JANUARY 2024

Water Innovations

Top 10 Trends For 2024

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FROM THE EDITOR

By Kevin Westerling
Chief Editor, editor@wateronline.com

Water Trends, *Now And Then*

Even though this edition of *Water Innovations* looks forward into 2024, I'd like to use this space to look back on trends within the water and wastewater industry in 2023. We've just begun 2024 — and we're still in the thick of 2023's issues, since they didn't get resolved with the turning of the calendar. Furthermore, recent challenges inform future trends, as policy and technologies are devised and improved to confront the most pressing needs of the day.

So, let's look back for a minute before delving into the "Top 10 Trends for 2024."

To do so, I'll rely on *Water Online's* trusted readership and their most-clicked articles throughout 2023, a list we compile annually and share via our newsletter. You can find those results here, sorted by areas of interest, as I'll do for this overview.

First up is source water and drinking water treatment, and it's no surprise that articles on per- and polyfluoroalkyl substances (PFAS) were the most popular. In fact, the top three articles of the year discussed methods for treating these so-called (but not really) "forever chemicals." PFAS are sure to be heavily researched in 2024 as well, as proposed rules regarding maximum contaminant levels (MCLs) get finalized — which is why they also show up as a top trend for this year.

Moving to (or through) distribution systems, the most accessed articles had to do with asset management and condition assessment — the top three of which focused on "future-proofing" your distribution system, predicting issues through pressure data, and various digital strategies for mitigating leaks. What's next for drinking water conveyance? We see a trend toward plastic pipes, covered on page 26.

The interest surrounding wastewater collection systems revolved around two main themes: pump station failures (those pesky "flushable" wipes!) and combating inflow and infiltration that often contribute to combined sewer overflows. Instead of all that wastewater transport, turn to page 23 to discover why decentralized/onsite wastewater treatment systems are trending for 2024.

There was no such consistency to be found in the area of wastewater treatment, which indicates that there isn't a single dominant concern but rather ongoing research into best practices and systems for efficacy and efficiency. While that will remain true, there's a new frontier in wastewater treatment that involves a previously mentioned trend; see page 10 on the need and methodology for treating PFAS in wastewater.

Finally, under the umbrella of utility management, *Water Online's* top stories of 2023 were largely focused on consumer engagement, public perception, and customer service, which are closely tied, in this digital age, to advanced metering infrastructure (AMI). The continuing evolution of smart meters, examined on page 18, goes beyond revenue collection and into the realm of customer relations, or, you might say, relationship-building. As we go ever more digital, however, there is a concern over customers' personal information and cybersecurity — a trend covered on page 16 by Petra Trevino, customer service manager for the City of San Angelo Water Utility, who shares "The Key To Restoring Customer Trust After A Data Breach".

Petra joins a host of other *Water Innovations* authors who look to the future by discussing current trends, but 2023's stories and challenges live on and provide valuable lessons and context. As is often said, the past is merely prologue.

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What To Expect In ***Smart Water*** For 2024

North American utilities are getting wise to smart technology, with over $530 million in new projects calling out a data-driven focus kicking off in 2024.

By Allie Parks

Water and wastewater operators have a tall order to fill, tasked with ensuring some of the most critical community services run safely and effectively. For the past several years, North American water and wastewater systems have been plagued by aging infrastructure and challenges meeting staffing needs, exacerbating the already demanding job of maintaining essential services. These challenges, combined with a once-in-a-generation burst of funding from federal and state governments, have created conditions perfect for a rise in the adoption of smart water technologies.

What Is Smart Water?

The phrase "smart water" is used to describe a number of initiatives that utilize a data-driven approach to manage water and wastewater systems. These tools are typically designed to identify inefficiencies in water or energy use or to sound the alarm when water quality begins to deteriorate. In many cases, it is designed to take the manual work out of utility maintenance, alleviating pressures on staff. The strength of smart water comes from its ability to leverage real-time information directly to operators or consumers.

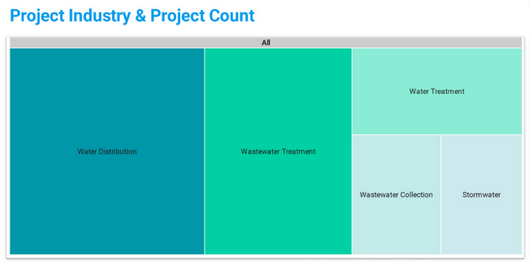


Figure 1: A breakdown of smart water projects by their larger industry. Water distribution is the largest segment, with smart meter and leak detection projects leading the pack.

Anticipated Spending

Just like the utilities themselves, our ability to understand utilities is evolving. We can now peek into the future of smart water initiatives by exploring the capital improvement plans of municipalities, districts, and authorities across North America in a structured format. These data are pulled from over 3,000 capital improvement plans, which house over 300,000 unique projects, representing trillions of dollars of investments. Sophisticated classification tools allow us to drill down on specific initiatives based on project titles, descriptions, start years, and overall budget to define funding plans for communities of all sizes.

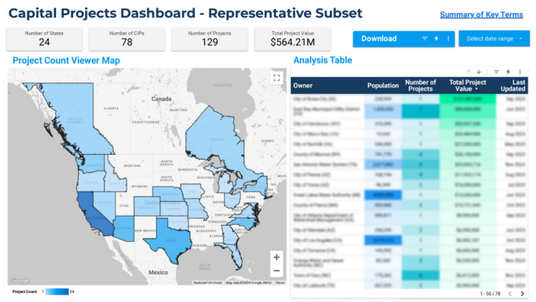
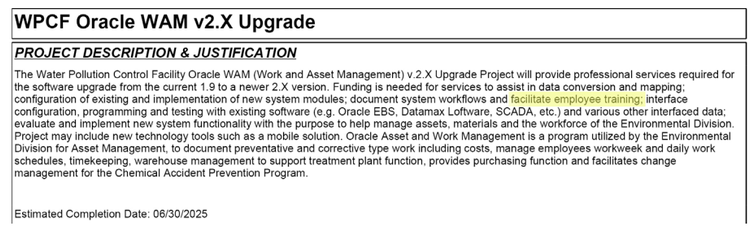


Figure 2: Geographic breakdown of data-driven projects. States with a significant number of projects mentioning "smart water," "real-time," or "data-driven" information are highlighted in blue, with darker shades representing more mentions.

Because smart water is broad and continually evolving, there are several ways to define these data, with the full North American market representing nearly $5 billion in spending. For the purposes of this analysis, we focus on infrastructure projects from capital improvement plans with a start date in 2024 mentioning "smart" infrastructure, "real-time," or "data-driven" solutions. By this definition, we drill down to 119 specific capital projects representing $534 million in spending for this analysis.

Advanced metering infrastructure (AMI) projects tend to be the most expensive and time-consuming. A $55-million AMI project in Nevada is the single most expensive smart water project kicking off in 2024, along with two additional metering projects in the top five. While some communities are brand-new adopters of smart meters, this technology was first introduced decades ago and made accessible to utilities in the early 2000s. In fact, the first generation of smart meters is now reaching the end of their useful life and requires replacement, further increasing the number of smart metering projects kicking off in 2024.



WPCF Oracle WAM v2.X Upgrade

PROJECT DESCRIPTION & JUSTIFICATION

The Water Pollution Control Facility Oracle WAM (Work and Asset Management) v.2.X Upgrade Project will provide professional services required for the software upgrade from the current 1.9 to a newer 2.X version. Funding is needed for services to assist in data conversion and mapping; configuration of existing and implementation of new system modules; document system workflows and facilitate employee training; interface configuration, programming and testing with existing software (e.g. Oracle EBS, Datamax Loftware, SCADA, etc.) and various other interfaced data; evaluate and implement new system functionality with the purpose to help manage assets, materials and the workforce of the Environmental Division. Project may include new technology tools such as a mobile solution. Oracle Asset and Work Management is a program utilized by the Environmental Division for Asset Management, to document preventative and corrective type work including costs, manage employees workweek and daily work schedules, timekeeping, warehouse management to support treatment plant function, provides purchasing function and facilitates change management for the Chemical Accident Prevention Program.

Estimated Completion Date: 06/30/2025

Figure 3: A snippet of text from a Nevada capital improvement plan (CIP) outlining software spending at their Water Pollution Control Facility, which will include an element of employee training.

