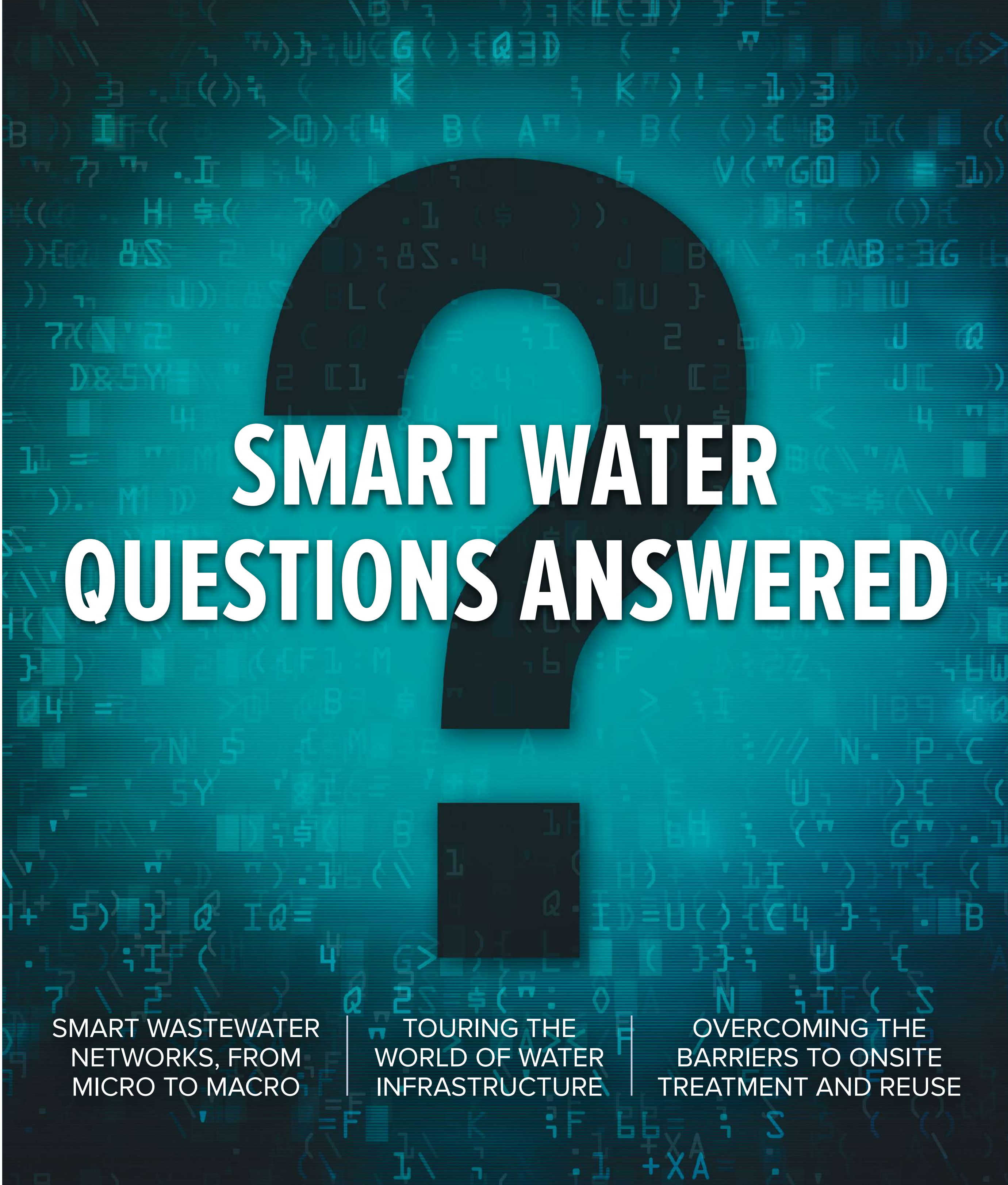
JULY 2017

Water Innovations



SMART WATER QUESTIONS ANSWERED

SMART WASTEWATER NETWORKS, FROM MICRO TO MACRO

TOURING THE WORLD OF WATER INFRASTRUCTURE

OVERCOMING THE BARRIERS TO ONSITE TREATMENT AND REUSE

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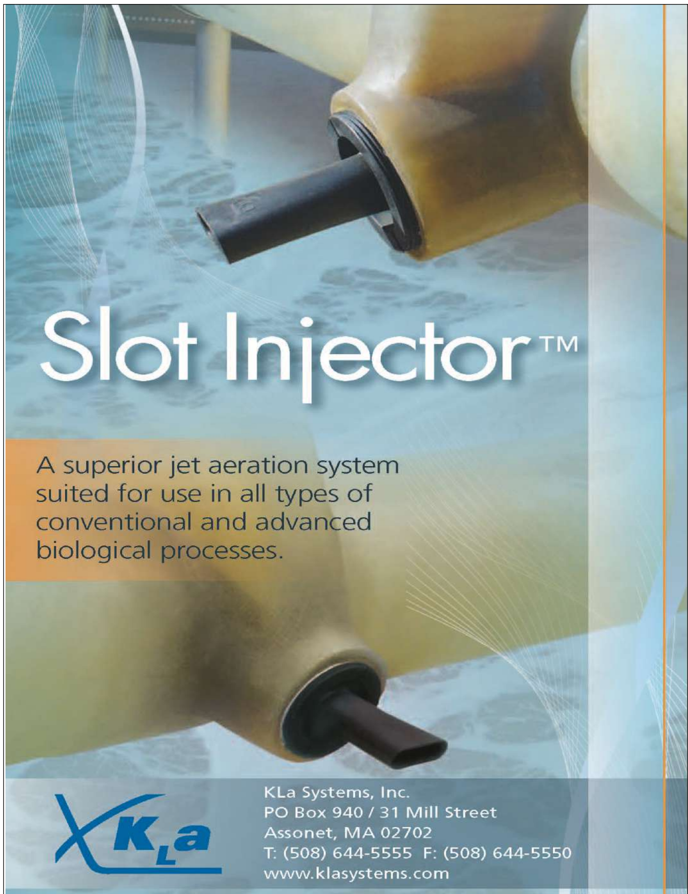


