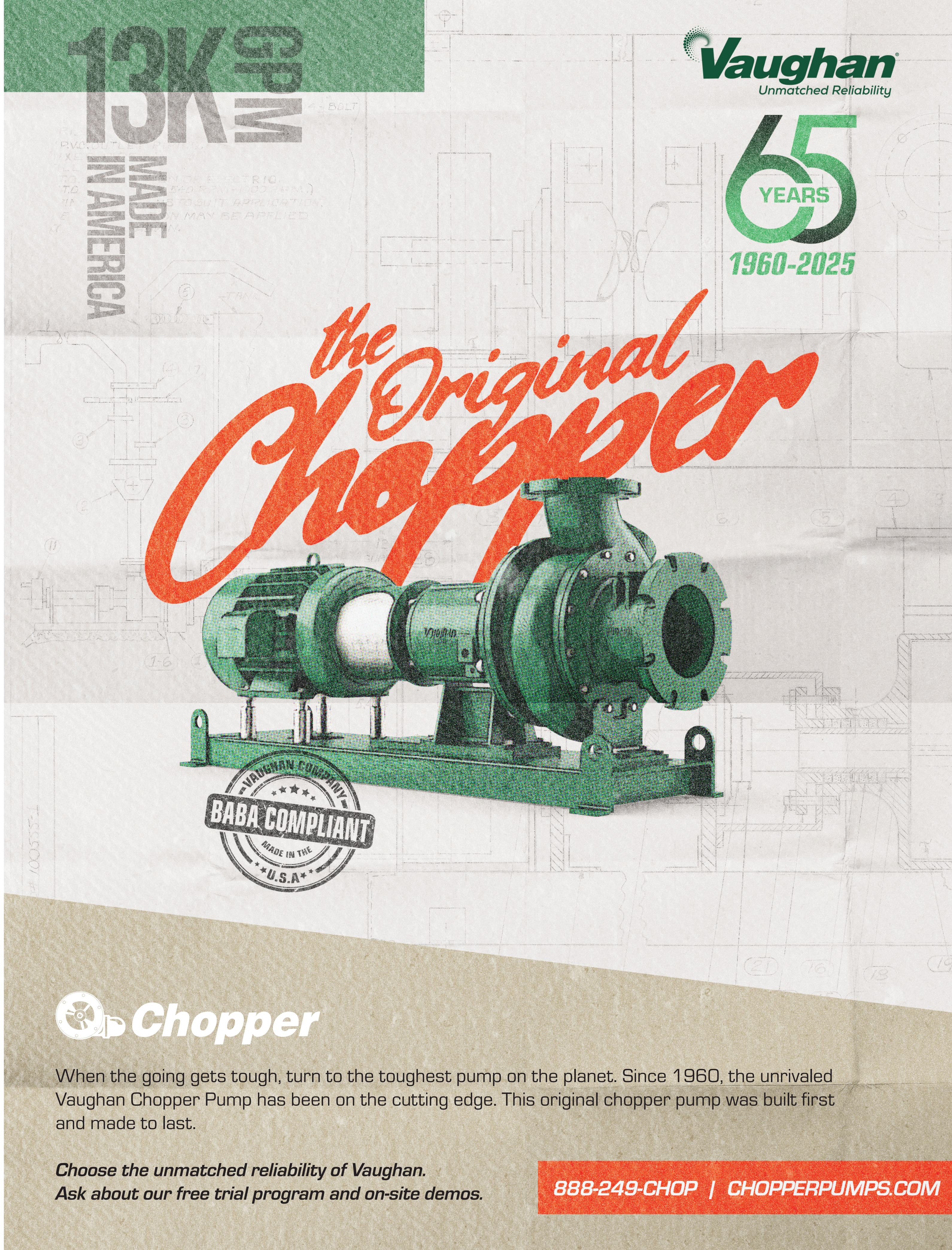
With targets set and game plan in hand, water utilities can then execute. There are a wealth of advanced technologies and tools that can be leveraged for NRW management, and water utilities would be well advised to consider those that fit their goals and budgets. This may include leak-detection systems, smart meters, and/or real-time monitoring and control systems. Data analytics systems can also help continuously identify NRW hotspots and trends.

But tools alone cannot reduce NRW. Instead, each utility must invest in training and capacity building for staff members involved in water-loss reduction. In addition, water utilities should implement operational best practices such as proactive maintenance of infrastructure, regular inspection, and optimizing water pressure. Where applicable, plant managers should also encourage personnel to take advantage of enhanced meter reading and billing accuracy to implement water-loss control programs.

