MARCH 2022

Water Innovations

THE ROAD TO NET ZERO

How The Water Sector Can Help Pave The Way

PLUS:

New Cybersecurity Initiatives

Rethinking Optimization

Understanding CMAR Project Delivery

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EDITOR'S LETTER

By Kevin Westerling
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100 Days And Many Ways To Cybersecurity

A Q&A with Riggs Eckelberry, founder and CEO of OriginClear, on the need to improve cybersecurity at water and wastewater utilities, which has elicited action from the Biden administration and everyday operators alike.

As water and wastewater utilities adopt digitalization more readily — a good idea, overall — it unfortunately leaves them (and the public) vulnerable to cyberattacks. In recent years, municipal drinking-water operations in Florida, the Bay Area, and Baltimore have been threatened, as have wastewater operations in Maine and California.[1] And as more systems go digital, the number of attacks is bound to follow suit, creating more likelihood for a tragic event.

In response, President Biden announced the Water Sector Action Plan in January, "to facilitate the deployment of technologies and systems that provide cyber-related threat visibility, indicators, detections, and warnings." The plan brings the Industrial Control Systems (ICS) Cybersecurity Initiative that was launched for the electric sector[2] in August 2021 to the water sector; and, like its predecessor, it aims to shore up and protect operations within 100 days. The sooner the better, to be sure, but is it enough?

I spoke with Riggs Eckelberry to get his thoughts on cybersecurity from the perspective of a company leader who earned renown for turning struggling companies around after the dot-com crash. He then turned his entrepreneurial spirit into a biofuels business that has since expanded into water recycling, using the same idea that extracts oil from algae to retrieve water from sewage.

Keenly aware of infrastructure issues, the need for source-water protection, and available funding mechanisms (or lack thereof), Riggs brought his innovative-but-practical mind to bear on the subject of cybersecurity in the following Q&A.

President Biden recently released a 100-day action plan to protect our water systems from cyberattacks. Why is cybersecurity now getting such attention?

Whenever you think of security, you have to think of the points of greatest vulnerability. And because the water industry is extremely ubiquitous, and greatly based upon infrastructure that was built over the last hundred years, it is vulnerable. So it makes sense to reinforce this point of vulnerability.

Do you think the plan sufficiently addresses the threats specifically posed to the water industry?

The plan is very similar to what the administration has done for other utility sectors. The problem is that the federal government's contribution to water utilities has been on a steady downtrend path since the '70s, and utilities are already under pressure to meet ever-stricter water quality standards. So without additional funding, the initiative is likely to fall short.

What aspects of water/wastewater operations are most vulnerable to hackers? What could cause the greatest harm?

The greatest harm could occur at a choke point such as tertiary treatment, or denitrification, which tends to be concentrated in one location. Other locations are more spread out and might not be as vulnerable.

What suggestions would you give to utilities to secure these high-risk areas?

Upgrading controls to current technology is about the only thing that can be done. It's not a simple solution, but I don't think it can be avoided.

Is cybersecurity a DIY effort, or does it typically require outside expertise?

Remember when the government attempted to build the Affordable Care Act database? It simply was not feasible for the government to do in-house, and it finally worked when Silicon Valley was brought in to help. I think we need the same kind of "Manhattan Project" approach to support water. We need to move beyond the complacency about water that seems to exist and create a sense of urgency so that security actors would jump in. That requires making water treatment and management more high profile — and even "sexy," which is a challenge!

Is lack of funding an impediment to implementing cybersecurity? How can that be overcome?

There's no question that the water utilities are chronically underfunded. So, yes — we need to think about how we overcome that. Perhaps it's done with donated efforts by security interests, assuming they can see some public-relations benefit. Really, it's about the water industry getting out of its shell and promoting itself.

What role can distributed water treatment play in the fight against cyberattacks?

Since a landmark study was done by Lux Research in 2016, which I wrote about for *Water Online*,[3] it's been obvious that decentralization of water treatment is not only a good idea but also inevitable. It will put the onus for cleaning water on the people who make it dirty in the first place and also will tend to unload the excessive burden on central utilities that have been underfunded for so long as to their infrastructure needs.

This decentralization or distributed water treatment is also a really, really good idea for cybersecurity. Remember, the internet was originally built by DARPA [Defense Advanced Research Projects Agency] to provide a failsafe computer network. By making the nodes in the network less dependent on each other, the critical technology infrastructure could withstand the greatest threat at the time, which was nuclear attack.

Cybersecurity is no different. By spreading out water treatment and water management, we reduce the choke points and the interdependency, and any local attack can be isolated to that point.

OriginClear has been implementing a new DBOO, or Design-Build-Own-Operate, capital program. How can this help in the fight against cyberattacks?

Historically, DBOO has been implemented for larger applications such as desalination plants for entire islands. But this private utility model is very useful for individual businesses that might not have a capital program for their own water system and also lack the expertise. That's the new program we call "Water On Demand." By solving capital needs and providing a fully outsourced managed service, we also can provide very high-quality site management and modern protection against cyberattacks.

What predictions do you have for the future of cyber-threats, cybersecurity, and cyber policies?

Security is always best carried out in layers and also with maximum isolation of network nodes. For this reason, I really see the trend toward decentralization of water treatment and water conveyance as being the most productive solution for effective cybersecurity. ■

Read the White House Fact Sheet on the 100-day Water Sector Action Plan.

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RETHINKING OPTIMIZATION FROM PLANNING THROUGH LONG-TERM OPERATION

"Optimization" isn't a new word in the water sector, but it has a broader meaning now as utilities plan for the future.

By Christine deBarbadillo

Most treatment facility owners and operators recognize the importance of optimizing operations efficiency. Making the most of existing treatment is a proven way to expand capacity and/or improve performance, so optimization is well-known and long-revered as an important strategy in that respect.

But not everyone realizes that optimization has a much broader application. More widely applied, it can help utilities meet new environmental regulations, adjust to workforce changes, and manage capital investments and operating costs. Every aspect of facility planning, design, operations, maintenance, asset management, and data management is impacted by the others, so coordinating and integrating myriad aspects of facility management is crucial (Figure 1). In a fully optimized plant, all components are working together and complementing one another for successful long-term operation.

Enhanced Operational Efficiency

The water sector continues to focus on operational efficiencies to enhance performance reliability and reduce consumption of resources such as energy and chemicals, but new directions and practices merit mention.

Selecting treatment strategies that reduce consumption of resources is a foundational opportunity to optimize a facility. Strategies that direct more organic material from wastewater toward anaerobic digestion, where it can be converted to biogas, potentially reduce the energy required for aerated biological treatment processes and provide a renewable energy source. Incorporating more resource-efficient microorganisms such as anaerobic ammonium oxidizing bacteria (anammox) into the treatment processes furthers the potential for optimization.