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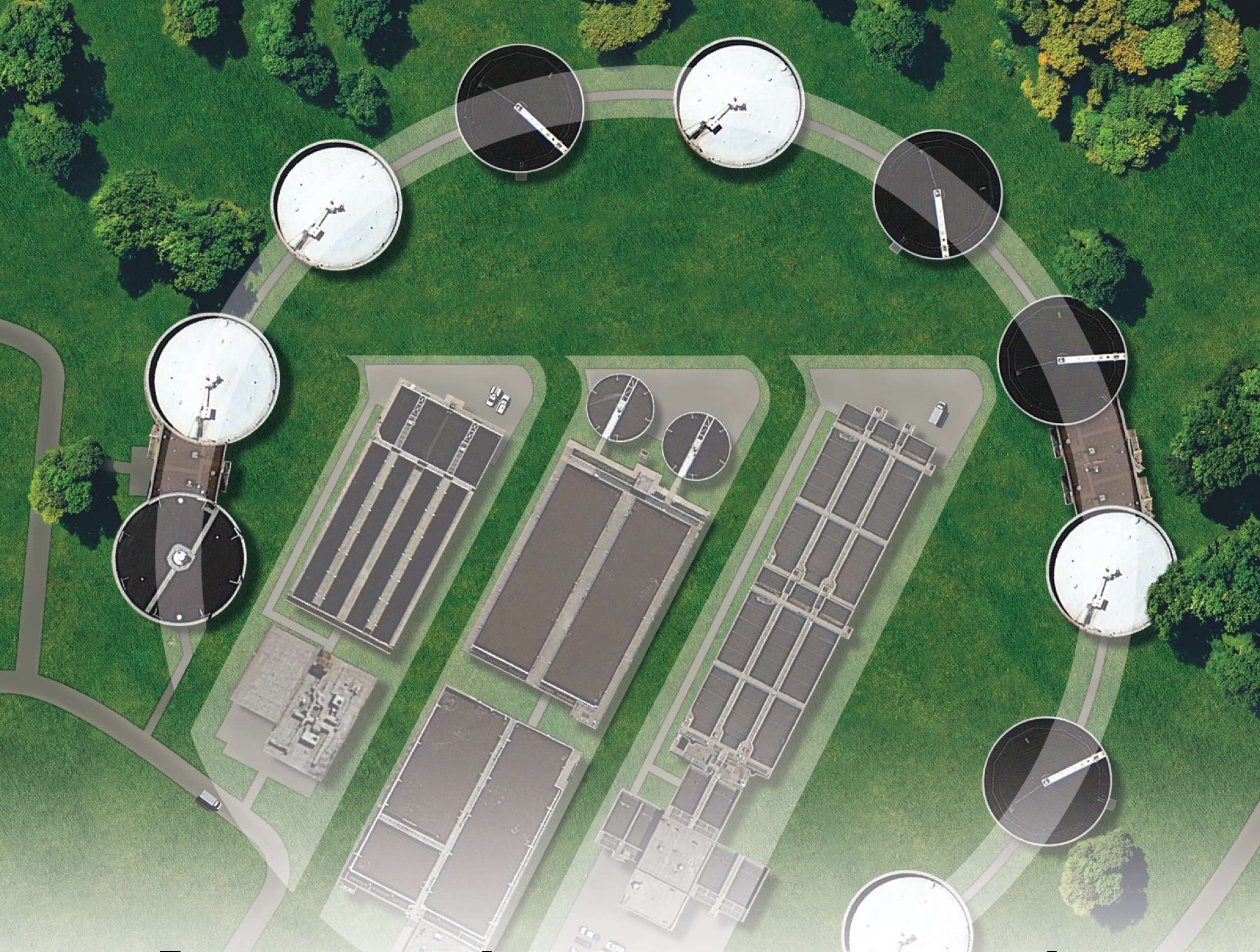


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TABLE OF CONTENTS

July 2017

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Advertiser Index

EDITOR'S LETTER

By Kevin Westerling
Chief Editor, editor@wateronline.com

Water Worries In 2017 And Beyond

The American Water Works Association's annual State of the Water Industry (SOTWI) study reveals declining confidence compared to recent years.

If the drinking water industry is anything, it's consistent. For over a century, at least since the inception of chlorine treatment in the early 1900s, clean water has been readily available thanks to the combination of people, technology, and infrastructure that make it so. And when it comes to utility operators, their outlook is on par with their performance — that is, remarkably consistent. In recent years, their concerns and outlook have remained largely the same, typically forecasting better days ahead. That hopeful attitude is natural, as scientific studies have shown that we humans have an ingrained "optimism bias."