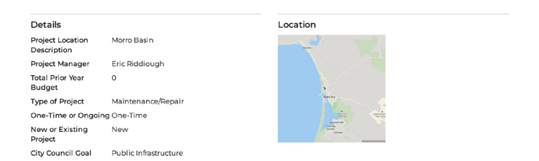
Regional Variations

The top three states by volume of smart water projects send a clear message: drier regions (where water loss consequences are most severe) are more invested in smart water solutions. California, Texas, and Arizona together represent 46%, nearly half of all projects calling for data-driven and real-time information. California has the most projects calling for smart water solutions, representing over 28% of all projects. A combination of high populations and drought-prone regions, along with a large amount of funding availability, have made California communities early and enthusiastic adopters of innovative solutions.

Interestingly, Ontario and British Columbia are the only Canadian provinces with any significant number of smart water projects planned for 2024. The dominance of opportunities in U.S. communities is likely in part due to the larger pool of funding made available through programs like the Infrastructure Investment and Jobs Act (IIJA) and the American Rescue Plan Act (ARPA), many of which specifically encourage spending on innovative technologies.

What Else Can We Expect From The Smart Water Surge?

The rise in smart water will also lead to new requirements for operators, as maintenance and understanding of these systems are critical. While many smart water innovations are designed to make the roles of operators more streamlined, requirements for employees to understand and continually adapt to new technologies will likely become a growing part of their positions. Employee training will need to be baked into these upgrades, as you can see in the example from a Nevada utility in Figure 3.



Morro Basin Wellfield Rehabilitation

Overview

Request Owner	Eric Riddiough, City Engineer
Est. Start Date	07/01/2024
Est. Completion Date	12/31/2026
Department	Water
Type	Capital Improvement
Project Number	New

Description

The Morro Wellfield Rehabilitation Project intends to address several potential vulnerabilities of the Morro Wellfield by implementing key infrastructure improvements to increase water production capacity, improve operational efficiency, and provide long-term reliability for the City's water production infrastructure. Currently, the project aims to rehabilitate the City's six active wells and install two new wells, though staff may recommend additional improvements upon completion of a needs assessment of the wells. The improvements to the existing wells will include rehabilitation or replacement of each of the following components: 1) Electrical, Instrumentation and Control (EI&C), 2) mechanical infrastructure; and 3) site civil and structural. The project components for the new wells will include: 1) well siting; 2) well drilling; 3) well equipping; and, 4) connection to the Brackish Water Reverse Osmosis Facility.

Staff is seeking grant funding from the U.S. Bureau of Reclamation's WaterSMART Drought Response Program. Once grant is obtained, work will begin on planning / engineering.

Details

Project Location Description	Morro Basin
Project Manager	Eric Riddiough
Total Prior Year Budget	0
Type of Project	Maintenance/Repair
One-Time or Ongoing	One-Time
New or Existing Project	New
City Council Goal	Public Infrastructure

Location

Figure 4: A snippet of text from a California CIP seeking funding through the WaterSMART Drought Response Program to bring a wellfield rehabilitation project to fruition.

Communities are also rising to the challenge of spending available federal and state funds on smart solutions. In the example above, a California city is seeking WaterSMART funding for improved operational efficiency at a wellfield.

The availability of funds will provide unprecedented access to some of the most innovative technologies on the market. As technologies get more advanced, available data become richer, creating a flywheel effect and further enriching utility operations. This technology renaissance makes the upcoming year an exceptional time to be in the water industry. ■

About The Author

Allie Parks is a senior solutions consultant at Citylitics, Inc., specializing in connecting infrastructure industry leaders to key municipal opportunities in North America. Citylitics delivers predictive intelligence on local utility and public infrastructure markets. The company's data engine transforms over a billion documents buried in 31,000+ cities and utility data sources into high-value intelligence for targeted business development.

Destroying PFAS In Wastewater To Help Safeguard Waterways

Technologies for the destruction of per- and polyfluoroalkyl substances (PFAS) hold promise, but also face challenges.

By Dr. Zekun Liu

There is growing concern about pollution from perfluoroalkyl and polyfluoroalkyl substances (PFAS), especially with a recent report that nearly half of all U.S. drinking water is contaminated.[1] U.S. industries are a primary source, having disposed of at least 60 million pounds of PFAS waste in the past five years.[2] Destroying PFAS at their sources is a critical first step to addressing this major environmental and health hazard. Addressing industrial wastewater is a solid first step.

PFAS are widely used synthetic chemicals with a powerful carbon-fluorine (C-F) bond that makes them highly resistant to heat, water, oil, and corrosion, leading to high environmental persistence. These properties also make them highly resistant to traditional water treatment strategies.

Common technologies used to treat wastewater, including granulated activated carbon (GAC) and membrane separation technologies such as reverse osmosis and nanofiltration, have at least three major shortcomings when addressing PFAS. First, though effective at removing long-chain legacy PFAS, these technologies have difficulty removing short- and ultrashort-chain PFAS. Second, certain emerging PFAS precursors (fluorinated compounds that break down into regulated PFAS compounds) can more easily pass through these separation barriers than the legacy PFAS, posing great challenges and unintended PFAS exposure in subsequent treatment. Lastly, these separation technologies do not destroy PFAS.

In fact, the way wastewater is currently treated can sometimes exacerbate the problem. For example, concentrations of PFAS have been found to be higher after treatment[3] in wastewater treatment plants, because PFAS precursors are converted into regulated compounds through oxidation.

One of the biggest challenges in destruction is ensuring that all PFAS, especially the overlooked short- and ultrashort-chain compounds, are treated. This is especially critical because a recent environmental analysis showed that more than 95% of all PFAS in the environment are shorter-chain PFAS compounds.[4] Short-chain PFAS are also in high demand in advanced manufacturing such as computer chips. In addition, new regulations are expected to focus on shorter-chain PFAS. All of this means that destruction methods that result in shorter-chain PFAS might not be relevant in the long run.

Five New PFAS-Destruction Technologies

Exciting new technologies have been developed to destroy PFAS.

Five especially promising technologies are hydrothermal alkaline treatment (HALT), supercritical water oxidation, electrochemical destruction, plasma-based water treatment, and photochemical defluorination.

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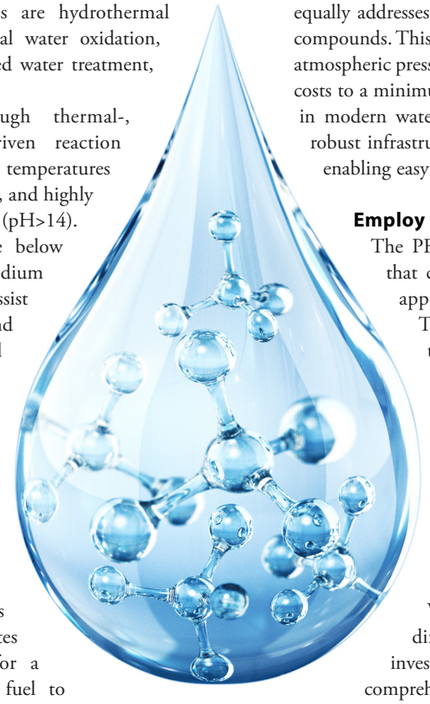

- ***HALT*** destroys PFAS through thermal-, hydrolysis-, and hydroxide-driven reaction mechanisms that require high temperatures (350°C), high pressure (<22MPa), and highly alkaline hydrothermal conditions (pH>14). These operating conditions are below the critical point of water. Sodium hydroxide (NaOH) is used to assist in the defluorination of PFAS and to avoid operating at supercritical conditions. High energy costs and component corrosion due to the harsh alkaline conditions are some of the potential drawbacks with this method.
- ***Supercritical water oxidation*** also uses high temperatures (374°C) and high pressure (22.1MPa) to induce a supercritical state that increases organic solubility and accelerates oxidation without the need for a reagent. This method requires fuel to maintain a sustained reaction, which drives up energy costs. The high pressure conditions raise concerns about safety and maintenance costs.
- ***Electrochemical destruction*** uses electrical currents for oxidation. It operates with ambient conditions and has low energy costs. These advantages are offset by some potentially major disadvantages, including potential generation of toxic byproducts and insufficient destruction of short-chain PFAS because of the limitation of mass transfer.
- ***Plasma-based water treatment*** uses high-energy electrical discharges to create ionized gas called plasma. The plasma converts contaminants in water into their constituent parts. Similar to electrochemical destruction, plasma-based water treatment suffers from insufficient destruction of short-chain PFAS compounds. Safety is also an issue because of the high voltages needed to generate plasma.
- ***Photochemical defluorination*** uses a combination of UV light and photosensitizer to break the C-F bonds of PFAS and convert them to naturally occurring, nontoxic elements. The unique advantage of this method is that it equally addresses long-, short-, and ultrashort-chain PFAS compounds. This method operates at room temperature and atmospheric pressure, keeping maintenance and operational costs to a minimum. UV technology is already widely used in modern water treatment plants, so there is already a robust infrastructure and a well-developed supply chain, enabling easy integration into current processes.