The final step is to establish a robust monitoring and evaluation framework to track progress toward NRW reduction targets. By regularly monitoring KPIs, conducting performance reviews, analyzing trends, and adjusting strategies as needed, water utilities can achieve NRW reduction goals. ■

About The Author

Christian Bonawandt is an industrial content writer for *Water Online*. He has been writing about B2B technology and industrial processes for 24 years.



The Role Of AI In Reducing Water Contamination Risks

Insights gained from artificial intelligence (AI) herald a high-water mark for public protection.

By Ainsley Lawrence

Water isn't optional. It's the foundation of life, industry, and civilization itself. But keeping it clean? That's a constant fight. Contaminants don't announce themselves. They slip in through failing infrastructure, industrial runoff, and aging water-treatment systems, often going undetected until the damage is done.

That's where AI is rewriting the rules. Predictive analytics is flipping the entire system from reactive to proactive. Instead of waiting for contamination to be discovered, utilities and industries can predict where, when, and how it's likely to happen.

This is more than an upgrade. It's a revolution. And in an industry where prevention is everything, predictive analytics is the tool that finally puts water managers ahead of the problem.

The Power Of AI And Data Science In Water-Quality Management

Water management has always been a battle against the unknown. Contaminants don't follow schedules, and traditional testing methods only provide a snapshot of conditions at one moment in time. Data science and AI[1] change that. They turn raw data into foresight by observing patterns, detecting problems, and more.

How AI Detects Contamination Before It Happens

AI thrives on patterns. It processes vast amounts of real-time data from sensors, historical trends, weather reports, and infrastructure conditions to detect contamination before it escalates. A shift in pH? That could mean a chemical spill. A sudden chlorine drop? A microbial breach might be forming. AI anticipates anomalies, giving water managers a critical window to take action before the contamination spreads.

And the scale is massive. AI models can monitor thousands of data points at once, spotting weaknesses in aging infrastructure, identifying pressure drops that indicate pipe damage, and even predicting seasonal contamination risks based on environmental conditions. It's the closest thing the industry has to a crystal ball — and it's already proving its value.

Comparing Water-Quality Risks: Well Water vs. City Water

All water isn't equal. Well water and city water[2] face entirely different challenges, but contamination is universal. AI helps both, tailoring predictive models to match their unique vulnerabilities.

City Water: A Complex Network With Hidden Risks

Public water goes through treatment, but that doesn't guarantee safety. Infrastructure is aging, chemical byproducts form in pipes, and contamination events can start anywhere in the system. A broken main can send rust and lead into drinking water. A treatment failure can allow bacteria to slip through unnoticed.

Predictive analytics gives utilities the ability to see weak points before they turn into crises. AI models analyze distribution networks, flagging inconsistencies in pressure, chemical levels, and flow rates. A sudden shift in turbidity? A pipe might be failing. A pattern of bacterial growth near a plant's output? The filtration process could need adjustment. AI takes what used to be guesswork and turns it into actionable intelligence.

Well Water: A System Without Oversight

For well owners, water safety is entirely self-managed. There's no centralized testing, no automatic filtration, and no backup system when contamination happens. Agricultural runoff, heavy metals, and naturally occurring toxins like arsenic can all seep into groundwater without warning.

That's why AI-driven monitoring is a game-changer for private wells. Predictive models can track environmental factors like rainfall, soil saturation, and nearby land use to assess contamination risks. If conditions indicate an increased likelihood of bacterial growth or chemical infiltration, AI can recommend testing before problems arise. It's a level of protection that owners have never had access to before.

Predictive Analytics In Action: Real-World Applications

AI in water management is already being deployed to stop contamination, extend infrastructure life, and cut costs.

One major breakthrough is AI-driven pipeline maintenance. Instead of reacting to breaks, utilities are using predictive analytics to pinpoint stress points in the system before failures occur. By analyzing pressure fluctuations, material degradation, and past leak patterns, AI can forecast which pipes are most likely to fail and recommend preemptive repairs. The result? Fewer emergency shutdowns, lower maintenance costs, and significantly less water waste.

Another game-changer is real-time microbial risk assessment. AI models continuously monitor microbial activity, using environmental conditions, temperature fluctuations, and historical contamination trends to predict when bacterial outbreaks are most likely. Instead of waiting for an outbreak to be detected, treatment adjustments can be made before water quality is compromised.