So it is slightly concerning that in 2017, SOTWI respondents bucked the trend — and even their human predisposition — by viewing the water industry as pessimistically as ever.

AWWA asked its members to rate the current health, or "soundness," of the water industry on a scale of 1 to 7, and to project five years into the future. In both cases, the scores came in at all-time lows for the SOTWI study, first conducted in 2004. Current soundness had always been rated between 4.5 and 4.9, but dropped to 4.3 this year. Likewise, the five-year outlook had always ranged from 4.4 (the previous low, in 2016) to 5.0, yet was also rated 4.3 in 2017 (looking ahead to 2022).

While this downtick does not signal an avalanche of pessimism, it does indicate a general and uncharacteristic erosion of confidence. So what is it that has these traditionally steady men and women of water concerned? The survey tells us that as well.

5 Biggest Issues

The issues aren't new. In fact, the top five for 2017 are the same as last year (with some rejiggering of order):

1. Renewal and replacement of outdated water/wastewater infrastructure (#1 in 2016)
2. Financing for capital improvement projects (#2 in 2016)
3. Long-term availability of water supply (#4 in 2016)
4. Public understanding of the value of water systems/services (#3 in 2016)
5. Public understanding of the value of water resources (#5 in 2016)

The consistency of concerns above is not surprising as they have not been appropriately addressed since they came to be a problem. Why is this? Because of the incredible scope of rebuilding needed (see #1), costs can be prohibitive (see #2), especially when there is scant public and political will (see #4 and #5) to fund improvements. These factors, considered alongside the natural threat of climate change, coalesce to put water supplies that have long been taken for granted at risk (see #3).

The shorter answer, however, is that it comes down to money.

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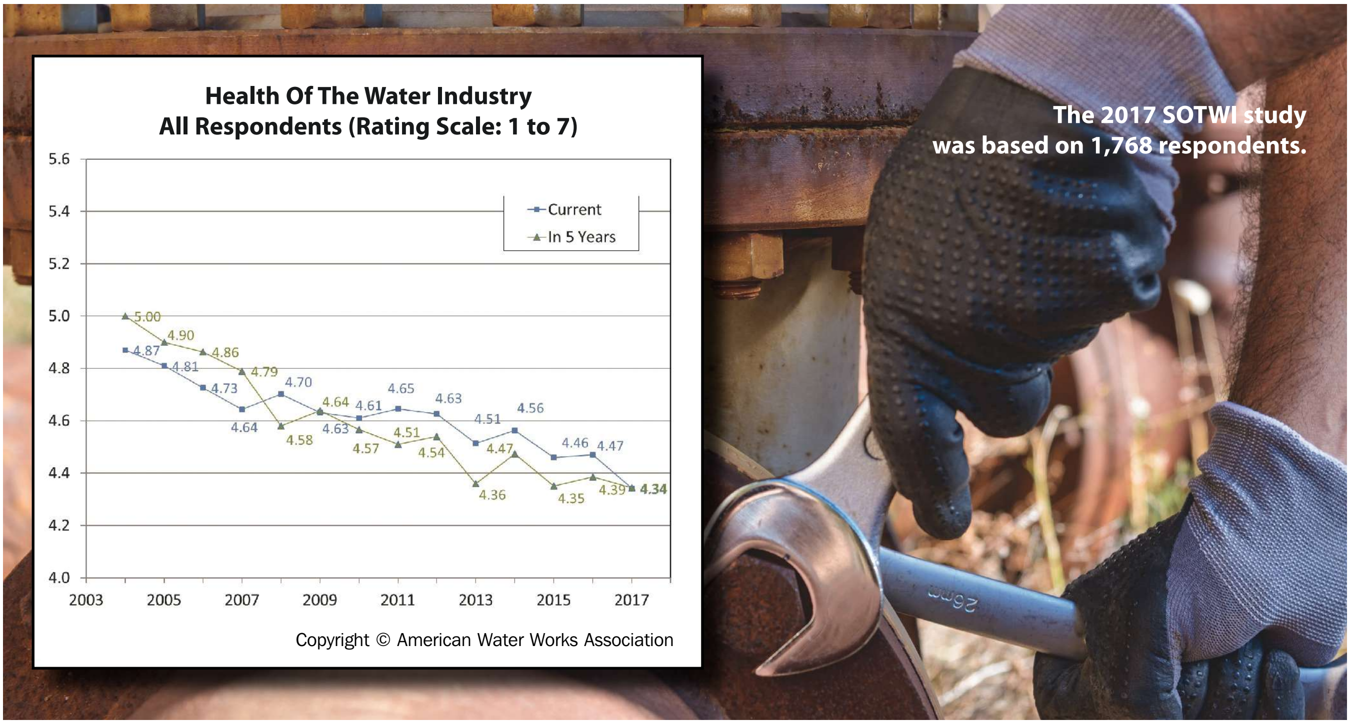

The 2017 SOTWI study was based on 1,768 respondents.

Penny Wise, Pound Foolish?

Any deferred maintenance for pipeline infrastructure will end up costing more in the long run, yet public money is often shifted from water and wastewater needs to pay for "showy" (i.e., above-ground) projects that elicit more immediate community gratification and, for politicians, votes.