Employ Sustainable Solutions Now

The PFAS pollution problem is a global threat that can only be addressed by a two-pronged approach: prevention and remediation. Thankfully, there are efforts being made to ban future use of PFAS. However, PFAS are so ubiquitous and persistent that eliminating all of the PFAS already in the environment will take years, so it is important to scale up effective defluorination technologies as quickly as possible.

There is no one-size-fits-all approach to PFAS destruction that will work. Various technologies will be needed for differing applications. The keys are to invest in promising technologies, to require comprehensive and transparent testing to ensure the technologies perform as promised, and to ensure that the solutions are sustainable. ■

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Dr. Zekun (Zack) Liu obtained his PhD in chemical and environmental engineering from the University of California, Riverside. His doctoral research specifically focused on UV-based PFAS destruction and membrane separation processes. He serves as an editorial board member for research journals such as *Chemosphere* and *Journal of Water Process Engineering* on the topic of PFAS treatment.

Safe Water For All:

New Advancements In Monitoring Technology

As water management issues proliferate due to scarcity, contamination, and stricter regulations, monitoring solutions are rising to meet the challenge.

By Ellie Gabel

Water quality monitoring is crucial to ensure everyone has access to filtered, sanitized drinking water. It's becoming increasingly important as the population grows and climate change leads to water scarcity, contamination, and rainfall unpredictability. How are engineers creating innovative solutions to monitor drinking water?

Microbial Fuel Cell Biosensors

Researchers at Ritsumeikan University in Japan have invented a cost-effective way to monitor water quality in lakes and rivers. The device, which uses floating biosensors[1] to monitor freshwater quality, is composed of carbon-based materials and is a type of microbial fuel cell (MFC).

> **Inland freshwater resources are experiencing widespread decline, including issues with algal blooms, eutrophication, and high turbidity.**

The device's anode contains soil and electrogenic bacteria, which give off an electrical charge as they break down organic matter. The microorganisms produce more energy as the amount of organic water pollution increases around them. Their electrical charge powers an LED that starts flashing when the contamination level rises above a certain threshold. The light blinks faster as pollution rates increase.

Importantly, the device doesn't require a battery because it produces its own electricity. It shows promise as an early detection system for monitoring freshwater resources.

The OASIS Device

Students from the University of Bath in England have created a portable water quality sensor. Called OASIS — an acronym for On-site Aquatic Safety Inspection System — the device rapidly analyzes water quality and plots the results on a map. It combines water diagnostic tools with GPS technology to accomplish this feat.

Dipping OASIS in water triggers the device's electrochemical sensors, which can detect fluorides, nitrates, and chlorides. The sensors can also determine a water source's pH level, turbidity, and temperature. The results appear on the OASIS device and any connected smartphones. Device users can upload and share the results online.

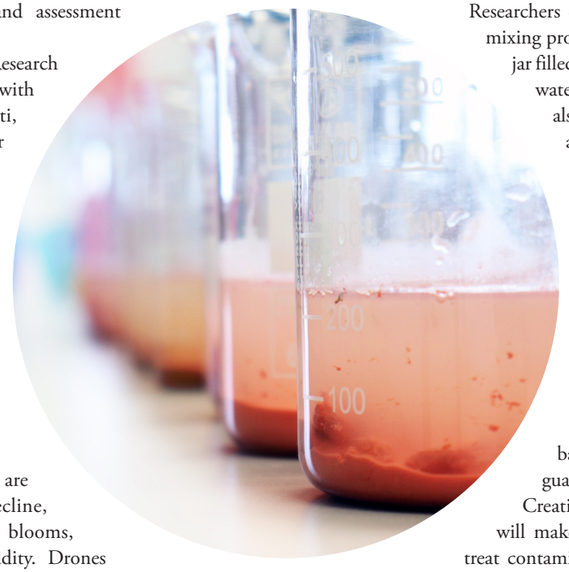
OASIS holds great promise for rural communities that use wells, which can often be contaminated. In some parts of the U.S., for example, around one in six wells[2] contains bacteria. The combination of quick, accurate results and GPS mapping from the OASIS device could give farmers and landowners valuable insights into the cleanliness of their water.

> **Creating new monitoring technologies will make it easier than ever to test and treat contaminated water, expanding people's access to water for drinking, cooking, and bathing.**

Satellite And Drone Imaging

Water isn't always easily accessible, especially in wilderness areas. Testing can be difficult and expensive. Now, however, the University of Alabama is creating software that will allow freshwater monitoring and assessment using satellites and drones.

With support from the Water Research Foundation and a partnership with the University of Cincinnati, researchers aim to produce water quality monitoring tools that resource managers can use in any setting. The project will use drone hyperspectral and satellite multispectral remote sensing technologies alongside on-location surveys. Once developed, this software could reduce the time and cost associated with monitoring inaccessible lakes and reservoirs.



Inland freshwater resources are experiencing widespread decline, including issues with algal blooms, eutrophication, and high turbidity. Drones and satellites will help gauge an ecosystem's health and detect anomalies in time to warn the public about water quality issues.

The Water Research Foundation has raised nearly $200,000 for the project[3] and expects to complete it in 2025.

A New Water Mixing Technique

Researchers from Texas A&M University have found an innovative way to monitor a key process of water purification — and fast. Untreated water often contains bacteria, viruses, and protozoans that are too small to be easily filtered out. Wastewater treatment centers use chemicals to form large clumps in the water, called flocs, to filter out pathogens in bigger quantities. This process is called flocculation.

Flocculation is a precise science. If the water and chemicals do not mix properly, the pathogens won't clump together very well — if at all — and could pass through the filters, contaminating drinking water. Mixing the water too intensely results in clumps forming but immediately breaking apart. Flocculation is also one of the most energy-intensive steps of water purification, so it's crucial to minimize errors to keep costs and carbon emissions low.

The new water mixing technique monitors the shape and size of flocs and water mixing intensity in one step, in real time, making it easier to take accurate measurements. This method would be useful to improve flocculation while minimizing energy use.

Researchers can non-intrusively monitor the mixing process by shining a green laser on a jar filled with water, highlighting how the water moves and forms flocs. They can also precisely control the reaction and analyze heterogeneities within the reactor, offering a way to optimize the process to create the right type of flocs. The technique could be profoundly useful for monitoring and addressing water quality issues within water treatment plants.

A Clear Path Forward

Fresh, clean water is a basic human right, but it isn't a guarantee — we have to procure it. Creating new monitoring technologies will make it easier than ever to test and treat contaminated water, expanding people's access to water for drinking, cooking, and bathing.

The world's water sources may be becoming more vulnerable, but scientists are making waves in the monitoring industry. ■

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Ellie Gabel is a science writer specializing in environmental science and innovative technologies. She can be reached at ellie@revolutionized.com.

SOARING ABOVE CHALLENGES:

Drone-Based Inspection And Maintenance Take Off

While drones first gained popularity among tech-forward hobbyists and video producers, they have since found use across various industries — including water and wastewater — to simplify asset management and O&M.

By Christian Bonawandt

Drinking water and wastewater utilities have long struggled to do more with less, be it workforce or budget. Gradually over the past decade or so, drone technology has begun to emerge as a valuable tool to do exactly that. Aerial, aquatic, and ground-roving drones allow operators to make observations efficiently while reducing physical risk. In addition, they can inspect difficult or dangerous areas without putting a human in harm's way. This is paying major dividends when it comes to inspection and maintenance tasks, providing utilities with efficient, cost-effective, and technologically advanced solutions. As drone technology continues to evolve, its adoption in the water sector is propelled by a host of advances that enhance the industry's ability to monitor, assess, and maintain critical infrastructure.