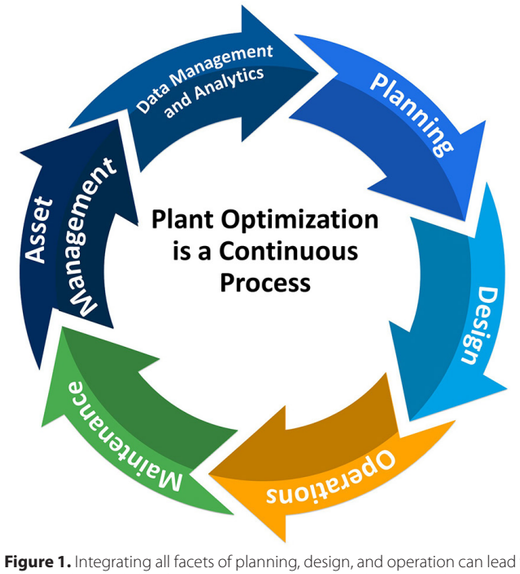

Figure 1. Integrating all facets of planning, design, and operation can lead to optimized and reliable facility optimization *(Credit: Black & Veatch)*

It's important to consider the impacts of mechanical and electrical design choices on efficiency over the life of the facility. The design life of treatment facilities often projects 20 years or more into the future. However, equipment that is sized and selected for efficiency at a future design capacity may operate inefficiently under conditions of lower wastewater flows and loads, thus increasing energy demands relative to the level of treatment in the near term. Incorporating appropriate new processes and tools into planning and design and simultaneously considering operation and asset management for the full life of the facility is a challenging, but essential, balancing act.

Although many designers are already mindful of how designs affect future maintenance, the true costs and challenges of maintenance are often not fully realized until well after commissioning. What's more, the results and feedback don't always make it back to the design and planning teams. Knowledgeable engineers enhance designs by incorporating risk-management practices such as hazard-and-operability review (HAZOP) and failure modes, effects, and criticality analysis (FMECA) results into facility designs or upgrades. The quality of 3D models and building information modeling (BIM) and the ability to link equipment information can provide an intuitive way for operations and maintenance professionals to access equipment data and other information.

A membrane aerated biofilm reactor (MABR) is a promising new biological nutrient removal (BNR) technology that offers optimization opportunities through process intensification. MABRs can help utilities reduce energy costs and simultaneously increase treatment capacity and process sustainability for BNR. *(Credit: Black & Veatch)*

Recognizing the need for guidance on the wide range of nutrient control techniques, The Water Research Foundation in 2020 launched "Guidelines for Optimizing Nutrient Removal Plant Performance" (WRF project 4973). The resulting roadmap will help water resource recovery facilities (WRRFs) optimize nutrient removal to reduce costs, increase efficiency, and reduce nutrient discharges. Researchers have already conducted a series of webinars about optimizing existing nutrient removal facilities to improve reliability and reduce costs and discharge concentrations. The project team will incorporate operational best practices and full-scale experiences into nutrient optimization guidelines to yield a roadmap for optimized operation.

Treatment Technologies

Recent trends in optimization practices include innovations in process intensification to increase the capacity or level of treatment achieved in a given site's footprint. Historically, owners and operators often have accomplished this through strategies that tend to increase the mechanical complexity of treatment facilities. More recently, the water sector has focused on doing so through better understanding of treatment mechanisms. Advancements in analytical methods of identifying microbial ecology and how microorganisms actually function in a given environment have substantially contributed to this enhanced understanding.

As one example, WRRF process engineers and operators are increasingly focused on optimization of performance, capacity, and space through a better understanding of biofilms. Although treatment plants in the U.S. have used biofilm processes — including trickling filters, biologically active filters, moving bed biofilm reactors, and integrated fixed-film activated sludge processes — for years, suspended growth activated sludge systems have been the mainstay. However, research and practical experience have shown that the organisms that remove pollutants from wastewater grow not only under different environmental conditions, but also at different rates. This necessitates the development and adoption of new ways to promote growth and retain slower-growing biomass in the treatment system.

The water industry is rising to this challenge by developing and commercializing processes and products to promote the growth of denser flocs or biofilm granules in activated sludge processes, applying deammonification processes using anammox biofilms in mainstream wastewater treatment, and combining an efficient aeration strategy with biofilm processes in membrane aerated biofilm reactors (MABRs). The key drivers behind this work are twofold: (1) to optimize and reduce space and costs, and (2) to optimize the use of resources. The application of MABR technology provides not only a reduction in reactor volume but also an enhanced means of delivering oxygen to microorganisms, which in turn reduces energy costs.

Under the U.S. EPA G2020-STAR-A1 program, The Water Research Foundation is managing a collaborative project team comprised of several utilities and universities to better understand the microbial ecology and establish design and operating conditions needed to apply partial denitrification/anammox (PdNA) process strategies for efficient mainstream nutrient removal (WRF project 5095, "Mainstream Deammonification with Biological Phosphorus Removal"). This process can reduce the reactor volume needed for

nitrification (oxidation of ammonia to nitrite) while employing slower-growing anaerobic ammonium-oxidizing bacteria on biofilms that use both nitrite and ammonia to achieve nitrogen removal. It therefore minimizes energy consumption and the need for dosing chemicals.

Data Management And Analytics

The world has greater access to data than ever, but the water industry is still developing data collection, management, analytics, and controls to more effectively use those data to inform decision-making across all management and operational functions. Many treatment facilities have centralized supervisory control and data acquisition (SCADA) systems or distributed control systems (DCS) for plant process and equipment control. Operators monitor equipment for status and performance, with perhaps thousands of signals collected as unique data points in the control system that can be stored in a data historian. Separately, and often manually, combining key operating data such as wastewater flows with laboratory data in spreadsheet software to develop trends for process analysis can be very time consuming. As a result, much of this data is relatively untapped to support decisions that would enable higher levels of performance and control. Recent advancements that leverage business-intelligence tools offer an opportunity to save time extracting, transforming, visualizing, and analyzing data for faster and more meaningful performance monitoring.

Data management platforms that serve as a datahub using inputs/data from the SCADA or DCS, laboratory information management systems (LIMS), and computerized maintenance management systems (CMMS) enable more efficient combination of these datasets for dashboards, tracking of key performance indicators, automated reports, and saving staff time for other things. Facility-specific systems can provide real-time (or frequent) updates for management and operations staff.

Once collected and organized, advanced analytics can identify trends and predict outcomes that in turn provide opportunities to optimize the performance of equipment and processes. Utilities are also starting to incorporate digital twins for asset management and/or wastewater processes. Advanced equipment monitoring and data analytics yield insights into equipment health and performance that maximize prioritization benefits.

Asset Management

Asset management is key for optimizing capital investments in treatment facilities. Taking care of equipment and infrastructure to ensure that it performs as required for the full design life of the facility is essential to managing cost and risk. A data-driven mindset is essential in this regard. Utilities continue to develop monitoring programs to collect the right data, populate maintenance management systems, and track and analyze data to facilitate better decisions. After implementing asset-level likelihood-of-failure and consequence-of-failure metrics, asset condition assessment procedures, and onsite condition assessment of critical assets at its largest treatment plant, the Hampton Roads Sanitation District has nearly completed the process at its other plants as well. Real-time asset management dashboards were developed to provide easy access to selected performance data at the overarching facility and asset levels. Various groups within the organization can easily harness the asset management data to inform workflow improvement, asset maintenance, replacement planning, capital planning, and regulatory compliance.