But pipeline breaks that cause service disruptions, property damage, and require emergency, around-the-clock repairs are much more expensive than planned, predictive, and preemptive maintenance, so it's better to invest sooner rather than pay the ultimate price later.

Unfortunately, utilities' main source of investment is trending down as the cost of maintenance is expected to rise. Sixty-six percent of survey respondents reported declining (40 percent) or flat (26 percent) sales at the utility level. At a per-account level, the combined number is nearly 80 percent — 49 percent in decline and 29 percent flat. If indeed the cost of service is increasing, it is clear that sales revenue cannot keep pace. As a result, 93 percent of survey respondents indicated that their utilities are adjusting their cost recovery approach. If rate hikes or the sometimes-controversial solution of public-private partnerships are part of the plan, effective communication will be critical and may also need adjusting. According to the AWWA report, "Both utility and nonutility personnel consider the water industry's communication somewhat ineffective."

AWWA asked its members to rate the current health, or "soundness," of the water industry ... and to project five years into the future. In both cases, the scores came in at all-time lows.

Regulatory Concerns

Shifting to what utilities have always done well, protecting the public, the survey asked what regulations are of greatest concern currently. The top three were: (1) point source pollution, (2) chemical spills, and (3) PFOA/PFOS, which are chemicals once used in commercial product manufacturing, firefighting foam, and industrial processes that persist regionally in groundwater.

Looking into the future, the respondents cited three different areas of regulatory concern: (1) pharmaceuticals and hormones, (2) security and preparedness, which includes cyber- and physical security as well as emergency response, and (3) nonpoint source pollution.

Whatever comes to pass, utilities have earned our trust in keeping the public safe and our water clean. However, they are being tested now more than ever and staring down the barrel at even greater challenges. Frankly, they are feeling the heat. What they need now, beyond the well-earned trust, is support from all whom they serve — that is everyone — so that they may continue to be models of consistency.

Overcoming The Barriers To On-Site Treatment And Reuse

The path to on-site non-potable water reuse has been beset by roadblocks, but a new initiative is removing them to clear the way for more efficient water management.

By Paula Kehoe

Whether challenged by multiyear drought, extreme flooding, impacts due to a changing climate, or increased demand on water supplies due to population growth, water utilities across the nation are taking on new approaches to manage local water supplies and increase resilience. Through a "one water" approach, all water — drinking water, wastewater, stormwater, graywater, and more — is managed as a resource that should be utilized and valued across all stages of the water cycle.

As utility leaders, city officials, and the general public embrace innovative, integrated, and inclusive approaches to water use, the opportunity to utilize alternate water sources (e.g., roof runoff, stormwater, foundation water, blackwater, and graywater) for non-potable uses is great. Water that we normally let run down our drains or through our streets into receiving waters has untapped potential to meet non-potable needs such as cooling buildings, irrigating landscapes, and flushing toilets, and offset valuable potable water supplies. The key is applying the right water to the right use.

On-site non-potable water systems are changing the way we think about matching water supplies with the right use. On-site non-potable water systems collect wastewater, stormwater, rainwater, and more and treat it so that it can be reused in a building or at the local scale for non-potable needs. These systems are usually integrated into the city's larger water and wastewater systems, while providing more sustainable management of water.

What originally began as a response to drought-driven conservation needs in urban cities, on-site non-potable water systems have increasingly gained interest as an element of long-term, resilient, and sustainable water supply planning. Other benefits can include stormwater pollution reduction, extending the capacity of existing infrastructure, potential reduction in energy consumption and greenhouse gas emissions from collecting and treating water at the source, and environmental stewardship.

If proven technology is available and the benefits are evident, why, then, haven't we seen more widespread implementation of these systems?

Breaking Barriers

First, communities are challenged by the lack of guidance on how to develop permitting processes, management, and oversight programs for these systems. That's why the San Francisco Public Utilities Commission (SFPUC) convened the Innovation in Urban Water Systems meeting in May 2014 with support from the Water Research Foundation (WRF) and the Water Environment Research Foundation (WERF) to share knowledge and best practices, discuss barriers in implementing on-site non-potable water systems, and identify model programs to learn from. The meeting was the first of its kind, bringing together a range of water utilities, public health agencies, and research institutions from across North America to develop recommendations to help communities overcome policy barriers to implementation. The meeting led to the development of the *Blueprint for Onsite Water Systems: A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems.*

The Innovation in Urban Water Systems meeting also uncovered that the most critical issue communities face with implementing and scaling on-site non-potable water systems is the lack of guidance on developing water quality standards and monitoring strategies to adequately protect public health. Currently, there are no national standards or guidelines for on-site non-potable water systems in the U.S. While some states may have limited standards in place today, there is wide variation in existing water quality criteria.

To further chip away at this barrier, we partnered with National Water Research Institute (NWRI) to develop recommendations and guidance for treatment requirements that ensure public health protections and to develop a management framework for the appropriate use of on-site treated water for non-potable applications. NWRI convened an Independent Advisory Panel to establish recommended strategies and standards for management, monitoring, permitting, and reporting by using a risk-based approach that was protective of public health. The research was published by WRF and the Water Environment & Reuse Foundation (WE&RF) as *Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-potable Water Systems.*

The report provides information and guidance through a risk-based framework to help state and local health departments develop on-site non-potable water systems that are adequately protective of public health. The framework includes risk-based performance criteria that are consistent with the most advanced and protective public health standards to ensure safe water is delivered at all times. Furthermore, the framework also fits the Water Safety Plan approach promoted by the World Health Organization. Unlike current limited standards for on-site non-potable water systems that often rely on end-point assessment of water quality, the risk-based framework focuses on a systems-based approach to setting water quality targets that will help reduce the public's exposure to pathogens. While this framework is new for on-site non-potable water systems, the approach is based on widely accepted practices for both drinking water and potable reuse.