These aren't small improvements. They're industry-shifting changes redefining how water safety is managed.

Why Analytical Thinking Still Matters in AI-Based Water-Quality Solutions

AI is an incredible tool — but it isn't flawless. Predictive models are only as good as the data they're trained on. A faulty sensor can send a flood of false alerts. A model built on outdated trends might miss emerging threats. That's why human oversight is still essential.

The Role Of Human Expertise

AI can tell you something's off, but it can't always explain why. It might flag a sudden pH drop, but is it an actual contamination event or just a temporary fluctuation? That decision still requires experienced professionals who can interpret the data and take the right action.

That's why the best water management strategies don't rely on AI alone. They integrate predictive analytics with human expertise, ensuring that AI-driven insights are used effectively rather than blindly followed.

Preventing AI Misinterpretation

Even the most advanced AI can make mistakes. A malfunctioning sensor might misread chlorine levels, triggering an unnecessary alarm. A sudden water-pressure shift might be misclassified as a break when it's actually a routine demand fluctuation. That's why utilities need a system of checks and balances: AI-driven insights combined with expert verification.

Predictive analytics isn't about replacing water professionals. It's about giving them better tools, faster insights, and a level of foresight that was previously impossible.

Conclusion

AI-driven predictive analytics is a fundamental shift in water-quality management. Instead of reacting to contamination after it happens, utilities and industries can now predict and prevent it entirely.

The advantages are undeniable: faster detection, smarter intervention, and stronger infrastructure. But technology alone isn't enough. AI provides the data, but human expertise makes sense of them. The future of clean water is about the perfect balance of innovation and experience. And with that balance, the industry is moving closer than ever to truly safe, reliable water. ■

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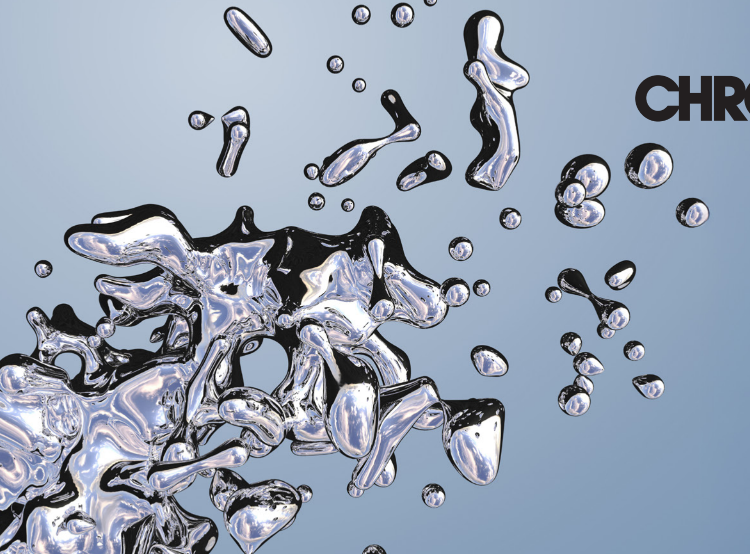

CHROMIUM IN DRINKING WATER: New Regulations In California And Engineering Challenges

Among other contaminant concerns, drinking-water managers in the Golden State are being held to tighter standards on chromium.

By Paniteja Madala

Chromium (Cr) is a naturally occurring element of the Earth's crust, and it exists mostly in two states of oxidation: trivalent chromium (Cr[III]) and hexavalent chromium (Cr[VI]). Cr(III) is a nutrient element promoting metabolism, while Cr(VI) is an aquatic toxic pollutant with severe health impacts such as cancer, reproductive toxicity, and organ damage. Chromium contamination of water can either be natural or can be caused by industries like metal plating, tanning, and textiles.

Because of the possible risks of Cr(VI), strict regulatory systems have been put in place worldwide to reduce exposure. California has led the way in chromium regulation, originally establishing an MCL of 10 ppb for Cr(VI) in 2014, which was repealed in 2017 because of economic feasibility issues. In 2024, the California State Water Resources Control Board reestablished the 10-ppb standard with increased compliance requirements and financial assistance programs.

Water utilities are facing significant challenges to comply and must implement costly treatment technologies to improve the water quality. Cooperative efforts by policymakers and engineers must find affordable, sustainable ways of supplying safe drinking water without compromising the economic and operational constraints.