Advances In Drone Technology

Drones have evolved significantly over the years. Once flimsy devices with simple cameras, many boast robust frames and an array of high-end gadgets. Some of the critical advancements include:

- *Precision imaging and sensors.* Today's drone imaging technologies allow utilities to capture high-resolution imagery and employ specialized sensors for detailed inspections. Optical and thermal cameras, LiDAR sensors, and even water quality sensors provide a comprehensive view of infrastructure conditions, enabling utilities to identify potential issues such as leaks, structural damage, and variations in water quality.
- *Autonomous navigation.* The integration of autonomous navigation systems enables drones to follow predefined routes or adapt to changing environments during inspections. This feature is particularly beneficial when assessing expansive water infrastructure, as drones can navigate complex terrains, hover over waterbodies, and cover large areas efficiently, reducing the time and resources required for manual inspections.
- *Ground drones for challenging terrains.* In addition to airborne drones, ground-based drones are gaining prominence, especially for water utilities burdened by challenging terrain. These rolling drones can navigate through rugged landscapes, inspecting pipelines and infrastructure in areas that are difficult to access. Equipped with advanced sensors, these ground drones contribute to a comprehensive inspection strategy.
- *More durable designs.* Physical resilience is crucial in emergency response situations, where the ability to assess damage quickly and reliably can make a significant difference in mitigating the impact of incidents such as leaks or natural disasters. Drone manufacturers have developed products with impact-resistant polymers, reinforced frames, and corrosion-resistant coatings to enhance longevity and improve performance in difficult applications. In addition, sealed electronics protect sensitive equipment from unexpected contact with water.

How Water Utilities Are Deploying Drones

Drones are transforming the way water utilities inspect infrastructure. Whether soaring above water treatment plants or swimming inside underground pipes, drones provide a level of visibility that was once logistically challenging. Utilities can now quickly identify corrosion or other structural issues without the need for extensive manual labor or disruptive shutdowns. In addition, many water utilities are employing drones for:

- *Leak detection.* The speed and agility of drones make them ideal for rapid leak detection. Those with thermal imaging cameras can identify temperature variations indicative of leaks, enabling utilities to address issues promptly and prevent further water loss.
- *Vegetation management.* Overgrown vegetation around water infrastructure can pose significant challenges. Drones equipped with LiDAR and high-resolution cameras can create detailed 3D maps of the terrain. Utilities can identify areas requiring maintenance, preventing vegetation-related disruptions and ensuring the integrity of their systems.
- *Emergency response.* In the event of natural disasters or critical infrastructure failures, drones can rapidly assess the extent of damage, providing real-time data to aid in decision-making. This capability improves the speed and efficiency of emergency responses, ultimately minimizing the impact on communities and the environment.

Whether soaring above water treatment plants or swimming inside underground pipes, drones provide a level of visibility that was once logistically challenging.

Regulations Cause Turbulence

Drone use isn't all fun and games. For aerial drones, the Federal Aviation Administration (FAA) has tight rules on usage[1]. The Part 107 regulations, implemented in 2016, set forth guidelines for commercial drone operators, requiring them to obtain a remote pilot certificate, adhere to altitude and airspace restrictions, and conduct flights within visual line of sight, among other stipulations. Commercial drone operators are required to keep certain records related to their operations, such as maintenance logs and flight records.

To overcome this, many utilities are turning to consulting and service companies that offer drones as a service. Such firms absorb liability, training, certification, maintenance, and other costs, allowing water utilities to pay for the use of drones and the data collected from them on an as-needed basis.

As water and wastewater utilities continue to embrace drone technology, the industry is experiencing a paradigm shift in inspection and maintenance practices. The combination of advanced features, including precise imaging, autonomous navigation, and other capabilities, equips utilities with powerful tools to address challenges proactively. ■

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About The Author

Christian Bonawandt is an industrial content writer for *Water Online*. He has been writing about B2B technology and industrial processes for 23 years.

The Key To Restoring Customer Trust After A Data Breach

Public confidence can be hard to win back, emphasizing the need for secure systems as utilities grow more reliant on digital technologies.

By Petra Trevino

Data breaches have become an increasingly prevalent issue for local governments and utilities around the globe. These breaches not only lead to financial losses but also erode public trust — an unfortunate and challenging circumstance my team in San Angelo, TX, faced just a few years ago.

The City of San Angelo Water Utilities department serves a population of more than 100,000 residents. When our previous online payment system left us vulnerable to a data breach, customers and staff alike were impacted; frustrated customers were reluctant to make digital payments after the incident, causing a significant spike in manual workloads for the city. In the aftermath of our data breach, my team determined that we had a critical need for an updated billing and payment system that could provide the highest level of security and reengage residents who had abandoned digital options.

The Challenge

San Angelo's previous digital payment solution lacked the modern security features needed to properly protect our customers' sensitive payment data, resulting in a breach and subsequent concerns about online payments. However, even before this lapse in security, there were payment barriers impeding online payment adoption. The lack of modern payment options and the difficult user experience of the city's legacy payment system regularly increased calls to the office and created a complicated reconciliation process for our staff, draining resources, fueling customer frustration, and ultimately discouraging self-service.

After the data breach — a culmination of years of frustration — my team knew that if we were going to restore customers' trust, improve internal efficiencies, and prevent breaches from happening in the future, we would need to reevaluate the city's billing and payment system.

The Solution

It was imperative to revive our customers' trust in their city's digital payment system, but it was almost as critical that our new system removed all friction from the payment process and the process of enrolling in self-service options. We knew that addressing these two major concerns would help our key organizational goals — increasing self-service, decreasing call volumes, automating manual processes, improving customers' satisfaction scores, and more — come to fruition.

Once the San Angelo team implemented a solution that addressed the needs of our customers and was designed to meet our goals, the results were immediately noticeable. AutoPay enrollment has increased by 180%, and overall digital payment adoption has increased by 222%. This swell of adoption has helped reduce payment-related calls by 20% since implementing our new system and has done wonders for improving customers' relationships. Another critical self-service route, paperless billing, has skyrocketed by 163% since implementation, significantly decreasing the tedious bill printing and mailing process for our team. Today, we've eliminated over 15 hours of payment-related work a week.

None of this incredible adoption and the subsequent benefits would be possible without the restoration of trust among our customers. The San Angelo team was able to accomplish this by selecting a billing and payment solution that boasts double encryption and full PCI Level 1 Compliance, ensuring staff and customers never have to worry about the safety of information and payments. Sharing the security credentials of our new system, including its place on Visa's Global Registry of Service Providers, bolstered trust among our customers in the wake of the city's data breach, empowering us to encourage the record-breaking levels of digital adoption we have today.

Looking To The Future

The looming threat of cybercrime is only becoming more prevalent for municipalities like the city of San Angelo. For our water utility staff, peace of mind around the sensitive information we handle daily cannot be overstated. The restored sense of trust from our customers is heartening, staff is much more relaxed and able to better address customer needs, and the SaaS (Software as a Service) delivery model of the city's new payments solution means our system will remain secure, despite how cybercrime evolves in the years to come. ■

About The Author

In the last seven years serving as the customer service manager for the City of San Angelo's Water Utilities department, Petra Trevino coordinates and manages daily activities related to customer service in water/utility billing, work order requests, and customers' accounts. With full oversight of collection accounts relative to water utility services, Petra's mission is to establish customer service excellence through quality assistance with initiating water services, closing accounts, and addressing billing-related issues.

THE EVOLVING LANDSCAPE OF SMART WATER METERS

Although advanced metering infrastructure (AMI) technology has been around for some time, it is still on the upswing in terms of adoption and performance.

By Travis Kennedy

The digital water market has undergone a remarkable transformation in recent years, with smart metering emerging as a cornerstone. Eric Bindler, senior research director for Bluefield Research, recently spoke with *Water Online* about major changes taking place in the world of smart meters. Drawing from a recent research report, *The Global Water Metering Landscape*[1], Bindler stated, "Metering constitutes a substantial portion, around 40%, of the global market for digital water." This fact underlines the pivotal role smart meters play in the collection, management, and analysis of data, providing utilities with valuable insights into customers' behaviors and broader network conditions. The report indicates that global digital water spend will scale at a 7.8% compound annual growth rate (CAGR) from $26 billion in 2021 to $55 billion in 2030, amounting to $387 billion over 10 years. This growth will be fueled by a combination of technical advances and a shift in manufacturers' business strategies.

The COVID-19 pandemic and more recent semiconductor shortages highlighted supply chain vulnerabilities within the smart meter industry.