Ideas Into Action

With this research as an essential tool, our attention is now on translating these risk-based standards into policy guidance and frameworks that support local implementation of this sustainable water strategy. To do this, the SFPUC partnered with the US Water Alliance, along with WRF and WE&RF, to convene the National Blue Ribbon Commission for Onsite Non-potable Water Systems from 2016 to 2018. The National Blue Ribbon Commission is composed of over 30 representatives from public health agencies, water utilities, and municipalities from 10 states and the District of Columbia. In addition to serving as a forum for collaboration and knowledge exchange, the commission is also charged with crafting a state guidance and policy framework that recommends mandatory water quality criteria for non-potable water systems that can transfer from state to state. Using the risk-based public health research as a guide, the model state guidance will focus on creating consistency in the elements of an oversight and management program including water quality performance, monitoring, and reporting requirements, as well as presenting various implementation pathways to establishing a successful local program. Additional items that will be included in the model state guidance are templates for an engineering report and O&M manual and other requirements for design, construction, and operation. With this document, states will be able to customize a guiding policy that is consistent with public health standards across other states, but that honors local context and meets local needs. The commission's goal is to work with our respective states, and others, to adopt similar guiding policies in order to address this barrier and advance local implementation of these systems.

However, even with addressing this policy barrier, other challenges that have inhibited the development of on-site non-potable water programs persist, one of which is generating interest in and demand for on-site non-potable water systems by developers and city officials. City officials need to better understand how on-site non-potable water systems can be a tool of flexibility within smart growth and retrofitting plans and policies. As new facilities are being constructed, city agencies can promote incorporation of on-site non-potable water systems and can set policies that incentivize, or even require, their integration. At the same time, developers need to better understand the connection between sustainable water management and business productivity and stability. By incorporating these systems, building owners can reduce water-related hard costs, as well as meet sustainability targets and minimize indirect risk exposures. However, developers need more data that demystifies the risks and demonstrates the return on investment. As more data that quantifies the benefits of these systems is available, the more it will shape market-driven and policy-driven demand.

Leading by example, SFPUC reuses water from its headquarters for on-site, non-potable needs.

And finally, as water challenges and our strategies for addressing them evolve, so should the water utility industry. Fundamentally, the utility business is changing as we introduce new types of infrastructure and innovations to centralized water and wastewater systems. Despite growing interest in this innovation, it has not been without concern for loss of revenue or loss of control as more commercial and industrial customers deploy these systems. How can utilities quantify the benefits beyond water saved? How can utilities continue to recover costs, reduce risk, and maintain system control? A report being developed by the National Blue Ribbon Commission will help answer these questions by demonstrating the potential business opportunities for public utilities and municipalities in the implementation of on-site non-potable systems. The commission is focused on helping utilities confront these concerns in order to focus on the ways in which utility business can benefit from integrating on-site non-potable water systems with centralized infrastructure.

As the field of on-site non-potable systems evolves, the commission is committed to staying abreast of new science and approaches that support on-site non-potable water systems, as well as identifying additional research needs in the field. An additional deliverable of the commission is a research agenda that will further advance the field.

As with any emerging innovation, the best way to evoke change is to model it. That's what the SFPUC and our two dozen public utility and public health agency partners are trying to emulate. We hope that through our efforts on the National Blue Ribbon Commission, we can break down policy barriers, demystify the unknown, and pave the way for future research. We've been able to forge great progress together and, with expanded partnership from other agencies, water industry organizations, and various stakeholders, we can continue to advance the field toward a more sustainable water future. ■

About The Author

Paula Kehoe is the director of Water Resources with the San Francisco Public Utilities Commission (SFPUC). She is responsible for diversifying San Francisco's local water supply portfolio through the development and implementation of conservation, groundwater, and recycled water programs. Paula spearheaded the landmark legislation allowing for the collection, treatment, and use of alternate water sources for non-potable end uses in buildings and districts within San Francisco.

Industrial Wastewater Treatment Options For Inorganic Contaminants

With a plethora of contaminants deriving from a multitude of sources and a variety of treatment solutions to choose from, the topic of industrial wastewater can get complex fast. This overview provides clarity.

By Mark Reinsel

Industrial wastewater treatment for inorganics can be as simple as settling or filtration and as complex as multistage chemical precipitation or ion exchange processes. Technologies continue to evolve; the following methodology is recommended for selecting the best technology for each application, and several proven technologies have been shown to be effective for the water quality parameters most commonly regulated. Typical parameters requiring treatment in industrial wastewater include suspended solids, dissolved metals, nitrate, ammonia, arsenic, and sulfate.

This article will be a high-level examination of the treatment options available for inorganic contaminants.

The same basic steps can be followed in selecting a process for most industrial wastewater treatment applications:

1. Evaluating and confirming the design criteria;
2. Reviewing potential treatment technologies to address those criteria;
3. Developing one or more process flow sheets;
4. Estimating capital and operating costs for one or more options; and
5. Performing bench and/or pilot tests.