Understanding Chromium Chemistry And Contamination[1]

Chromium is a naturally occurring element in rocks, animals, plants, soil, and volcanic dust and gases. It exists in multiple oxidation states including +2, +3, +6, but the two most common states in water systems are:

- Cr(III), a vital micronutrient aiding metabolism.
- Cr(VI), a toxic compound associated with cancer and other severe health conditions.

Cr(VI) compounds are highly toxic and are strong oxidizing agents. Cr(VI) contamination in drinking water can originate from both natural sources and industrial activities. Chromium compounds, in either the chromium (III) or chromium (VI) forms, are used for chrome plating, the manufacture of dyes and pigments, leather and wood preservation, and treatment of cooling-tower water. Smaller amounts are used in drilling muds, textiles, and toner for copying machines. The contamination occurs when Cr(VI) dissolves into groundwater or surface-water supplies, affecting drinking-water systems.

Health Impacts Of Hexavalent Chromium[2]

Prolonged exposure to Cr(VI) through drinking water has been linked to numerous health risks, including:

- Carcinogenic effects: Long-term ingestion of Cr(VI) is associated with an increased risk of lung cancer, stomach cancer, and other gastrointestinal cancers.
- Reproductive toxicity: Studies have shown potential adverse effects on reproductive health and fetal development.
- Liver and kidney damage: Chronic exposure may lead to liver and kidney dysfunction.
- Skin and respiratory issues: Direct exposure to Cr(VI)-contaminated water can cause dermatitis, nasal irritation, and respiratory conditions.

These concerns have led regulatory agencies, including the U.S. EPA and California's State Water Resources Control Board, to tighten drinking-water standards to minimize exposure.

California's Revised Regulations On Chromium In Drinking Water[3,4]

California has been a leader in regulating Cr(VI) in drinking water. In 1977, California set the state's total Cr maximum contaminant limit (MCL) in drinking water at 50 µg/L, which continues to be the state's drinking water limit for total Cr. The EPA adopted the same 50 µg/L MCL for total chromium, but in 1991 raised that federal MCL to 100 µg/L.

After years of research and stakeholder engagement, SWRCB introduced a revised standard in 2024, setting the MCL at 10 ppb again, with enhanced compliance strategies and financial-support mechanisms.

Key elements of the new regulations:

- Lower MCL for total chromium: The state aims to reduce total chromium levels further by monitoring Cr(VI) and Cr(III) separately.
- Increased monitoring and reporting requirements: Water utilities must conduct more frequent sampling and implement public-notification procedures.

Compliance deadlines: The regulation employs a phased-compliance approach based on system size:

- Systems with 10,000 or more connections: compliance within two years.
- Systems with 1,000 to 9,999 connections: compliance within three years.
- Systems with fewer than 1,000 connections: compliance within four years.

Funding and grants: The state is offering financial assistance to small water systems struggling with compliance via the Safe and Affordable Funding for Equity and Resilience (SAFER) drinking-water program.

Engineering Challenges And Treatment Technologies[3]

Meeting California's new chromium standard requires innovative treatment technologies, robust monitoring systems, and significant financial investment. Engineers and water treatment professionals must consider several key factors when selecting the appropriate treatment method. Some of the best available technologies (BAT)[3] identified for treatment proposed by California's state board are:

1. **Reduction-coagulation-filtration (RCF) process**
   - Converts toxic Cr(VI) to Cr(III) (a less harmful form) using ferrous sulfate or another reducing agent.
   - Cr(III) is then removed via coagulation, sedimentation, and filtration.
   - Widely used but requires careful pH control and sludge management.
2. **Ion exchange (IX) systems**
   - Strong base anion (SBA) and weak base anion (WBA) exchange resins selectively remove Cr(VI) from water.
   - Effective for low-to-moderate concentrations but requires resin regeneration and disposal of brine waste.
3. **Reverse osmosis (RO)**
   - High-rejection membranes remove Cr(VI) efficiently, achieving over 90% removal rates.
   - Produces high-quality water but involves high-energy consumption and concentrate-disposal challenges.

Some of the other available technologies treating hexavalent chromium are listed below. However the approach, the selected technology should be based on research and careful consideration of individual system needs.

1. Stannous chloride (SnCl2) reduction
2. Electrocoagulation (EC) technology
3. Activated carbon adsorption
4. Biological treatment (under research)

Key Considerations

- **Regulatory compliance:** Technologies must meet the required chromium limits.
- **Operational needs:** Some methods require special handling, such as pH control or waste disposal.
- **Cost:** Treatment expenses vary based on system size and water quality.
- **Feasibility:** Smaller systems may struggle with certain methods due to cost and operational challenges.