Looking outside the water industry has helped — and can continue to help — water utilities advance asset management practices for facility optimization. Development of ISO standards demonstrated the value of collaboration across industries and countries for effective asset management. There is room to learn more from manufacturing, electric, gas and oil industries, particularly with their advanced monitoring and diagnostics of asset health.

Planning

Utilities are continuously challenged to balance many demands on resources and must find ways to cost-effectively upgrade aging infrastructure and maintain high levels of service. A focus on innovation and best-value solutions is critical to making the most of assets. In a recent project, the Miami-Dade Water and Sewer Department (MDWASD) leveraged an aggressive value-engineering approach with innovative design that provided cost savings of more than $300 million for capital projects and O&M efficiency savings of $3 million annually at the county's treatment facilities. Through a pilot program with Black & Veatch, MDWASD demonstrated that newer, less-expensive filtration technology would comply with Ocean Outfall Legislation Program's requirements while providing significant savings. Reducing costs and nutrient discharges to the ocean optimizes resource management.

Full-Facility Optimization

Optimization is a proven way to enhance water resource recovery and sustainability. Incorporating water resource recovery processes that reduce energy, chemicals, and/or costs through initial design or subsequent improvements continues to be important, and emerging tools such as process intensification through biofilm technologies can also help communities meet new environmental regulations, adjust to workforce changes, and manage capital investments as well as operating costs. But within the water sector, there's an overall refocus on the bigger picture as exemplified by increasing use of "One Water" and watershed management strategies. This integrated-solutions approach also applies to optimization practices and creates valuable synergy across the myriad aspects of facility management. Long-term operation is most effective when all components work together in a fully optimized facility. ■

About The Author

Chris deBarbadillo, PE and ABC class IV wastewater operator, is an associate vice president and plant optimization practice leader for Black & Veatch. In this role, she helps water resource recovery professionals develop and implement strategies that optimize projects at each stage of their lifecycles, from assessments and planning through technology selection, process design, and project implementation with long-term operations in mind.

ENVIRONMENTAL RACISM IN AMERICA:

How It's Affecting Vulnerable Communities

The history of decisions that have led to environmental pollution, with impact on some more than others, calls for corrective measures to atone for the injustice.

By Jonathan Sharp

Environmental racism is a kind of systemic racism in which industrial facilities are located in low-income neighborhoods, particularly communities of color. This results in a polluted environment, which frequently results in health problems such as asthma, the most prevalent chronic disease in the U.S., impacting over 6 million children. In comparison to white children, black children are disproportionately harmed since studies found that they are 79 percent more likely to reside in communities where industrial pollution is thought to pose the highest health risk.

Fossil fuel facilities are suspected of contributing to increased death rates in these areas because of exposure to the pollutants they create. Before environmental racism was widely acknowledged, a report by the U.S. General Accounting Office in 1983 studied the race distribution of persons in hazardous waste settings, including landfills and power stations. They discovered that 75 percent of the areas located near hazardous landfills had a predominance of Black residents. Affecting climate change can be possible only if we are aware of and address how socioeconomic disparities relate to it. In order to present the full narrative of climate change, we must first recognize that it isn't an issue that impacts everyone equally, but rather one that has a bigger impact on people who are suffering from other challenges.

What Exactly Is Environmental Racism?

When we talk about environmental racism, we are talking about how people of color are often forced to bear more of the burden of environmental hazards than white and higher-income groups. This discrimination is frequently systemic, as a result of inadequate or poorly enforced laws and regulations for polluting sites located in or near lower-income communities of color.

People of color are more likely to be exposed to a range of dangerous pollutants than white and higher-income populations, leading to much higher rates of major health issues in communities of color, including cancer, lung disorders, and heart attacks, as well as a greater prevalence and severity of asthma and lower birth weights, and a higher prevalence of hypertension.

While uncovering the diverse effects of poverty and race may be difficult, a growing body of research points in one direction: Oftentimes, race serves as a more trustworthy indication of pollution proximity than economic success alone. According to 2018 research done by U.S. EPA experts, individuals of color have a 28 percent greater health burden than the overall population as a result of living near businesses that release particle pollution. To be sure, community wealth is frequently a determining factor in environmental policy, particularly when it comes to land use, zoning, building permits, and regulatory enforcement. As a result, low-income families of all races are exposed to higher levels of pollution than wealthier ones.

How It's Impacting Vulnerable Communities

When fossil fuels are burned, hazardous pollutants such as fine particles and ground-level ozone are released. Carbon dioxide and other greenhouse gases generated as a result of this process intensify the greenhouse effect and contribute to climate change. Nitrogen oxides, sulfur oxides, and carbon dioxide are produced during the burning of oil and coal, as are hydrocarbons, lead, soot, and heavy metals. Surface coal mining operations such as strip mining and mountaintop removal result in the discharge of hazardous substances such as heavy metals and arsenic. By contaminating streams, these chemicals pollute communal groundwater. Chemicals used in natural gas production, notably fracking, are dangerous and are often kept in open-air waste pits, where they release poisons into the air. These hazardous compounds have a detrimental effect on human health, inflicting both physiological and psychological suffering.

Particles generated by fossil fuel burning can remain in the atmosphere for weeks and travel hundreds of kilometers. When we breathe, toxic particles enter the lungs and are transported into the blood stream. Global climate change, according to the United Nations, is already responsible for 400,000 premature deaths each year, and current statistics indicate that pollution kills three times as many people as AIDS, TB, and malaria combined.

The U.S. has a long-standing history of toxic exposure — for example, asbestos in 1900, followed by such events as toxic exposure and contamination in the military and around military bases, and recent discoveries of "forever chemicals" (PFAS) contamination and heavy metals contamination that has even affected baby foods. However, aside from this, there are some striking examples that perfectly illustrate the notion of environmental racism and how vulnerable communities are affected.

One of these examples is what happened in Flint, MI, when it switched to the Flint River as its water supply in 2014 to save money. However, it did not apply suitable water purification methods, exposing the city's 100,000 citizens, most of whom were African American, to pathogens like *E. coli* and *Legionella*, as well as pollutants like lead. The water's low quality resulted in a horrible odor and discoloration, and despite widespread complaints from the residents regarding hair loss and skin issues, the city took no action for 18 months. Twelve persons died of Legionnaires' illness during this time period. The Michigan Civil Rights Commission described the situation as a catastrophe stemming from Flint's history of segregation, which limited communities of color to regions with poor services.

Another striking example is the contamination of the San Joaquin Valley with arsenic, which is a naturally occurring chemical element in groundwater that is increased by agricultural operations. Industrial usage such as wood treatment techniques and pesticides contributed to the natural accumulation of arsenic in the San Joaquin Valley, California, while irrigation and drainage operations then contributed to its spread and accumulation in shallow groundwater levels. However, in the San Joaquin Valley, the primary supply of drinking water for about 1 million persons is groundwater, with low-income areas and communities of color facing the greatest risk. Prolonged arsenic exposure can result in the development of multiple types of cancer.