Design criteria include average and maximum anticipated flow rates, influent concentrations, and effluent concentrations (discharge permit limits). Concentrations may be unknown early in the design process but can be estimated through modeling or by examining similar sites. It is important at this point to analyze for both total and dissolved contaminants.

Treatment Limits

A logical starting point is to examine the regulations that determine (or are interpreted to determine) an industrial facility's discharge limits. These limits then form the basis for all of the water treatment work that follows. Effluent limits allow the environmental professional to specify treatment goals and process design criteria.

Regulatory limits come from four main programs:

1. For point source discharges to surface water, National Pollutant Discharge Elimination System (NPDES) permits or the state equivalent;
2. For groundwater discharges, the appropriate state program;
3. Underground injection control program (U.S. EPA or state); and
4. Nonpoint source controls such as total maximum daily loads (TMDLs) or best management practices (BMPs).

In the most common program, NPDES permits are generally required for discharge of pollutants from any point source into "waters of the U.S." An NPDES permit is essentially a license or contract for discharge of specified amounts of pollutants into a water body under specified conditions. Exceeding those specified amounts or conditions may bring legal and/or financial penalties.

A point source is any discernible confined and discrete conveyance from which pollutants are or may be discharged. Examples include pipes, ditches, leachate collection systems, and publicly owned treatment works (POTWs). The term "waters of the U.S." (or State) covers a broad range of surface waters and may include hydrologically connected groundwater. This subject has been the source of numerous court cases.

A logical starting point is to examine the regulations that determine (or are interpreted to determine) an industrial facility's discharge limits.

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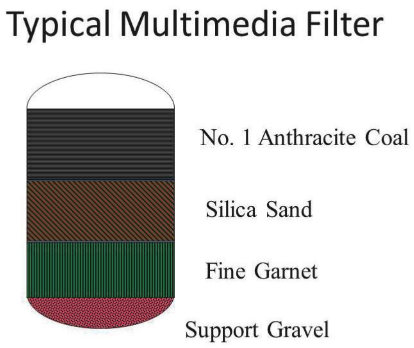

Figure 1. Multimedia filter configuration

Physical Treatment

Treatment technologies will involve physical, chemical, or biological processes. Physical processes include clarification, filtration, and membrane technologies. Except for the most rigorous membrane process (reverse osmosis), physical processes will generally not remove dissolved contaminants. Clarification uses a combination of coagulation, flocculation, and settling to remove suspended particles and typically involves sludge recycle.

Filtration methods include bag filters, cartridge filters, sand filters, and multimedia filters (Figure 1). Multimedia filters, which typically utilize anthracite coal, sand, and garnet, are probably the most common filters now in use. These filters are pressure vessels that use downflow operation to remove suspended contaminants and a periodic upflow backwash to transfer these contaminants to a waste stream.

The most common membrane technologies are microfiltration, ultrafiltration, nanofiltration, and reverse osmosis (RO). These are listed in order of decreasing pore size, increasing removal efficiency, and increasing pressure requirements. The primary disadvantage of RO is a high-volume waste stream, which often limits its applicability.

Chemical Treatment

Chemical treatment processes include hydroxide precipitation, sulfide precipitation, oxidation/reduction, ion exchange, and natural zeolites. Hydroxide precipitation typically uses lime to increase the pH. Hydrated lime or pebble lime (which requires a slaker) may be used. Other chemical alternatives include caustic soda (sodium hydroxide), soda ash (sodium carbonate), or magnesium hydroxide. For ease of addition and to avoid make-up of chemical solutions, liquid caustic soda or lime slurry is sometimes purchased.

The pH target for hydroxide precipitation depends upon the contaminants of concern. After precipitation and subsequent clarification or filtration, acid is often added to meet discharge requirements for pH. Coprecipitation, a process in which dissolved contaminants are pulled out of solution along with precipitation of high concentrations of contaminants such as iron, manganese, and sulfate, can also help to meet discharge limits.

Sulfide precipitation, which can achieve lower levels than hydroxide precipitation, is typically used as a "polishing" step to meet low metals concentrations. Sodium sulfide or sodium hydrosulfide (NaHS) is typically used. This process requires only small quantities of reagent and a short retention time. The process is typically done at neutral-to-high pH to avoid generating dangerous H2S gas.

Oxidation/reduction processes are used to transform contaminants into less soluble or more easily removed forms. For arsenic removal, oxidizing agents such as chlorine/sodium hypochlorite, hydrogen peroxide, ozone, or permanganate are commonly added. Conversely, reducing agents such as sodium bisulfite or metabisulfite may be added to remove contaminants such as chromium and selenium. Oxidation and reduction are typically rapid reactions but, since they require chemical addition, will increase the total dissolved solids (TDS) in treated water.

Specific ion exchange resins from several manufacturers are available to remove dissolved metals, arsenic, and nitrate (Figure 2). In this process, sodium or chloride ions are exchanged for the target contaminants. Resin is relatively expensive but has a long life and can be chemically regenerated (either on-site or off-site). The waste stream from ion exchange is typically much less than that generated by RO.

Figure 2. Treatment with ion exchange resins

Biological Treatment

Biological treatment processes include attached growth, suspended growth, and membrane bioreactors. Attached growth processes are most common, but membrane bioreactors are a growing application. Biological treatment can be used to remove ammonia, nitrate, selenium, sulfate, and dissolved metals.