Expert Insights On Engineering Solutions

As a water professional with experience in infrastructure projects, I have observed the increasing complexity of regulatory compliance and the need for innovative solutions. Some key considerations to keep in mind include:

- evaluating the cost-benefit trade-offs of different treatment methods
- assessing the long-term sustainability of various chromium-removal approaches
- collaborating with interdisciplinary teams and vendors to design resilient water systems
- conducting pilot testing for site-specific solutions
- designing systems for future scalability.

Conclusion

California's new chromium regulations are a model for other states to emulate in enhancing drinking-water quality. While technically and economically demanding, compliance requires engineers, utility managers, and policymakers to work together to implement feasible and sustainable solutions. State-of-the-art treatment technologies, in conjunction with financial-support mechanisms and regulatory coordination, will play critical roles in safeguarding public health and facilitating compliance.

As water professionals, it is our duty to continue researching and implementing the best solutions to fight Cr(VI) contamination and balance operating costs with sustainability. Through proactive planning and investment in technology, we can navigate the evolving regulatory landscape and uphold our responsibility to protect water quality for future generations ■

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4. Hexavalent Chromium Information - California State Water Resources Board

About The Author

Paniteja Madala is a water/wastewater engineer at AECOM with over six years of experience across India, the UK, and the U.S. Holding master's degrees in environmental engineering and construction and facilities engineering, he is actively contributing to reshaping the water industry by co-authoring standards, publications, and technical materials with organizations like AWWA, ASTM, WEF, and ASCE. Recognized with a 40 Under 40 award by AAEES for his leadership and commitment to environmental engineering, Madala is also involved in Engineers Without Borders, addressing global water challenges and promoting long-term water resilience.

EMBRACING DATA-AS-A-SERVICE FOR OPTIMIZED AND RESILIENT UTILITY OPERATIONS

As more water utilities explore digital transformation, DaaS presents a compelling opportunity to modernize operations while minimizing risk.

By Sielen Namdar

Imagine a world where water utilities can tackle their toughest challenges with leading-edge technology and creative business models — what would that look like? Today, water utilities are navigating a complex landscape filled with aging infrastructure, workforce shortages, regulatory requirements, climate-change impacts, financial constraints, potential tariff impacts, and the ever-growing demand for affordable water services. To overcome these hurdles, utilities must embrace innovative approaches and technologies, optimize their operations, and explore new business models that enable them to achieve more with fewer resources.

As digital transformation sweeps across various industries, it offers innovative methods to help manage infrastructure and enhance service delivery. Despite these advancements, the water sector has been cautious in embracing these alternative models. This hesitation stems from factors such as risk aversion, public-health concerns, regulatory complexities, budget constraints, the long lifecycle of water infrastructure, and concerns about cybersecurity and data privacy.

A promising method that has shown success in other sectors and is now gaining traction with water utilities is Data-as-a-Service (DaaS). According to the Smart Water Networks Forum (SWAN) DaaS Playbook, DaaS is a partnership model where a technology supplier operates and maintains specific hardware for data collection, transmission, and processing, while the utility pays only for the delivered results and outcomes. This allows utilities to access high-quality data on demand without the need to own and maintain the underlying infrastructure. Additionally, this model shifts certain risk areas such as operations, financial performance, technology advancement and upgrades, and cybersecurity to the provider.

While DaaS has gained momentum in the industrial and agricultural sectors for addressing water-related concerns, there is limited information on how to adopt this model, including the associated risks and required utility maturity factors.

Water utility and industry leaders are exploring the potential of accelerating DaaS in collaboration with SWAN, the American Water Works Association (AWWA), and the Water Environment Federation (WEF). Recent case studies from various organizations, such as the city of Grand Rapids, MI, have showcased successful implementations of DaaS solutions for water utilities. These examples highlight how DaaS can be applied in utilities of different sizes, providing valuable insights into the benefits and challenges of this business model.

Utilities that have adopted DaaS have enjoyed several key benefits, including cost savings, operational efficiencies, and improved access to advanced digital technologies. While initial adoption may require overcoming procurement and regulatory hurdles, the long-term advantages — such as enhanced predictive maintenance capabilities, reduced downtime, and optimized asset and energy management — make this model an attractive option for many water organizations. DaaS is particularly beneficial for utilities with limited resources or those looking to enhance their data-management capabilities without significant up-front investments.