Maybe the most serious example stems from Louisiana's "Cancer Valley," a region that has been given this name due to the high prevalence of cancer among its community, most likely tied to the high levels of industrialization and pollution present in the area. A 2021 study expressed worry about industrializing the tract of land between Baton Rouge and New Orleans in Louisiana, called "Cancer Alley." According to the paper, pollution from present construction puts local residents, most of whom are Black, in danger of developing cancer and respiratory ailments, among other maladies. This indicates that federal environmental restrictions are failing to adequately safeguard citizens.

The issues in Louisiana's Cancer Valley are contemporary and egregious manifestations of environmental racism. Industrialization breaches the basic human rights of the mostly African American population by putting them at a disproportionately high risk of incurring health problems.

What Are The Long-Term Health Consequences, And What Can Be Done?

Numerous hazardous industrial byproducts have major long-term adverse health consequences. Businesses must develop suitable methods for filtration, treatment, incineration, disposal, emissions, and the usage of poisonous or hazardous products to mitigate these health problems. Whether it's PCBs, dioxins, furans, benzene, PFAS, uranium, or particulate matter, businesses have typically used the cheapest and quickest means of disposing of anything they don't want. As an added incentive for businesses, penalties are sometimes less expensive than following the regulations. Stricter EPA laws mandating appropriate testing and recordkeeping, random inspections, and increased penalties have helped rein in some of the worst performers in recent years, but we still have a long way to go, and enforcement is inconsistent.

Pollution from industry has resulted in contaminated waterways and bad air for decades. As a result, lower-income populations have statistically increased rates of cancer; developmental and birth abnormalities; and cardiovascular, pulmonary, and endocrine illnesses, as well as a plethora of other toxin-related health problems. The demand for and cost of medical treatment exacerbates this challenge in regions already struggling with a lack of adequate economic prospects.

While many communities have suffered harm, actions must be made to mitigate or eradicate harmful community exposure in regions where it has gone uncontrolled. Policy changes, such as tighter regulation, greater and more consistent enforcement, and increased fines, are all part of the answer. When the most cost-effective course of action is for a business to pay penalties while remaining careless or lax in its compliance with environmental rules, the policy has failed.

While everyone is aware of climate change and the impact of pollution on the global environment, altering the climate for those who live near the source of pollution is at the heart of both environmental and racial injustice. Emphasizing the rectification of environmental racism's widespread consequences will assist in shifting the systemic racism imbalance.

The Biden Administration is taking steps to right past wrongs and establish a more just future for all communities with its plan to secure environmental justice and equitable economic opportunity. Amongst other things this plan promises to:

- Create a division of environmental and climate justice inside the U.S. Department of Justice.
- Elevate environmental justice inside the federal government and update the approach across all levels of government.
- Restructure the EPA's External Civil Rights Compliance Office.
- Require more surveillance in frontline and fenceline communities.
- Require notice of the community.
- Create interagency task forces to handle specific issues and work directly with communities.
- Take a scientific approach to addressing water contamination.
- Prioritize initiatives and technology that will help impoverished communities minimize traditional air pollution.

This decade will be vital for reorienting our economy along a climate-safe path, and the next year will be a critical opportunity for action to get us started. By commencing a fossil fuel phaseout, President Biden can keep his commitments to challenge systemic racism and address the climate catastrophe. ■

About The Author

Jonathan Sharp is the CFO of Environmental Litigation Group, P.C., a law firm in Birmingham, AL, that helps vulnerable communities struggling with illnesses caused by environmental toxic exposure.

The Water Sector's Role In The Race To Net Zero

The water sector's road to net zero is paved with significant challenges and great opportunities. However, a shortcut may be in sight if you scout across the Atlantic to Denmark, where the water sector is well on its way to becoming climate-positive in 2025 and energy-neutral by 2030.

By Frederikke Rørvang Mikkelsen

Frequent and intense water events, such as droughts, flooding, and changes to rainfall patterns have become more and more visible around the globe — many of them as consequences of climate change. As 2 percent of the total U.S. energy consumption is used for drinking water and wastewater services, emitting more than 45 million tons of greenhouse gas (GHG) annually,[1] there is no doubt that the water sector plays an essential role in decarbonization, lowering climate impacts, and mitigating new challenges related to efficient water management. However, many utilities struggle with the question, "Where to start?"

According to the nonprofit U.S. Water Alliance, one of the answers is net-zero targets. To identify the innovative, efficient, and affordable solutions to achieve these targets, the organization launched the initiative, *The Imagination Challenge: Water's Role in the Race to Zero*, in 2021.

Katy Lackey, senior program manager at U.S. Water Alliance, explains that the core of the initiative is to bring together stakeholders in the water industry to foster collaboration and peer exchange. In this light, she explains that on the route to reaching net zero, the path could very well go through Denmark, since U.S. utilities increasingly look toward their Danish counterparts and their efforts of mitigating and lowering GHG emissions.

"As one of the first water sectors to set a net-zero water goal and support federal regulations, Denmark offers a strong model for taking this step," Lackey mentions.

Climate-Positive By 2030: Energy Efficiency Is Key

The Danish water industry has already set targets for a climate-positive and energy-neutral water sector by 2030 — targets that support the Danish government's strategy to reduce GHG emissions by 70 percent by 2030. Additionally, the government introduced a tracking framework to support the utilities' ambition in limiting net energy use and reducing GHG emissions. Utilities can report voluntarily, and the first status report from 2021 shows that the sector is well on its way to becoming climate-positive already in 2025.[2]

Sofie Hyldal Thorgaard, a technical advisor at the Danish Water Technology Alliance in North America, explains that Danish solution providers and utilities have pushed the limits for operational efficiency for decades. Political incentives and regulation have also been vital drivers in the Danish model. Since 2011, the Danish water sector has been economically benchmarked and has had individual economic efficiency requirements. Today, the benchmark includes both OPEX and CAPEX measures, to compare the utilities on total economic efficiency[3] (TOTEX). Additionally, performance benchmarks on various environmental factors and financial incentives to limit pollution and discharge of nutrients to levels even below regulatory limits are in force. As a result, these efforts have pushed the utilities to monitor and measure their operations in real time. This is where digitalization takes center stage.

"Collecting data is essential because you cannot manage what you cannot measure. In my experience, a utility can typically find 50 to 70 percent of energy savings by implementing digital solutions and measuring operations with an eye to real-time control," Thorgaard states.

As part of Thorgaard's position at the Danish Water Technology Alliance, an outreach program that works to bridge the gap between the Danish and U.S. water sectors, she spends a great deal of time visiting U.S. utilities. In her experience, the digitized approach to monitoring and control is something many water utilities and wastewater treatment plants (WWTPs) on this side of the Atlantic find inspiring, as it is an easy way to save not only energy — but also dollars.