Expanding Meter Capabilities

Smart water meters are seeing a greater need for precision in order to meet the efficiency and sustainability goals of water utilities. Bindler explained, "The biggest trend we see is the move toward solid-state meters, whether electromagnetic or ultrasonic. These meters, devoid of moving parts, offer heightened accuracy, reliability, and durability over time, significantly reducing maintenance costs."

Moreover, Bindler highlighted innovative trends in hardware, such as the integration of additional sensors within residential meters. "Embedding pressure sensors, temperature sensors, or even acoustic leak detection capabilities within meters is gaining traction," he added. "This enhances the meters' functionality and provides utilities with a more comprehensive understanding of network conditions."

Data Demand Drives Software Developments

Metering-related software alone is expected to grow at 12.7% annually. A major driver is the focus beyond traditional billing toward proactive customer engagement. Bindler elaborated, "Smart meter data can be leveraged to build more proactive relationships with customers. Utilities can analyze individual water usage, identify potential leaks, and provide customers with personalized tips to reduce their water footprint."

This shift toward customer-centric approaches is accompanied by the development of sophisticated customer portals. Meter vendors are increasingly investing in customer-facing portals, offering users a comprehensive view of their water consumption. These portals offer value-added services and empower customers to make informed decisions about their water usage.

Moreover, the integration of meter data into broader distribution network management is gaining prominence. "Meter data can contribute significantly to leak detection, water quality management, and overall network understanding. This holistic approach allows utilities to manage their networks more efficiently," Bindler noted.

Meter vendors are increasingly investing in customer-facing portals, offering users a comprehensive view of their water consumption.

Innovation Through Acquisitions

The smart water meter market has experienced a significant reshaping due to mergers and acquisitions, with several industry players strategically joining forces. For example, over the past few years, Badger Meter broadened its portfolio to include water quality monitoring technology from Analytical Technology, Inc., as well as pressure monitoring through Syrinix. These acquisitions signify a broader vision by many smart meter suppliers to offer comprehensive solutions rather than focusing solely on traditional metering.

Such mergers and acquisitions are not merely business transactions; they are part of a collective push toward innovation and comprehensive solutions. "Companies are not just acquiring for the sake of growth but are strategically integrating new technologies, data analytics, and management capabilities into their portfolios, enhancing the value proposition for utilities," said Bindler.

Communication Diversity

Metering connectivity spending is expected to experience an 11.9% growth rate through 2030, according to the report. Much of this growth is fueled by growing options for communications technologies. While radio-frequency-based communications technology remains both relevant and highly effective, adoption of cellular-based metering is on the rise and poised to continue growing. Cellular technologies, such as NB-IoT, eliminate the need for dedicated infrastructure and have the potential to be cost-effective and scalable solutions.

However, Bindler noted that the landscape is diversifying with emerging technologies like Amazon Sidewalk, which uses existing Alexa and Ring devices and communication meter and other data. In addition, low-power wide-area networks (LPWAN) such as Long Range (LoRa) and Sigfox also provide utilities with alternatives, each with its own set of trade-offs, including signal penetration and dependency on external providers. "The industry is navigating a landscape of choices, considering factors such as cost, coverage, and signal strength," noted Bindler.

Supply Chain Vulnerabilities

It won't all be smooth sailing, according to Bindler. The COVID-19 pandemic and more recent semiconductor shortages highlighted supply chain vulnerabilities within the smart meter industry. Manufacturers often rely on third-party suppliers for batteries, chips, and other critical components. Supply chain shortages affect the production capabilities of certain companies. For the most part, however, manufacturers have not extensively explored proprietary battery or other component solutions.

The recent Infrastructure Investment and Jobs Act (IIJA) includes provisions like the Build America Buy America Act (BABAA) that encourages domestic sourcing. While this has the potential to reduce vulnerabilities by bringing more manufacturing capabilities into the U.S. or nearby regions, it can also limit supply chain diversity, creating or exacerbating future constraints. ■

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About The Author

Travis Kennedy has over 20 years of experience in the water and wastewater market and is the group publisher for *Water Online* and the host of the *Water Talk* podcast.

WASTEWATER TO BIOGAS: *From Trash To Treasure*

How U.S. wastewater treatment plants can learn from the example of others to transition into wastewater resource recovery facilities and create more sustainable, liveable communities.

By Jesper Køks Andersen and Zahra Khadir

Opting for biogas production from wastewater offers a spectrum of benefits, from environmental and economic gains to promoting technological innovation.

In Denmark, a country so small it could seemingly be tucked away into one of the Great Lakes, our approach to transforming wastewater into biogas extends far beyond processing. It gives Danish utilities economic advantages, energy security, and environmental benefits, and is part of our national strategy to reach climate neutrality. Embarking on a journey toward efficient wastewater treatment over 40 years ago, Denmark has dedicated itself to unlocking wastewater's full potential as a resource. This journey has placed our small nation at the forefront of developing solutions and practices to responsibly and innovatively recover the resources from our waste. In this process, Danish utilities have transformed how we view and utilize wastewater, from trash to treasure.

The Benefits Of Biogas Production From Wastewater

Now, let's explore why transitioning to biogas production from wastewater is a choice worth considering:

A source of renewable energy: Utilizing biogas means tapping into a significant renewable energy source. For wastewater utilities, this shift is a step toward greener operations, aligning with global environmental goals while minimizing their carbon footprint. This approach plays a crucial role in reducing greenhouse gas emissions, minimizing the ecological impact of waste management. Furthermore, utilizing digestate as a biofertilizer effectively closes the nutrient cycle, promoting sustainable agricultural practices.

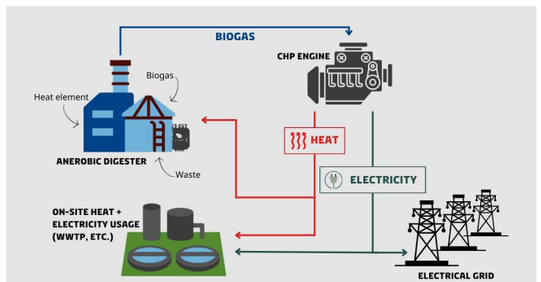
Economic advantages: Generating energy in-house can substantially cut operational costs for wastewater utilities. Moreover, the ability to sell excess energy offers a significant financial incentive, enhancing the economic feasibility of investing in biogas technology.

Energy security: Producing energy onsite means utilities are less affected by fluctuations in the energy market. This level of self-sufficiency is especially valuable, as it ensures a more stable and secure energy supply.

Opting for biogas production from wastewater offers a spectrum of benefits, from environmental and economic gains to promoting technological innovation. It's a holistic approach that positions wastewater utilities as leaders in sustainable practices and resource management.

Denmark's Historic Journey In Biogas Development

Denmark's journey toward harnessing biogas from wastewater treatment began in the early 20th century, with the first digesters being installed at Danish wastewater treatment plants in the 1920s. These early initiatives marked the start of what later became a resource-recovery evolution. The first digesters were installed to stabilize sludge, and the gas was merely used to warm up digesters.



Wastewater to biogas transformation - **Credit WTA**

Now, we produce biogas, electricity, and heat from sludge and recover nutrients and sand.

The 1987 Danish Aquatic Environment Action Plan was another important moment, addressing challenges like oxygen depletion in aquatic environments. This plan demanded a significant reduction in nutrient discharge from wastewater, which led to nationwide upgrades of treatment facilities. These modernizations not only met environmental standards but also accelerated the development of biogas infrastructure.

In recent years, the production of renewable biogas has become central to Denmark's strategy to reach climate neutrality by 2050, and to specifically reach climate neutrality for the water sector by 2030. The water sector's emissions are often overlooked. Yet water use, storage and distribution, and lack of wastewater treatment are responsible for approximately 10% of greenhouse gas emissions globally. The Danish government has backed up the ambitious targets with a range of incentives, including water sector emission reporting and subsidies for biogas technology development. The government's initiatives have contributed to making Denmark a global leader in this field.

From Wastewater To Clean Energy

In Denmark's advanced wastewater treatment processes, the utilization of sludge is strategic. By accumulating larger quantities in digestion tanks, we significantly enhance energy production through biogas. This method is not only about efficient waste management but also about maximizing energy recovery.

Our process carefully manages the aeration of wastewater. By employing precise control mechanisms and real-time online water quality measurements, we effectively reduce the nitrogen content in the water. Such attention to detail ensures that every step of the treatment contributes to a cleaner, more sustainable output.