The decision to adopt DaaS depends on a few factors, including understanding the specific circumstances under which a utility might benefit from the model, overcoming challenges based on the size of the municipality, ability to structure a successful DaaS initiative, and to measure its effectiveness. Considering the tactical and technical aspects of implementing DaaS are also crucial. Utilities need to define service-level agreements (SLAs) with solution providers to ensure reliable and regulatory-compliant data delivery. Procurement strategies should include specific language in requests for proposal (RFPs) to ensure technology providers meet performance expectations. Additionally, the location of data-collection devices, system integration with existing infrastructure, and ongoing maintenance responsibilities can significantly influence the success of a DaaS implementation.

Water utilities must also consider key adoption barriers such as varying levels of digital maturity, data-security concerns, and internal resistance to outsourcing data-related operations. Building a strong business case for DaaS is essential, with a focus on clear ROI calculations and an effective internal and external stakeholder-engagement program. Some utilities may also be concerned about the potential impact to the workforce. Providing training and support to help employees adapt to new technologies are critical. This transition can create opportunities for employees to develop new skills and take on more strategic roles within the organization. Regarding financial concerns, while there may be initial costs associated with transitioning to DaaS, the long-term savings from reduced capital expenditures and operational efficiencies can outweigh these costs. A detailed cost-benefit analysis can illustrate the financial advantages.

For water utilities that want to get started on DaaS, the following tips can be useful:

- **Assess Utility Maturity:** Begin by evaluating your utility's digital maturity and readiness for adopting DaaS. Identify any internal challenges, such as cultural resistance or legal constraints, that need to be addressed before implementation.
- **Build a Strong Business Case:** Clearly articulate the benefits of DaaS, including potential cost savings and operational efficiencies. Develop a robust ROI calculation to gain buy-in from internal and external stakeholders.
- **Engage Partnerships and Ecosystem Collaboration:** Foster strong partnerships between the utility and technology providers. Understand the digital solutions and facilitate continuous communication and collaboration to build trust and ensure the success of the DaaS initiative.
- **Define SLAs:** Establish clear SLAs with solution providers to ensure reliable and regulatory-compliant data delivery. Include specific performance expectations in RFPs.
- **Plan for Integration:** Consider how DaaS will integrate with existing infrastructure and systems. Address any potential challenges related to data-collection device locations, system integration, and ongoing maintenance responsibilities.
- **Ensure Compliance and Security:** Adhere to regulatory requirements for data privacy and cybersecurity.
- **Start Small, then Scale:** Identify high-impact use cases, implement pilot projects to test feasibility of full-scale deployment, and then drive scale.

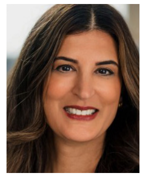
Strong partnership between utilities and technology providers is perhaps the most essential component for ensuring data reliability, service continuity, and long-term scalability. Schneider Electric has emerged as a key player and technology partner in providing DaaS solutions to water utilities. Leveraging their expertise in digital transformation and smart technology, they design and implement DaaS models tailored specifically for the water sector. These services include managing and maintaining state-of-the-art sensors, meters, and data concentrators that gather real-time information to drive operational awareness, monitor flow rates, and provide visibility into infrastructure health. Their DaaS solutions ensure that utilities receive accurate and actionable data without the burden of managing the technology themselves.

DaaS is particularly beneficial for utilities with limited resources or those looking to enhance their data-management capabilities without significant up-front investments.

The approach includes sophisticated data analytics and cloud-based platforms that are built on EcoStruxure architectures. This allows utility operators to monitor and diagnose issues remotely and optimize operational efficiency, while reducing costs. With the DaaS platform, utilities can enhance their decision-making capabilities, ensure regulatory compliance, and address water-scarcity challenges proactively. There is also a strong focus on building strong partnerships with water utilities, providing ongoing support and customization to meet the unique needs of each customer. This collaborative approach ensures the reliability and high performance of the DaaS model, ultimately contributing to a sustainable and resilient water future.

By shifting from traditional infrastructure ownership to an outcome-based service model, water utilities can leverage leading-edge technologies without heavy capital investments or risks. With the right strategy and partnerships in place, DaaS has the potential to become a critical component of how water utilities enhance operational efficiency, improve data utilization and service reliability, mitigate operational risks, and ensure long-term viability and sustainability. ■

About The Author



Sielen Namdar is an industry executive with more than two decades of experience leading high-impact strategy for digital transformation of industries. She is currently the U.S. head of the water and environment segment for Schneider Electric and leads the strategy to drive long-term growth for municipal and industrial water segments. Prior to this role, Namdar was Cisco's global head of sustainability for industries, and before that she was Jacobs' global senior director of strategic sales and co-founder of Smart Cities Initiative.