"Most wastewater treatment plants spend approximately 54 percent of their total energy consumption on aeration. Utilizing variable frequency drives (VFDs) on the blowers and controlling air distribution remotely according to actual needs instead of a fixed setpoint saves both energy and money. Furthermore, it is a small exercise with a significant impact and a relatively short ROI," Thorgaard explains.

She further adds that just as energy efficiency is at the core of the Danish path to becoming climate-positive five years ahead of schedule, efficient wastewater treatment and energy production are also inevitable parts of the solution. Lastly, Thorgaard points to the fact that producing energy from the sludge in the longer run also offers great savings on OPEX, as a typical WWTP spends 25 to 40 percent of its operating budget on electricity.

Wastewater — A Challenge Or Opportunity?

In Denmark, more than 90 percent of all wastewater is collected and treated. Furthermore, many utilities turn sludge from the process into energy, and a study by the Danish Environmental Protection Agency shows that the Danish wastewater sector produced two-thirds of the amount of energy it used to transport and treat wastewater in 2018. Some even produce enough electricity to supply the entire water stream from groundwater harvest to distribution and wastewater treatment from a WWTP's perspective.

You can find one of these utilities in Aarhus, the second-largest city in Denmark, as it achieved 150 percent energy self-sufficiency in 2020. Aarhus Vand accomplished impressive results by combining a digital approach to energy efficiency and using the nutrients from the wastewater at Marselisborg WWTP to produce energy. As a result, today, the GHG emissions at Aarhus Vand are 77 percent lower than in 2008 — proving that wastewater truly has the potential to play an essential role in reaching net zero — both from an energy and emission perspective.

The waste-to-energy approach has also gained increased momentum in the U.S. — in fact, the U.S. Department of Energy[4] estimates that wastewater contains more than five times the amount of energy needed for the treatment process. Additionally, the federal government has brought attention to the subject in Congress over the past year, and several WWTPs across the country utilize combined heat and power units (CHPs) to produce energy.

Thorgaard and Lackey, however, acknowledge that although we have come a long way with the waste-to-energy approach, we still have a long walk ahead of us — not just in Denmark and the U.S., but globally. First, energy production primarily solves the challenges related to carbon footprint; other GHGs, such as nitrous oxide, still pose great difficulties to reduce, especially because they are hard to measure. As Lackey puts it: "Process emissions from wastewater remain a significant 'nut to crack.'"

Furthermore, only half of all wastewater is collected, and less than 20 percent is treated on a global scale — and untreated wastewater is a major environmental challenge, posing a threat to the sustainability of access to clean water sources.

Echoing this notion, Lackey describes collaborations and partnerships as vital weapons in reaching net zero and crucial to the future of the water sector, because, as she puts it, "We are all in this together."

Collaboration Is An Inevitable Part Of The Solution

Taking our two experts' statements into account, we find the road to net zero is full of both challenges and opportunities. Moreover, it is evident that the global water community faces many of the same issues related to climate change.

Thorgaard, who for the past three and a half years has brought water professionals from Denmark and the U.S. across the Atlantic, explains that, though there are many local differences such as regulation, culture, and environmental elements, the overarching purpose is the same.

"Whether you live in California or Copenhagen, water professionals every day show up at work to ensure reliable, safe, drinkable water and to provide efficient, secure wastewater treatment for a constantly growing population while resource scarcity is increasing," she states.

At the U.S. Water Alliance, Lackey echoes this notion: Sharing knowledge, experiences, and solutions is necessary to accomplish shared goals and for the sector to go further and faster in reducing emissions and reaching net zero.

"We need the best ideas coming together and diverse perspectives and experiences on all fronts. What we do here will have reverberating impacts across the world and vice versa," Lackey finishes. ■

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About The Author

Frederikke Rørvang Mikkelsen is the PR and communications advisor of the Energy and Environment Team at The Trade Council of Denmark in North America. Based in Houston, she primarily supports the activities of the Danish public-private partnership, the Water Technology Alliance (WTA), which aims to share Danish know-how and foster collaboration. Prior to joining The Trade Council, Mikkelsen worked as a communications assistant at the Danish Society of Natural Conservation.

CMAR: A Project Delivery Method That Can Deliver For Water System Owners

Learn the reasons why construction management at risk (CMAR) is gaining in popularity, and the specific benefits it offers.

By Sherri Leonard

Water system owners often have years to plan and build projects to replace aging equipment or deal with expected capacity changes. In such cases, they frequently use either the design-bid-build approach of project delivery, which entails contracting an architectural/engineering firm to design the project and a construction firm to build it, or the design-build approach, which entails contracting one firm to both design and build it.

Occasionally, however, owners have to respond quickly to emergencies, such as damage to their physical plants or contamination of their water sources. In those instances, one possible solution is a project-delivery method called construction management at risk, which is commonly known as CMAR.

The city of Woodbury, Minnesota, turned to CMAR when it had to get a temporary water treatment plant up and running in six months after seven of its 19 wells were found to be contaminated with perfluoroalkyl and polyfluoroalkyl substances, or PFAS. My firm, Rice Lake Construction Group, was selected to be the CMAR on the project, which won an American Public Works Association 2021 Public Works Project of the Year award in the Disaster or Emergency Construction Repair category, $5 million to $25 million division.

CMAR's Advantages

Like design-bid-build, CMAR involves contracting with both an architectural/engineering (A/E) firm and a construction firm. Instead of working sequentially, however, with the A/E firm producing a design that the construction firm then uses to build the project, the A/E firm, the construction firm, and the owner work together collaboratively, solving problems as they arise. Additionally, at some point, the owner negotiates a guaranteed maximum price, or GMP, with the construction firm. That feature is what gives CMAR its name because it puts the construction manager at risk for cost overruns.

In addition to cost, CMAR offers these other potential advantages over the design-bid-build and design-build approaches:

- *Quicker delivery* — CMAR can accomplish this because it enables the participants to work collaboratively rather than sequentially, which, among other things, allows them to order long lead-time equipment early in the process.
- *Flexibility* — CMAR makes it easier for participants to incorporate any design modifications required to complete the project as they work on it.
- *Cost Transparency* — CMAR requires the owner, A/E firm, and construction firm to work collaboratively through each step of a project from preconstruction to completion, which enables cost transparency by getting the owners involved in real-time decision-making.

Water System Owners, CMAR, And PFAS

How often water system owners use CMAR varies from region to region, but it is becoming more common due to the benefits it offers. Rice Lake Construction Group has completed over 75 projects using CMAR.

PFAS may force water system owners to consider using CMAR more frequently. Also known as "forever chemicals" because they don't break down in either the environment or the human body, PFAS have been widely used in everything from firefighting foam to food wrappers and nonstick cookware, and, as a result, are popping up in water systems across the country. Additionally, according to draft toxicity analyses released by the U.S. EPA in late November 2021, there may be no safe exposure levels for at least two of them. That means that when water system operators discover PFAS in their water, they have to move fast to treat it, which can require them to get new water treatment plants built and online very quickly.

Woodbury's PFAS Challenge

Woodbury found itself in that position in late 2019 as a result of a series of events that began two years earlier when it was notified by the Minnesota Department of Health that water from five of its 19 production wells exceeded a PFAS health-based guidance value and/or a health-risk index value, and that other wells were showing changes in detected PFAS concentration levels.