Energy efficiency is a key focus, with the introduction of energy-efficient pumps improving the transportation of wastewater. We prioritize the strategic use of existing equipment, opting for upgrades over immediate replacements when feasible. This approach extends the life of our infrastructure while enhancing its efficiency.

Energy conservation is further maintained by improved insulation, reduced heating requirements, and the innovative use of heat pumps. We also recover heat from equipment like transformers, ensuring that no energy goes to waste.

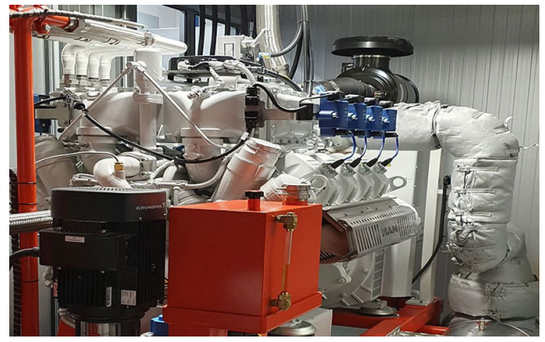
The Danish Method Of Biogas Production

Collection and pretreatment: Our journey begins with the collection of wastewater from various sources. The pretreatment stage is critical, involving processes like screening and sedimentation, and sometimes advanced techniques like thermal hydrolysis. These steps break down complex molecules, preparing the organic material for digestion.

Anaerobic digestion: At the heart of our process is anaerobic digestion. In an oxygen-free environment, specific microorganisms metabolize the organic matter, producing biogas rich in methane. We carefully maintain optimal conditions for microbial activity to ensure the efficiency of this stage.

Biogas upgrading and cleaning: Once we have the biogas, it's not ready for immediate use. It undergoes a cleaning or upgrading process, removing contaminants like hydrogen sulfide and moisture, and sometimes separating carbon dioxide to increase methane concentration.

Energy generation through CHP: Our use of combined heat and power (CHP) technology is a key highlight. These units efficiently convert biogas into electricity and heat, maximizing the energy content of the biogas and providing sustainable solutions for both power and heating needs.



CHP motor at Kishwaukee - **Credit Nissen Energy**

Digestate management: Finally, the process generates digestate, a nutrient-rich byproduct. This material is then used as biofertilizer, contributing to sustainable agricultural practices.

In summary, Denmark's approach to transforming wastewater into biogas is a combination of innovation, efficiency, and sustainability. Each step of our process reflects our commitment to environmental practices and sustainable solutions.

Danish Technology In Action In The U.S.

Transitioning from the benefits of biogas production, let's look at a practical implementation of Danish technology in the U.S. The Kishwaukee Water Reclamation District in the U.S. has taken significant steps toward sustainable energy. The Illinois facility has adopted a Danish-built CHP generator, using it to convert sewage into electrical power. This innovative application of CHP technology allows for efficient conversion of biogas, obtained from wastewater,

Damhusaen WWTP - **Credit State of Green**

Marselisborg WWTP II - **Credit Aarhus Vand**

into a source of electricity. The implementation of technology has gone beyond supplementing the facility's power needs. Kishwaukee has achieved a level of efficiency where it is capable of selling surplus energy to Meta's DeKalb Data Center, showcasing a successful and economically viable model of wastewater-to-energy conversion. The achievement not only highlights the effectiveness of Danish wastewater technologies but also sets an example for international collaboration in renewable energy and sustainable waste management.

In U.S. WWTPs, the opportunity for biogas production offers not just environmental benefits but also economic ones.

Exploring The Untapped Biogas Potential In U.S. WWTPs

Following the example set by the Kishwaukee Water Reclamation District, it's clear that the potential for biogas production in U.S. wastewater treatment plants (WWTPs) is significant yet largely underused. The U.S. EPA estimates that an impressive amount of digester gas — about 1 cubic foot from every 100 gallons of wastewater — can be produced, emphasizing the vast amount of untapped potential in this sector.

The energy generated from these WWTPs could potentially meet up to 12% of the national electricity demand, according to the EPA. This underexplored area in biogas production is more than just a solution for electricity generation; it offers a versatile energy source for heating and transportation fuel. Implementing innovative treatment methods could increase this efficiency, transforming waste management into a significant source of renewable energy.

In U.S. WWTPs, the opportunity for biogas production offers not just environmental benefits but also economic ones. By utilizing this technology, already effective in U.S. sectors like food processing and farming, these facilities could significantly reduce greenhouse gas emissions while generating a cost-effective source of renewable energy.

Investing in biogas technology isn't just about the present; it's about paving the way for the future. It promotes innovation and technological development, encouraging more efficient and eco-friendly energy production methods, and it sets a great example for other sectors to follow.

Bringing Danish Innovations To The U.S.

As we explore the potential for biogas production in U.S. WWTPs, the Water Technology Alliance (WTA) at the Danish Diplomatic Representations is willing to promote knowledge-sharing, partnerships, and exchange of best practices across the Danish and North American water sectors. If you're considering how Danish expertise could benefit your WWTPs, the WTA team in Chicago, Palo Alto, Houston, and Washington, D.C., is ready to assist. Feel free to reach out to our team for further information. ■

About The Authors

Jesper Køks Andersen is the consul general of Denmark in Chicago and head of water, where he leads the Danish Water Technology Alliance. With a strong background in the Danish Ministry of Foreign Affairs, Jesper specializes in export counselling for Danish businesses in the U.S. and has extensive experience in strengthening Denmark-U.S. relations, particularly in sustainable water management.

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The **FUTURE** Of Decentralized Onsite Wastewater Treatment Systems

Numerous factors coalesce to create a rising demand for decentralized solutions.

By Ashley Donnelly and Dennis F. Hallahan

Decentralized systems are a part of the nation's wastewater treatment infrastructure and play a significant role in protecting public health and the environment, and the future of the industry is promising. The decentralized system industry has greatly developed with new technologies, regulatory programs, and expanding professional organizations. On the horizon there continue to be many new challenges to face, including increased treatment limits, the implementation of regulations to address nutrients and contaminants of emerging concern (CECs), which are chemicals and toxics that have been found in waterbodies that may cause ecological or human health crises. Further, groundwater resources are quickly becoming depleted.

The good news is that managed aquifer recharge offers many benefits in this challenging situation. With the traditional practice of extending centralized sewers as a solution to wastewater challenges no longer taken for granted — being financially unfeasible in many cases — communities are turning to decentralized solutions. These and other challenges and developments will help realize a promising future for decentralized solutions.

Decentralized Industry Milestones

The decentralized wastewater treatment industry has made significant gains in the past, most notably in 1997 when the U.S. EPA issued a report to the U.S. Congress that stated: "adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals ..." This was a watershed moment for the decentralized industry. Prior to this point, nothing had been written about the long-term status of the industry, and onsite wastewater systems were only viewed as a short-term solution until sewers were available.

Key to the development of the industry and associated technologies since that time is a trained, professional base of onsite experts, including those benefiting from continuing education credits. Innovation in the form of advanced treatment to address nutrients was a huge step forward and is now the norm in many states with environmentally sensitive areas. Operations and maintenance (O&M), once the Achilles' heel of the industry, are now seen as critical to many decentralized system designs, and programs continue to evolve to ensure system performance and longevity.

Future Direction Of The Decentralized Wastewater Industry — An Ever-Evolving Landscape

Where the decentralized industry is going can be described by one challenge that we all face: change. Change is one of the realities that all people and businesses must embrace to remain viable. Businesses that haven't responded to change, such as video movie rental stores and suburban malls, fail. Changes in technology, pollution constituents, population, and climate will all shape the future of the decentralized industry.

Focus on Advanced Treatment to Combat Contaminants

Many states and provinces were slow to adopt treatment into regulation, but many have recently made the bold jump. From a

Operations and maintenance, once the Achilles' heel of the industry, is now seen as critical to many decentralized system designs, and programs continue to evolve to ensure system performance and longevity.

regulatory perspective, this is no easy step. The technologies are the easy part. It's the politics that can slow down the adoption of new approaches and the selection of the right solution for a community's problem. Community leaders and residents must first be convinced that there is an environmental problem that requires a new solution. Then the hard work of dealing with a disgruntled public that, wary of the sticker price of the necessary upgrade, requires education. Next, creating and funding an O&M program can add to the cost of treatment and complicate gaining approval.