In an attached-growth system, bacteria are attached to a media surface (Figure 3). Media can range from plastic to activated carbon to rock, with media diameters ranging from microns to centimeters. The attached bacteria (a biofilm) provide a very robust process in that it is very resilient to changes in flow, pH, and contaminant concentration. Attached-growth systems are the best choice for treating high or variable concentrations.

Suspended-growth systems are commonly used for municipal wastewater treatment but can also be used for industrial wastewater. Activated sludge is an example of suspended-growth biological treatment. Suspended growth is often used for removal of nutrients (nitrogen and phosphorus). When properly designed, these systems can be used for both nitrification (ammonia removal) and denitrification (nitrate removal). Nitrification is an aerobic

Figure 3. Attached-growth media system

process, while denitrification is anaerobic. Suspended growth is best used for relatively low contaminant concentrations.

In a suspended-growth system such as activated sludge processes (also aerated lagoons and aerobic digesters), wastewater surrounds the free-floating micro-organisms, gathering into biological flocs. The settled flocs containing bacteria can be recycled for further treatment.

Suspended-growth systems typically operate poorly when encountering highly variable waste streams. Suspended-growth systems also require more energy, more equipment maintenance, and are more complex to operate because they involve more equipment than attached-growth systems.

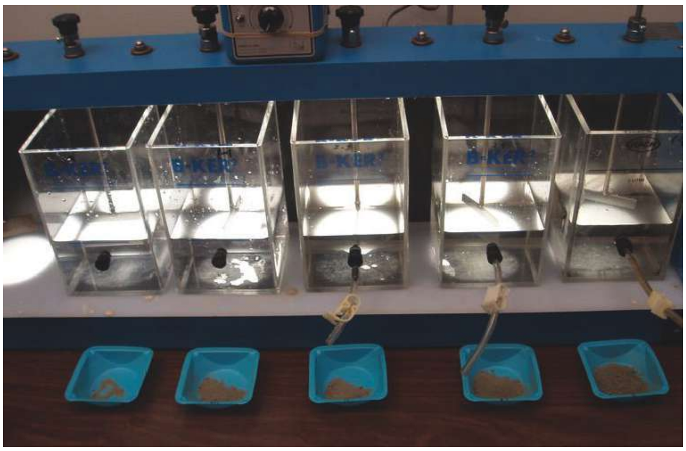

Figure 4. Jar testing

However, attached-growth systems typically require more land, may have odor issues associated with media clogging, and may be unable to treat high wastewater flows. Consequently, urban wastewater facilities often opt for suspended-growth processes, while attached-growth processes are common in small- to medium-size operations.

Bench or pilot testing will usually determine whether the selected technologies can meet the discharge limits and may be required or "suggested" by the regulating agencies. These tests can also provide valuable information for estimating full-scale capital and operating costs. Treatment evaluations can range from jar tests performed in a day (Figure 4) to column tests lasting weeks or months.

Emerging Contaminants Of Concern

Potential emerging inorganic contaminants of concern (COCs) include:

- Methylmercury, which is one of the EPA's National Recommended Water Quality Criteria.
- Radon. A maximum contaminant level (MCL) is being developed by the EPA.
- Cobalt, molybdenum, strontium, tellurium, and vanadium. All are included in the EPA's Contaminant Candidate List (CCL) 3.
- Sulfate, aluminum, chloride, iron, manganese, and TDS. These all currently have secondary drinking water standards.
- Electrical conductivity and sodium adsorption ratio (SAR). These parameters are of concern in coalfield-produced water.

Emerging Technologies

Emerging technologies for inorganic contaminants include:

1. Biochemical reactors for removal of sulfate, TDS, and dissolved metals.
2. Enhanced solar evaporation.
3. Innovative nitrate removal technologies.
4. Innovative arsenic removal technologies.

Summary

Physical, chemical, or biological processes can be used to remove inorganic contaminants from industrial wastewater. Common parameters requiring treatment include suspended solids, dissolved metals, nitrate, ammonia, arsenic, sulfate, and TDS. Prior to selecting a process and designing a water treatment plant, potential treatment technologies should be investigated and bench and/or pilot tests performed.

Recommended technologies for inorganic contaminants commonly found in industrial wastewaters are:

- Suspended solids: clarification and/or filtration;
- Dissolved metals: hydroxide precipitation, sulfide precipitation, or ion exchange;
- Nitrate: attached growth biological processes (denitrification) in almost all cases;
- Ammonia: attached growth biological (nitrification), natural zeolites, or breakpoint chlorination;
- Arsenic: iron addition/filtration, iron adsorption, or ion exchange;
- Sulfate and TDS: attached growth biological or nanofiltration. Enhanced solar evaporation is an option for zero liquid discharge.

For more information, contact Mark Reinsel at http://apexengineering.us. ■

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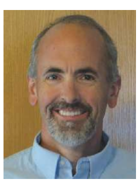

Mark Reinsel, Ph.D., PE, is president of Apex Engineering, PLLC. A process engineer with more than 30 years of experience in consulting, industry, and academia, Mark's recent work has focused on treating mining and other industrial wastewaters through chemical, physical, and biological methods.

Smart Water Questions Answered

A smart-water expert details the impact of data and analytics on the water sector.