After the state of Minnesota received an $850 million settlement from a lawsuit it had filed against 3M Company for PFAS pollution, Woodbury secured a grant from the state to develop a mixing model of its distribution system so it could see how the impaired wells could affect its ability to provide clean drinking water to its residents. When it received the results of the model in late 2019, the city learned it was facing an impending crisis. The model showed it would have to use one or more of the impaired wells in order to meet the forecast water demand of its residents in the summer of 2020.

Fortunately, by then, the 3M settlement had enabled Woodbury to retain two companies, Advanced Engineering and Environmental Services (AE2S) and Jacobs Engineering, and begin working with them to plan how to deal with the PFAS contamination in its wells. In early January 2020, after learning what the model showed, Woodbury, AE2S, and Jacobs devised a plan that included designing, building, and operating a temporary water treatment plant (TWTP) that would serve the city for an estimated five to seven years, meet its near-term peak water demand, and provide it with time to develop a long-term water treatment solution.

The CMAR Solution

The plan called for having the TWTP operational by June 1, 2020, a little less than five months away. To meet that deadline, the city, AE2S, and Jacobs decided to use the CMAR project delivery method. The three stakeholders developed preliminary conceptual drawings and site plans of the TWTP, interviewed three potential CMARs, and selected Rice Lake Construction Group; and, on Feb. 7, 2020, they provided Rice Lake Construction Group with the first set of drawings and site plans, allowing us to establish a GMP for the project. Woodbury also used the first set of drawings and site plans to finalize its grant for the construction of the TWTP with the Minnesota Pollution Control Agency.

With that accomplished, the design team went to work on a final design for the TWTP. To expedite construction, it broke the design documents into three packages, the first of which covered the TWTP's below-grade piping and foundation. On Feb. 20, 2020, that package was delivered to Rice Lake Construction Group and the Minnesota Department of Health, which had to make sure the designs met federal and state code. The documents enabled Woodbury to finalize its contract with Rice Lake Construction Group and issue its notice to proceed on Feb. 24, 2020. Rice Lake Construction Group began clearing the site that day.

The second design package to be finalized was the civil site package, which had to account for the TWTP's proximity to a protected nature preserve. The package had to be done quickly to allow Woodbury's engineering staff to review it, the local watershed district to obtain permits for the project, and Woodbury to solicit comments on the project. The Minnesota Department of Health approved a version of the second package with a 95 percent completion rating on March 6, 2020.

The final design package was the building package, which included all the architectural, structural, process, mechanical, and electrical construction details that normally would be included in a fully bid construction set. It was delivered March 9, 2020, and approved by the Minnesota Department of Health on March 17, 2020.

Additional Challenges

That left two and a half months to finish construction of the TWTP, which would have been challenging under any circumstances, but proved to be particularly so after the COVID-19 pandemic erupted. Among other things, the project team had to be extra flexible to ensure the TWTP could be built on time and within budget using materials that weren't affected by the supply chain disruptions brought on by the pandemic. The team also had to keep the number of people working on the project smaller than usual to enable social distancing and enforce other safety protocols to make sure no one working on the project caught COVID-19.

The team faced another challenge when water from another of Woodbury's wells exceeded health index levels for PFAS, meaning a trunk line had to be built from that well to the TWTP. During the construction of the trunk line, an unmarked gas main was ruptured during directional drilling, forcing the team to spring into action in the middle of the night. The team worked with public safety officials and the local gas utility to make sure the main was repaired without incident by morning.

As if all that weren't challenging enough, on May 25, George Floyd was killed, plunging the Twin Cities area, which Woodbury is part of, into civil unrest. That meant that security on the project had to be increased.

Success

Despite everything, the TWTP was completed by June 1, 2020, as planned, thanks in no small part to the collaboration enabled by CMAR.

"It can't be emphasized enough how important collaboration and communication were to the success of this project," said Jim Westerman, Woodbury's assistant public works director. ■

About The Author

Sherri Leonard, director of collaborative delivery at Rice Lake Construction Group, is a 15-year veteran in construction specializing in large, complex, and collaborative projects in the water and wastewater industry. Sherri's background is rooted in working with owners and engineers across the country on CMAR and design-build projects.

Best Practices For Decentralized Wastewater Treatment System Upgrades And Replacements

Onsite wastewater treatment solutions are practical and popular, but changing regulations and conditions may require an update to operations.

By Dennis Hallahan

Wastewater is not typically discussed at the dinner table and most people take wastewater treatment for granted, preferring to flush and forget. This makes the work by wastewater professionals, regulators, and health departments to protect public health and our water resources even more challenging. Wastewater treatment, both residential and commercial, is a community concern. The topic needs to be more widely discussed, including the value that a comprehensive plan to keep community wastewater treatment systems working properly can have on tourism, recreation, increased business, quality of life, preservation of fishing and shellfish beds, and other tangible benefits.

As a result of regulatory enforcement orders or proactive communities, requirements to upgrade or replace underperforming or failing existing onsite systems are being enacted.

In communities located in highly sensitive watershed or other environmentally sensitive areas, regulators and residents are more keenly aware of the values of their local water resources and have a heightened awareness of the issues that result from outdated or underperforming wastewater treatment systems. These areas are instituting more stringent regulations and working together as a community to access funding and educate the public about what needs to be done and the options available. For example, lake associations in upstate New York have adopted higher levels of treatment to protect the lakes from wastewater pollution. Suffolk County, NY, has adopted higher levels of treatment to address nitrogen concerns. And there are several other "hot spots" throughout the nation: coastal estuaries in Cape Cod and Rhode Island, the many springs of Florida, and the Chesapeake Bay, to name a few.

As a result of regulatory enforcement orders or proactive communities, requirements to upgrade or replace underperforming or failing existing onsite systems are being enacted. This is not easy and is often unpopular. The community may be divided about the issues, the extent of the requirements needed, and, most importantly, the cost burden as community leaders juggle the options, including centralized versus decentralized treatment designs. When a costly centralized sewer option is heavily pushed, not only is the overall cost a burden on taxpayer dollars, but the individual cost to connect to a centralized system is often more than many residents can or want to bear. Further, the centralized option brings with it a plethora of secondary concerns for the community: increased residential density, larger commercial facilities, increased traffic, loss of character of the town, and continual increases in user rates that are out of the hands of the homeowners. This has catalyzed new technology and creative system designs that can solve wastewater challenges and do so using a decentralized approach with less infrastructure and most often lower cost.

The decentralized option has its challenges as well. It can be more difficult to obtain funding for decentralized treatment, and the old, small, lakeside/coastal lots may have preexisting, nonconforming lot sizes and may not have room to fit conventional code-sized onsite wastewater treatment systems. That's where creativity on the part of the system designer comes in, and that often includes elements taken from both the decentralized and centralized treatment playbook.

At Surgoinsville, TN, the difficult Appalachian sites with steep slopes and limited backyard access to existing homes made system design and installation challenging. Ultimately, individual STEP services were installed at more than 200 residences. The ease of handling the plastic tanks in tight quarters made them the ideal solution.