Nutrients of Concern — Nitrogen, Phosphorus, PFAS, and Microplastics

Nitrogen

Nitrogen continues to be one of the major environmental challenges that communities face, including nitrogen reduction and higher overall treatment standards, as well as a series of new technologies introduced by manufacturers.

Phosphorus

Phosphorus has come to the forefront as the limiting nutrient in freshwater ecosystems. Regulatory requirements related to phosphorus have been introduced in Ontario, Florida, and New York, and this is just the beginning. In addition, more stringent regulations include the introduction of new effluent limits for CECs such as PFAS.

PFAS

While still new to many wastewater professionals, PFAS are hot on the radar screen and are a popular topic at all the major conferences. The EPA has set regulations for PFAS in drinking water, so it is only a matter of time before the EPA carries that guidance over to wastewater. These per- and polyfluoroalkyl substances stem from a large group of synthetic chemicals used in consumer products since the 1950s. PFAS have over 9,000 compounds and can be found in nonstick cookware, carpeting and stain-resistant clothing treatments, outdoor clothing waterproofing, and the material that makes dental floss slippery, to name just a few. Labeled "forever chemicals" because of their strong carbon-fluorine bond, PFAS are hard to break down by normal treatment processes. The health concerns are still being understood, but PFAS can remain in the human body and elsewhere in the environment for decades. The EPA says there are thousands of different types with potentially varying effects and toxicity levels. Researchers have linked them to reduced liver and kidney function, cancer, birth defects, and hormone disruption. Drinking water is considered a major pathway for human exposure.

Microplastics

Microplastics are another contaminant gaining national attention. These tiny particles of manufactured or decayed plastics from various sources have been found everywhere from the Arctic to U.S. tap and bottled drinking water. It is estimated that food intake results in the consumption of up to 52,000 microplastic fragments per person each year, and microplastics have even been found in human blood. The toxicity of plastics in the food chain and within our bodies can lead to numerous health disorders. Regulations have not yet been proposed for microplastics, but this is not far off. One benefit of decentralized systems with subsurface disposal is that the soils can be an effective filtering and treatment mechanism for these elements, reducing their impact on the water supply.

Innovative Decentralized Approaches

Replenishing large volumes of groundwater at point of source with managed aquifer recharge incorporating reuse at Gillette Stadium in Foxboro, MA

When the new Gillette Stadium was constructed in 2000, the wastewater treatment system was required to be upgraded according to current state codes. A wastewater treatment plant (WWTP) was designed for 250,000 GPD (945 m3/d) following a 680,000-gallon (2,575 m3) flow equalization tank to accommodate the 1 MGD (3,785 m3/d) design flow from the stadium during events. The wastewater is treated to a level acceptable for reuse for toilet flushing. The wastewater is then returned to the stadium for reuse when needed or discharged to subsurface disposal chamber beds installed below the parking lots for groundwater recharge.

Gillette Stadium

Changes in technology, pollution constituents, population, and climate will all shape the future of the decentralized industry.

Strict effluent requirements achieved with extended aeration wastewater treatment system at Lauloa Maalaea Resort in Maui, HI

With stringent effluent quality requirements and limited space onsite at the Lauloa Maalaea Resort in Hawaii, the engineer specified an extended aeration package wastewater treatment plant. To meet the new regulatory requirements and the design flow of 21,000 GPD, the extended aeration process selected for this system utilizes flow equalization, aeration, clarification, and disinfection.

The flow equalization chamber receives the incoming wastewater, then duplex pumps discharge the wastewater to the aeration chamber. Duplex positive displacement blowers and an air distribution manifold system supply air to the system, including air diffusers, airlift pumps, and a skimmer. The hopper-style clarifier has baffling to prevent short circuiting and to provide the maximum uniform solids settling area. The settled sludge returns from the clarifier to the aeration chamber through the positive sludge return system. Immediately following the clarifier is a chlorine contact chamber. The influent characteristics were typical domestic waste loadings, with effluent requirements of less than 20 mg/L biochemical oxygen demand (BOD)/total suspended solids (TSS).

Community WWTP upgrade utilizing passive, decentralized, onsite wastewater treatment in Newbury, NH

In 2001, the community of Blodgett Landing in Newberry was faced with the decision of investing in a wastewater treatment plant or upgrading the existing treatment system installed in 1959. For half the cost of a WWTP, the community decided to implement a passive treatment, denitrification, and dispersal system. An Enviro-Septic treatment system was specified for a design flow of 50,000 GPD. The Enviro-Septic pipe uses passive filtration with recirculation and bacterial ecosystems, eliminating the use of harmful chemicals or an external power source. The green treatment process enabled the community to protect its natural resources.

Construction of multilevel treatment beds. Wooden spacers are used to hold pipes during backfill.

The Bottom Line

One of the biggest limitations in the decentralized industry has been funding. While decentralized systems serve approximately 25% of the population, they received only a fraction of federal wastewater treatment and environmental funding. Fortunately, many years of lobbying by the National Onsite Wastewater Recycling Association (NOWRA) is beginning to turn the tide. While still not equivalent to centralized system infrastructure, there have been significant gains.

The future is looking bright for the decentralized industry, technology, rules development, and investment. The evolution of the decentralized industry is staggering, and this article only touches on some of the changes. Additional hot developments include sensors, automation, privatization, AI, contractor's equipment, and nonbiological methods of treatment. This is great news for the industry, as it offers opportunities for professionals, communities, and manufacturers. Most promising of all is the positive impact these developments will provide to the most important goal: protecting public health and the environment. ■

About The Authors

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Building Trust In The Age Of Plastic Plumbing

There is momentum for the use of plastic pipe in water distribution systems, but also some uncertainty. Standards have been put in place, however, to alleviate concerns.

By Nasrin Kashefi

Though plastic pipes have been used in water systems in the U.S. since the 1950s, the public commonly views them as a new material for drinking water systems where lead piping and other materials were previously used. Since the 1950s, knowledge about plastic pipes has only increased, and they are now becoming a key product in the water industry, as seen in their selection for projects being completed through the Bipartisan Infrastructure Law. As this material becomes more popular because of its durability and cost-effectiveness, manufacturers must be prepared to stand behind the safety of their products.

A Guide To Health And Safety Standards

The best way manufacturers can build trust in their products is to emphasize the health and safety standards in place and educate the public on them. These standards create streamlined requirements for various materials and products and provide a benchmark product quality level. The NSF standards process is accredited by the American National Standards Institute (ANSI) and Standards Council of Canada (SCC), developing standards through a public process with industry representatives, certification bodies, testing labs, regulatory officials, and end users. These standards are recognized worldwide and have been adopted in numerous countries, further adding to their credibility within the industry as mainstay standards of quality and safety. Standards that plastic pipes are tested to include:

- NSF/ANSI/CAN 61: *Drinking Water System Components — Health Effects*[1]
  A common question about plastic pipes is how they impact public health. First published in 1988, NSF/ANSI/CAN 61 establishes minimum health effects for any products that come into contact with drinking water. Products that fall under its scope include, but are not limited to, faucets, plumbing devices, tanks, gaskets, coatings, pipes, hoses, and fittings.

- NSF/ANSI 14: *Plastic Piping System Components and Related Materials*[2]
  NSF/ANSI 14 specifically covers quality aspects of plastic piping system components and related materials for potable and non-potable water. Established in the 1960s, product applications include drinking water, sewer piping, oil pipelines, cooling, gas, electrical conduits, and drain piping, just to name a few. These products are highly regulated through this standard as they undergo qualification testing, monitoring, facility inspections, and quality control testing. NSF/ANSI 14 also references NSF/ANSI/CAN 61 for potable water piping systems.

- NSF Guideline 533: *Ingredients Used in Drinking Water Products*[3]
  NSF Guideline 533 was launched at the beginning of 2023 as a solution for water product manufacturers to pre-qualify ingredients in the event of a product redesign, manufacturer backorder, or other delaying event. This new guideline increases the product formulation flexibility for certified products to use certified ingredients, allowing them to maintain their certification without having to undergo retesting, helping to affirm the product's safety.

End users can be assured that, as plastic pipes increase in popularity, 49 of the 50 states and 11 of 13 Canadian provinces or territories have regulations that require drinking water distribution products to comply with the NSF/ANSI/CAN 61 standard.