How Water Utilities Can Support The Electric Grid While Reducing Costs

Orange County Water District is combining operational flexibility with environmental stewardship by participating in demand response, earning millions in payments while maintaining their commitment to delivering clean, reliable water.

By Mike Williams

Orange County Water District (OCWD) is a public agency managing three of Southern California's greatest water supplies: the Santa Ana River, the Orange County Groundwater Basin, and the Groundwater Replenishment System (GWRS). They are steadfast in their mission of providing reliable, high-quality water to more than 2.5 million residents in north and central Orange County while protecting environmental habitats and natural resources.

The GWRS, operational since 2008, is the world's largest water-purification system for indirect potable reuse, producing an impressive 130 million gallons of pure water daily. Following its completion, OCWD recognized that the facility's electricity demands would be substantial, accounting for a significant portion of their operating costs. Then, they learned about demand-response programs[1] through their local utility, Southern California Edison (SCE). By participating, they could receive financial incentives to reduce energy usage, helping to offset the operational costs of the GWRS while also doing their part to ensure grid stability.

Demand Response — Reduce Costs, Contribute To Grid Reliability

Demand response is a critical reliability resource that helps the electric grid prevent blackouts and brownouts. It's often much more efficient and cost-effective for grid operators and utilities to bring demand levels down to meet available supply instead of ramping up supply to meet periods of high demand. As a result, they incentivize companies to be flexible with their energy demand through demand-response programs, paying participants to reduce energy usage strategically during periods of high demand.

Demand response presented an attractive opportunity for OCWD. According to Mehul Patel, executive director of operations at OCWD: "We were interested in helping with statewide electrical-grid emergencies while also finding a potential outside revenue source to offset operating costs of the new GWRS facility."

OCWD's energy reduction strategy focuses on reducing plant water production to offset significant electrical usage — and remain operational.

OCWD initially had concerns that participating in demand response could significantly reduce water production, potentially increasing the unit cost of water. Lower production could also result in lower groundwater-recharge volumes, especially during dryer-than-normal precipitation years. These concerns were well-founded because demand response requires energy reductions, and OCWD must maintain operational continuity to uphold their commitment to providing clean water to the community.

However, their concerns were alleviated upon further investigation into how demand-response programs work and learning about flexible participation options — including not curtailing all electrical load, which allowed essential administrative-business functions to continue operating during demand-response events.

In addition, since the GWRS is not an essential direct-water supply facility, planned and temporary reductions in production could be effectively managed. This flexibility made GWRS well-suited to participate in voluntary electrical-load curtailment.

OCWD's Strategies For Success With Demand Response

Ultimately, developing an effective demand-response participation strategy and achieving success hinged on selecting the right curtailment service provider (CSP).

OCWD enrolled in SCE's Base Interruptible Program (BIP)[2], a demand-response program where strong and reliable performance is essential to maximizing payments. BIP compensates participants based on the difference between their typical energy usage and a pre-established energy-reduction target — their maximum allowable energy demand during a demand-response event. The more consistently participants achieve or surpass their target during events, the more they will earn.

OCWD's energy-reduction strategy focuses on reducing plant water production to offset significant electrical usage — and remain operational. Enel North America, Inc., helped OCWD develop an energy-reduction plan that enables OCWD to shed 10-11 MW of load, on average, during events. OCWD accomplishes this reduction by lowering the flow rate from 130 million gallons per day to 25 million gallons per day. At this flow rate and level of electrical usage, OCWD can continue operating the GWRS and administration building without jeopardizing their ability to replenish the Orange County Groundwater Basin, all while significantly reducing electrical load to assist in alleviating stress on the California electric grid during grid emergencies.

Rewarding Good Stewardship For Responsible Energy Usage

Participating in demand response aligns with OCWD's philosophy to be a good steward of responsible energy usage in California — and adopt sustainable practices while supporting grid reliability. By enrolling in SCE BIP, OCWD has turned energy management into a significant financial and operational advantage.

Participating in demand response aligns with OCWD's philosophy to be a good steward of responsible energy usage in California — and adopt sustainable practices while supporting grid reliability.