Selecting The Best Approach For Individual Community Needs

Let's say that the community has hired a consulting engineering firm to investigate options to address the environmental concerns with a wastewater plan. The plan offers two alternatives: sewering or a decentralized approach. Each alternative should be investigated, as no two communities are alike and the best solution for each will vary. A strong public outreach campaign is important throughout the process to keep residents apprised of the progress and to ultimately help them make the choice to approve the best option for the community.

The Decentralized Path To Treatment

For the purposes of this article, we are going to focus on the decentralized option. In these cases, it is common that upgrades and/or replacements to a significant percentage of the systems in the community may be needed to meet new regulations, and difficult situations will arise. It is best to conduct a site-by-site accounting of each home's or business' existing system. Visiting each site is a time to engage homeowners and business owners and to get buy-in from them. It's also a chance to have a questionnaire for them to complete and to hear their concerns. Once there is a legitimate wastewater-induced problem identified, it must be conveyed and communicated to the public along with the public benefit from the investment in new systems. It suffices to say that the residents' greatest concern will be how much it will cost and whether there is any funding or loans available to offset the individual system owner's expense.

If the home or business owner is not convinced there is an environmental problem, it will be a difficult process. For example, if a homeowner or business recently had a new code-conforming system installed at great expense, the current system could be fine, or it may need to be upgraded to include some form of advanced treatment to meet new regulations and conform with the town requirements. That wastewater treatment system owner is going to push back strongly against those new upgrades and the cost to complete them.

Decentralized Options For Upgrades And Replacements

Repair and replacement standards, codes, and regulations differ by state and province. Upgrades and replacements can take many forms and there are many solutions available. If there is room on the site, then an advanced treatment system (ATS) can be installed with a disposal field. Many types of treatment systems are available, and the approved ATS varies per regulations. For small, undersized, tight lots it may be best to install septic tank effluent pumping (STEP) systems to convey the effluent to a remote site that has available area, good site and soil conditions, and is located away from the sensitive waterbody. The point is that the options are varied, and understanding the area and the individual sites within it is the only way to make the best recommendation.

Best Practices To Assess Wastewater Treatment Needs And Evaluate Design Options

1. Understand local codes, including special regulations for environmentally sensitive locations.
2. Determine current effluent volume, anticipated future needs, and effluent strength.

3. Ask about intermittent or seasonal flows and usage patterns.
4. Evaluate the current system size and the footprint available for a new system or upgrade.
5. Establish the optimum treatment levels to attain based on usage, effluent strength, daily flow, and location.
6. Research any existing site and soil conditions that could affect system selection, performance, and longevity.
7. Ascertain if there is a current system O&M provider; if not, research options in the area.

All of these variables are important and play a significant role in the decision-making process around individual and community systems. One of the most important that has been overlooked for years is the operations and maintenance element. All systems require maintenance, even the most standard septic tank and drainfield designs. For ATS systems, maintenance contracts are a necessity. They can be with the individual home or business owners, homeowners association, or the utility district. These contracts should be a part of the plan from the start to ensure that the systems will perform as intended and will meet the regulatory permit requirements. After all, one of the selling points for communities to embark on a wastewater treatment upgrade is to enhance performance and safe operation over the longest period of time possible.

Regulations Respond To Developing Technology

As is the case with Suffolk County and other states and provinces, regulators have embraced new products and engineered wastewater treatment solutions by adjusting codes to reflect the increased performance of new products, including the higher throughput rates of aggregate-free products such as plastic-leaching chambers and engineered geosynthetic aggregate. The scientific research findings and third-party performance testing data are helping regulators to be proactive to the benefit of the communities they serve, which benefit from the inclusion of advanced treatment systems in their wastewater arsenal.

Individual And Community Wastewater Treatment Upgrade/Repair Examples

Alternative Onsite Wastewater Treatment System Project

An example of forward thinking in action is Suffolk County, NY. Nitrogen from residential septic systems has been identified as a significant factor in the degradation of Long Island estuaries. Sewering most of the county was investigated and determined to be financially unfeasible. Therefore, the Suffolk County Health Department has been very proactive instituting a septic demonstration program that will implement advanced treatment technologies and shallow dispersal drainfields to reduce nitrogen. In addition, the county sanitary code has been upgraded to allow for these changes. The demonstration program results in a public-private partnership where manufacturers donate systems as part of the program.

When New York listed portions of the Long Island Sound, Peconic Estuary, and South Shore Estuary as impaired waterbodies,

When the Lauloa Maalaea Resort in Hawaii was required to update its wastewater treatment unit due to tighter effluent requirements required in a forthcoming permit update, the new system had to maintain the same footprint of the existing below-grade treatment unit that was being replaced.

Suffolk County officials began a review to understand the source of the water supply pollution. Seventy-four percent of Suffolk County utilizes onsite sewage disposal systems. Currently, the drainfield systems in Suffolk County consist of deep leaching pits, cesspools, concrete rings, or leaching pools that can be installed as deep as 25 feet. A study revealed numerous pollution sources; however, nitrogen pollution from cesspools and septic systems was identified as the primary cause of water-quality issues. Impacts include beach closures, toxic algae blooms, and shell fishing restrictions, which are all detrimental to resident health and tourism.

Since sewering was unfeasible, the Suffolk County Health Department participated in the "Reclaim Our Water Initiative," focused on reducing nitrogen by replacing existing septic systems with alternative onsite wastewater treatment systems (AOWTS). The initiative includes a demonstration program to pilot these advanced treatment technologies. In this public-private partnership, manufacturers donate the systems, including advanced treatment technologies and shallow dispersal drainfields, to the demonstration program. Tested and monitored by the county for six months, if the system meets the county "pass criteria" standard of a 50 percent reduction in nitrogen, it gains Provisional Use Approval. The county also upgraded its sanitary code to allow for the changes needed to incorporate these advanced technologies.

STEP Systems Replace Failing and Compromised Subsurface Disposal Systems

Surgoinsville was one of the few municipalities in Tennessee without a public sewer system, limiting economic development opportunities. Existing homes were served by subsurface sewage disposal systems that were failing and compromised by other factors, including structures built over these systems. The existing package plant, in operation since 1959, served the Surgoinsville elementary and middle schools and was at the end of its useful life. The town decided to pursue a sewer system that could handle current needs with capacity for the future.

Once there is a legitimate wastewater-induced problem identified, it must be conveyed and communicated to the public along with the public benefit from the investment in new systems.

The $4.5 million project serves 247 residences, two schools, and nine businesses. Installed on lots with existing homes, outbuildings, driveways, and landscaping, the project was designed with the additional capacity to serve approximately 700 properties. The low-pressure sewer system delivers wastewater to the city of Church Hill's wastewater plant. The system comprises approximately nine miles of low-pressure sanitary sewer collection lines, two pump stations, and individual STEP services at more than 200 residences that include Infiltrator IM-Tanks. Difficult Appalachian sites with steep slopes and limited backyard access to existing homes made tank installation challenging, and the ease of handling of the plastic tanks provided the ideal solution. As well, the tanks were delivered to the installer's onsite staging yard nested, and the staff assembled the tanks as needed to complete the project. This saved time and space prior to installation.