End users can be assured that, as plastic pipes increase in popularity, 49 of the 50 states and 11 of 13 Canadian provinces or territories have regulations that require drinking water distribution products to comply with the NSF/ANSI/CAN 61 standard. Additionally, both U.S. major plumbing codes require certification to NSF/ANSI 14 for plastic piping products. This shows how end users are protected when selecting these products for use in drinking water systems.

Verify Safety With Third-Party Certification

To help manufacturers create and maintain transparency for consumer trust, third-party certification bodies like NSF certify plastic pipes to these trusted industry standards. This type of testing is not new. Plastic pipe products have been third-party tested and certified to NSF/ANSI/CAN 61 in NSF labs, which have been testing for these materials in our drinking water systems since 1989. Third-party verification plays an integral role in building consumer confidence as it is an unbiased way to verify product claims, rather than having consumers rely only on manufacturers' claims. This adds another layer of credibility in proving a product's compliance to the standard's requirements.

In conclusion, manufacturers of plastic pipes must be prepared for questions about these materials, considering that in mainstream media they are still considered "new." Manufacturers can leverage the facts when educating the public about the safety of plastic pipes, emphasizing the trusted standards and regulations in place for these materials. Further, manufacturers can earn certification for their products to demonstrate that they meet the standard requirements and increase their competitive advantage in the marketplace. Through these tactics, manufacturers can be a guiding voice in helping consumers feel more confident in the drinking water system materials utilized in public and building water systems. ■

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A CAREER IN GIS:
HOW TO CREATE MORE OPPORTUNITIES FOR THE NEXT GENERATION

Whether for water quality, conservation, governance, stormwater management, resiliency, or a host of other needs, geographic information systems (GIS) are in demand, presenting an excellent opportunity to grow — and diversify — your workforce.

By Luis Olivieri, Lawrence Burden, Le'Aundra McCullough, and Ashley Pena

Geographic information systems (GIS) is a field that has become an essential tool in many industries, and the skills required to be a successful GIS professional have evolved over the years. There are a variety of ways organizations utilize GIS technologies, such as sharing information, communicating data, and performing analyses. However, the industry is dealing with the challenge of young adults not knowing what GIS is and how to secure a career in the field.

Raising Awareness About GIS

When it comes to choosing a career path, there is a lack of awareness and understanding on how many doors a geography degree can truly open. However, in order for the industry to continue creating a pipeline of successful GIS professionals and have a strong retention rate, there needs to be more exposure to the field and how GIS impacts so many different industries.

- ***Making GIS More Easily Understood:*** Those in the GIS field face challenges in raising awareness about what GIS is, as well as its value and benefits, because not everyone is familiar with what GIS can do, how it works, or why it matters. The first step utilities, businesses, and organizations can take is to explain GIS in simple terms by using examples or stories through interactive tools, such as web maps, that allow your audience to explore the data themselves. This can help them engage with the data, ask questions, and discover insights. You could also use videos, podcasts, or blogs that showcase how GIS is used in different fields, industries, or contexts.

- ***Providing Hands-On Experience Through Partnerships:*** GIS impacts real-world situations, so real-world experience is invaluable. Hopeworks — a social enterprise based in Camden, NJ, that uses technology, healing, and entrepreneurship to transform lives — partners with corporations to provide young adults with real-world experiences in the GIS field that they would not have been exposed to otherwise.

  Several years ago, Hopeworks partnered with New Jersey American Water to assist with its GIS needs. When the partnership began, Ashley Pena served as an intern with the project. Since then, she has been able to expand her expertise in the field and inspire other young adults to learn more about GIS and pursue a career in the industry. Before arriving at Hopeworks, Ashley did not know what GIS was, but through this partnership and providing hands-on experience, she found a career she is passionate about.

How Can We Create More Opportunities For The Next Generation?

- ***Looking Past the College Degree:*** In the past, most employers who were looking for GIS employees were focused on finding a candidate with a degree from an accredited university with a strong understanding of GIS. Over time, these employers started noticing that not all of their GIS personnel needed a higher education, but instead should be employees who could be trained for specific jobs, such as field data collection and data processing. Now, they are looking for candidates with a strong work ethic whom they can train according to their needs, taking them to a level that can be productive and meet their requirements.

  Hopeworks has developed a new pipeline to provide these candidates by taking young adults to the next professional level and furnishing them with the necessary skills and training. By doing this, those young adults are not just capable of finding better jobs but also of keeping those jobs.

  Innovative organizations across the nation who have talent needs should be thinking about other workforce pipelines to find their candidates, rather than going the traditional route of accepting an individual with a degree and some experience in the field.

- ***Identifying Opportunities for Women and BIPOC Individuals:*** Investing and identifying opportunities to develop women and BIPOC (Black, Indigenous, and People of Color) individuals' workforce skills will build a more resilient and adaptable workforce. Companies and municipalities need to ensure there are meaningful and different pathways that will lead to high-quality jobs and a supply of workers who have mastered the skills necessary to succeed.

  Retention of women in the industry is often hindered by a lack of proactive policies and an inequitable environment. Women are also not always offered the same opportunities as their male counterparts, which is an additional challenge to retention. This can be addressed by increasing training opportunities and offering mentorship programs.

- ***Establish Mentorship Programs:*** Establishing a mentorship program provides the opportunity to have experienced GIS professionals guide and inspire young adults who are interested in pursuing a career in the GIS field. The mentors can provide real-world experience and advice that can be instrumental in developing their skills and shaping the future.

Building A Career In GIS Through Workforce Development Programs

GIS has become an essential tool across various industries, from urban planning and environmental conservation to health services and transportation. Building a career in GIS can offer promising opportunities, especially with the rising demand for spatial data analysis and geospatial intelligence.

Choosing to build a career through workforce development programs offers unique benefits, including practical training, mentorship, and connections to employment opportunities. These programs are designed to equip individuals with the necessary skills for specific job roles in the market, such as GIS technician, GIS analyst, and so on. Alongside the theoretical knowledge, practical applications are emphasized.

Hopeworks created a GIS program as part of its business, providing young adults the opportunity to learn basic concepts of GIS through training and real-world experience through their partnerships, such as New Jersey American Water and the city of Camden. The young adults also get the opportunity to utilize ESRI software for their projects. When the young adults enter Hopeworks, they may not have awareness of the GIS field, but through the program, they learn what it is and what they can expect if they pursue a career in the field. In addition to learning about GIS, they learn about the skills and strengths they need for any career path, such as responsibility, how to talk to their supervisors, paying attention to detail, following detailed and complex instructions, critical thinking, and problem solving. When Hopeworks' young adults apply for a job, all this puts them ahead of other candidates and makes them more appealing to potential employers.

Several years ago, the U.S. Department of Labor identified geospatial technologies[1], which includes GIS, remote sensing, and global positioning systems (GPS), together with biotechnologies and nanotechnologies, as the three fastest-growing technologies. The opportunity is now. It is a great time for young adults to engage with a career in GIS — the tools are more accessible and more powerful than ever. And with technology capable of processing and analyzing increasingly complex data sets, the GIS employees of the future can address challenging problems of both small and large scales more effectively. ■

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About The Authors

Luis Olivieri is the director of GIS at Hopeworks in Camden, NJ, a nonprofit that for over 20 years has used an advanced training curriculum, working with youths 17-24 to get them back in school and find a safe pathway to their future. He has worked for 16 years as a professor in the areas of GIS, remote sensing, and GPS at different universities and colleges, including the University of Puerto Rico at Mayaguez and Rowan University.

Le'Aundra "Lily" McCullough is currently a Hopeworks GIS team lead. During her two years in this position, she has worked to ensure the completion and accuracy of projects. Starting out as a trainee at Hopeworks in 2013, Lily completed internships in the web department and GIS, gaining the experience that allowed her journey to come full circle and become a full-time staff member.

Lawrence Burden, senior director of career programing at Hopeworks, is an experienced coach, youth development professional, and organizational leader. He leads the Hopeworks youth development team and was recently recognized by Governor Phil Murphy for his expertise by being selected for New Jersey's prestigious Workforce.

Ashley Pena is a GIS analyst for New Jersey American Water, the state's largest water and wastewater services provider. She joined the company in 2021, after serving as a GIS intern with New Jersey American Water through its partnership with Hopeworks since 2020. Ms. Pena served as a GIS intern and trainee with Hopeworks for a total of four years. In addition to receiving career and technical training through Hopeworks, Ashley attended Camden County College. She is a Camden resident.

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