Since 2014, OCWD has earned approximately $12.5 million in demand-response payments. This substantial return underscores the value of participating in demand-response programs to unlock revenue opportunities and operational efficiencies.

Patel encourages other companies to follow their lead and participate in demand response, having witnessed the benefits firsthand: "We recommend participation in demand response to others in our industry. It is relatively easy to manage participation in the program, it brings in additional sources of revenue, and it helps the state of California with electrical-grid emergency events." ■

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About The Author

Mike Williams is the account manager for demand response at Enel North America, Inc., and is responsible for helping customers manage and execute their demand-response curtailment strategies in order to maximize performance and revenue.


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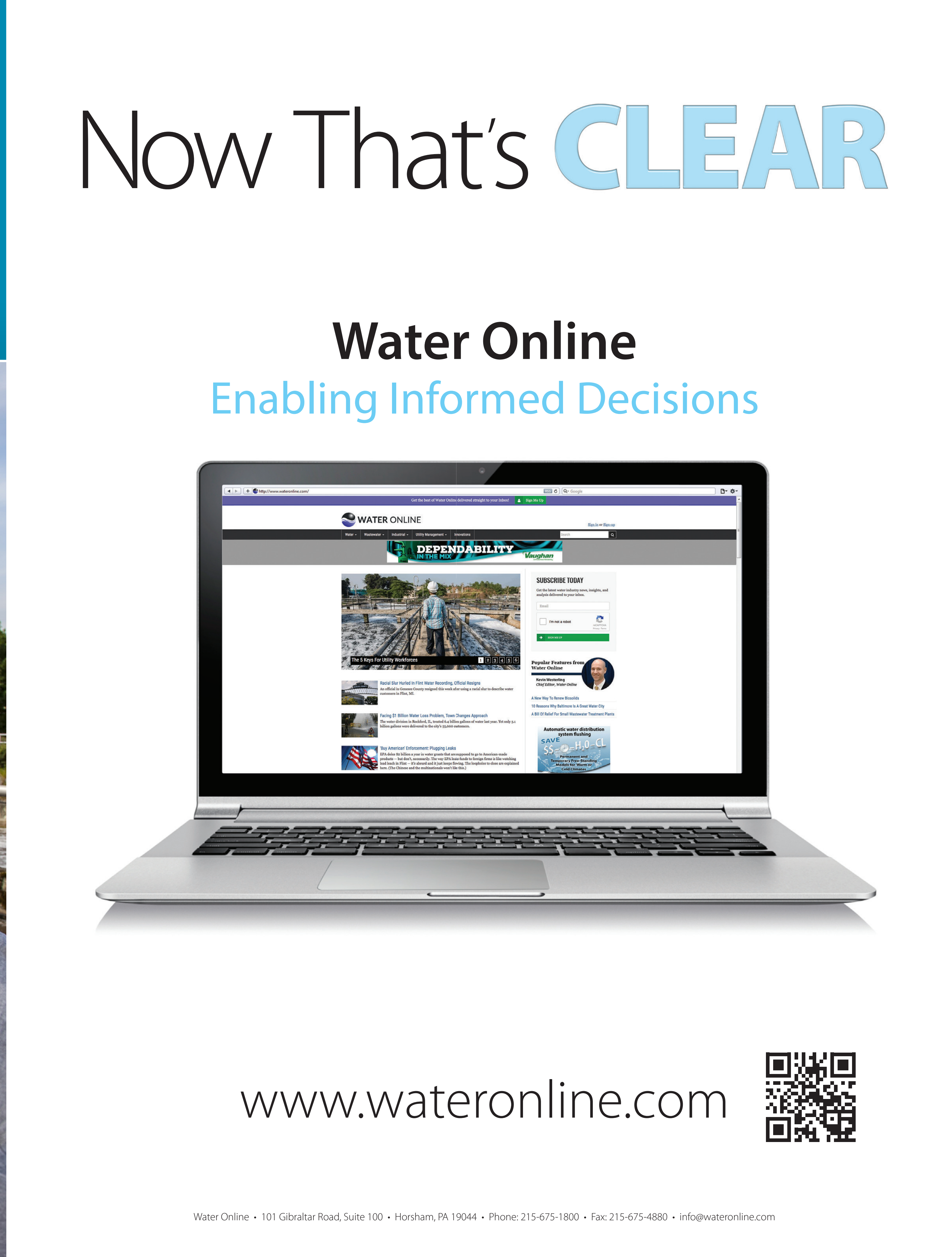
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