Extended Aeration Unit Solves Wastewater Treatment Challenges at Resort

The Lauloa Maalaea Resort in Hawaii was required to update its wastewater treatment unit due to tighter effluent requirements required in a forthcoming permit update. The existing treatment unit to be replaced was installed below grade in the resort's parking lot. Due to limited space on the site, this was also the only possible location for a new system, so the new system had to maintain the footprint boundaries of the existing system. To meet the new regulation requirements and handle the design flow of 21,000 GPD, the resort selected a new extended aeration treatment unit. The old treatment unit was completely removed from the site, followed by the placement of a foundation on which the new treatment system was installed. To ensure the treatment unit was out of sight, secure, and aesthetically pleasing, a building was constructed around the unit. The extended aeration process selected for this system utilizes aeration followed by clarification and disinfection.

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

Conclusion

Decentralized wastewater treatment system upgrades and replacements offer many solutions to protect our water resources. One important consideration is that the water is returned to the local aquifer for recharge, thereby supporting the natural ecosystem. Thorough planning and design by a licensed firm with decentralized experience can open up the possible solutions that provide high performance that might have been overlooked. There are technologies available today to address the wastewater constituents of high concern such as nitrogen or phosphorus and/or to meet site constraints such as high water table, small lot size, or difficult soils. The fact that there are many solutions is the easy part. The hard part is getting the community together to agree on a plan and approve it. To that extent, as much time and energy should be focused upon community education and communication as it is with the engineering plans. Meetings with key groups, mailings, clear objectives, and goals listed on a community project website for anyone to access are all simple, but they go a long way toward gaining the support needed to move forward. Without community support, the project will not survive, and fines and mandates from those outside the community, along with the environmental detriments of inaction, can be devastating. ■

About The Author

Dennis Hallahan has more than 30 years of experience with onsite wastewater treatment systems design and construction. Currently the technical director at Infiltrator Water Technologies, he is responsible for technology transfer between Infiltrator and the regulatory and design communities, and he consults on product research and testing for universities and private consultants. Dennis received his MS in civil engineering from the University of Connecticut and his BS in civil engineering from the University of Vermont. He is a registered professional engineer in Connecticut and holds several patents for onsite wastewater products. Email: dhallahan@infiltratorwater.com

The Importance Of Diversity, Equity, And Inclusion In The Water Sector

Improving diversity, equity, and inclusion (DEI) has become one of the most important topics in the workplace, let alone the water sector. The business case for diversity has been made, but because DEI has not been a regular discussion topic, some organizations are struggling with how to define what their DEI initiatives should be.

By Andrea Hall

For the water sector, DEI should always be an open dialogue. We need guiding principles around water equity, affordability, and access as we approach our work because, unfortunately, it is not the same for every community. Water is a fundamental right for all of us, and people shouldn't have to deliberate whether they can afford water or what they may have to sacrifice to gain access to clean water in their homes. Before COVID-19, the number of households unable to afford water and wastewater services was already high, and likely soared with the pandemic's onset. As noted in *The Guardian* (Lakhani, 2021),[1] residents and water utilities are under stress. One in every eight households has water debt, and water utilities aren't receiving the payments they need from residents that are used for operations.[2] Thus, it is critical for everyone working in the water sector to understand the challenges different communities are facing with water affordability and access, especially as we prioritize our work.

We should be asking ourselves, "How can utilities, engineering firms, water and wastewater treatment businesses, and other essential services begin to address these issues?" This will require a heightened level of commitment across the water sector to get closer to the communities we are part of.

By keeping DEI out of the discussion, we don't create space for dialogue where people can understand what they don't know about underrepresented communities. By not facing the challenges head on, we aren't tested to think differently and more inclusively to know how we can better support these communities. This is hard work, but it pays off. Getting comfortable with being uncomfortable plays a critical role in discussing DEI. Some of the steps you and your organization can start taking now include:

- Pushing past your comfort zone.
- Being honest about your knowledge and comfort level with the subject of DEI.
- Showing grace and asking for grace. Be clear about what you are looking for to better understand.
- Networking and connecting with others in communities outside of your own.
- Participating in community meetings for the cities you serve.

An inclusive workplace doesn't just have a diversity of people represented; it also has a variety of people engaged, included, empowered, and trusted by the organization.

DEI is both internal and external. We also must remember to invest in our teams. When employees don't feel that their organization truly values their thoughts, ideas, commitments, and contributions, they will eventually shut down and possibly seek employment elsewhere. An inclusive workplace doesn't just have a diversity of people represented; it also has a variety of people engaged, included, empowered, and trusted by the organization.

The debut of Brown and Caldwell's *Balance and Belonging* (B&B) report is an essential first step to having an ongoing, transparent dialogue about our progress in creating a more diverse organization and fostering a culture of belonging. Although crucial, the report is just the beginning. We are taking a holistic approach to DEI and believe our methods will ensure long-term systemic change — not just for our organization, but for our industry. One of the initiatives we are focused on is our B&B Diversity Council, which includes members from across the company with varied backgrounds and experiences. The mission of the B&B Council is to foster an environment that attracts and retains top talent, values diversity of life experiences and perspectives, and drives innovation in pursuit of our Company of Choice strategy.

Another important step to help us continue our DEI work in an authentic way is the establishment and growth of our employee network groups (ENGs). These ENGs foster an environment in which every one of Brown and Caldwell's 1,700 employee-owners feels that they belong and can do their best work. An ENG provides a way for employees to come together to promote diversity and inclusion within an organization; they are self-sustaining and employee-run groups in which members can develop new skills, network, and grow professionally, and they provide a safe space for sharing and exchanging ideas. The focus of an ENG is to work on the "how" of improving inclusion rather than the "what" of diversity, so that as the diversity of hiring pools improves, employees feel a sense of belonging and choose to stay in a given workplace. ENGs are an opportunity for marginalized people to feel seen and heard, in some cases for the first time in their careers. The Brown and Caldwell ENGs have inspired others to form similar groups, including ENGs for working parents, virtual employees, the LGBTQ+ community, and people of color. This is just the start, and we welcome more groups to form over the course of time.

These actions and initiatives are a fraction of our ongoing commitment to DEI, and we value the experiences and continued growth we make with having DEI at the forefront. As a contributor to the water industry, we look forward to our continued journey and helping the water industry along the way by sharing our progress and looking to others' initiatives as well. ■

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About The Author

Andrea Hall, PHR, SHRM-CP, serves as the head of diversity and inclusion at Brown and Caldwell. Hall has a 17-year track record of creating and leading companywide diversity and inclusion strategy and strengthening equitable processes for global organizations. She is a thought leader and strategic partner with a track record of improving diverse talent hiring, launching employee empowerment platforms, enhancing career progression policies, developing solutions to interrupt process and procedural bias, and driving diversity and inclusion education and awareness.

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