By Kevin Westerling with Will Maize

It may be time to shed the quotes around the term *"smart water."* When it was the water industry's pipedream, so to speak, the buzzword-y connotation was appropriate. But smart water technology is now fully functional and greatly effective, at least where implemented, with a trajectory that is both ascending and inevitable. Or, as market intelligence firm Bluefield Research contends, smart water is here to stay.

The prediction for profound impact comes from the many benefits, mostly geared toward improved efficiency, enabled by smart water technology. And while the transition to a proven, more-efficient water management system makes common sense, it is still far from commonplace among utilities. Smart water is here to stay, perhaps, but it nevertheless has a long way to go.

So, in these still-nascent stages of a new era, you may have a number of questions about smart water technology basics, capabilities, operation, and obstacles. The following Q&A — a conversation with Will Maize, Bluefield's senior analyst covering smart water applications and emerging technologies — provides some answers.

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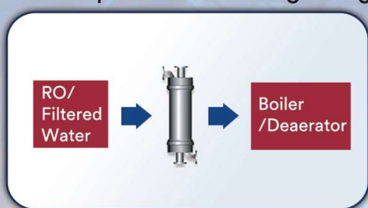

- **Alleviate Pitting and Corrosion**
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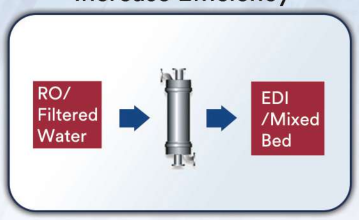

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How do you define smart water?
There are a lot of varying definitions out there, but we define smart water as a group of emerging technology solutions that help water managers operate more effectively. These solutions harness state-of-the-art hardware and software to provide increasing levels of system intelligence, visibility, automation and control, and customer service.

At Bluefield, we take a holistic approach to consider the entire spectrum of smart water solutions — from hardware (e.g., smart meters) to software solutions (e.g., data platforms). The aim is to improve customer and network management through new technologies, data-driven platforms, and more advanced business models.

To give you an idea of scale, Bluefield forecasts the U.S. municipal water sector's spend to surpass $20 billion on software, data, and analytics solutions over the next decade. It's still early, so this could scale quickly.

What is the problem that smart water solutions are attempting to solve?
Historically, utilities have been hobbled by their inability to generate actionable insights from disparate network and water usage data, but this is changing with more advanced data management and cloud-based solutions. Water utilities have been stereotyped in the past as stodgy and never-changing, but this no longer holds true; smart water is bringing the water industry into the 21st century as companies look to adopt these cutting-edge solutions.

By leveraging Big Data, analytics, and the Internet of Things (IoT), key players in the water sector are proactively innovating to help solve issues of water scarcity and address aging water infrastructure. Smart technologies help water utilities be more proactive vs reactive. For example:

- Using imaging to inspect corroding pipes, enabling predictive maintenance;
- Analyzing data in real time to identify leaks that would otherwise go unnoticed; and
- Leveraging software to help utilities and consumers track their home water usage.

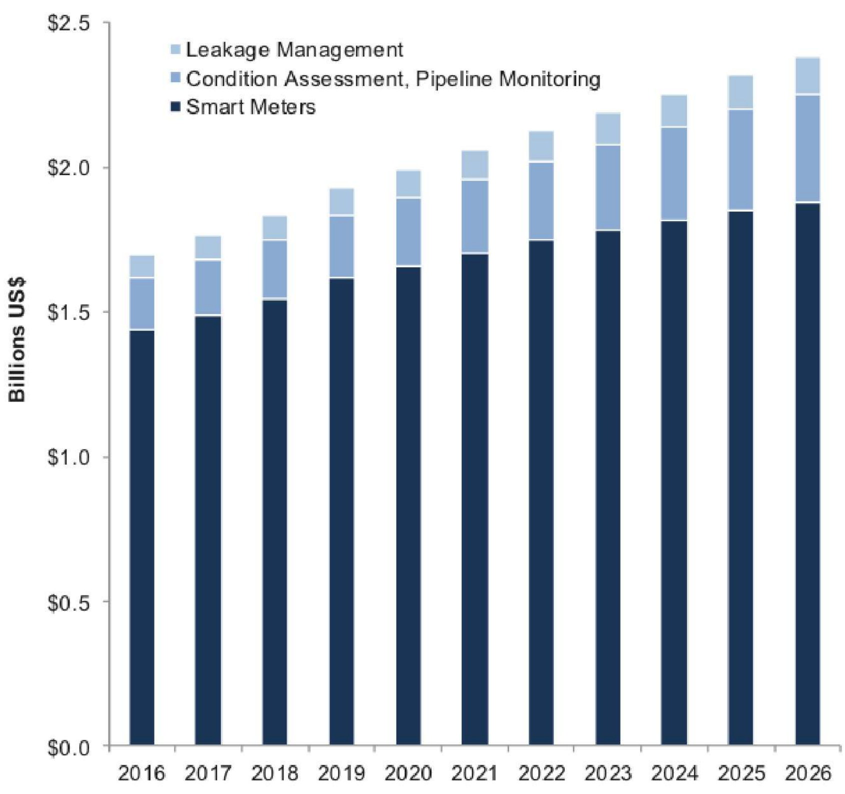
Why is the industry turning to data and analytics now?
There are a number of factors that are leading to somewhat of a perfect storm. First, there is more pressure than ever on utilities to do more with less. Consumers are pushing back on rising water rates and expecting better customer service.

Utilities and municipalities find themselves facing mounting financial constraints driven by falling water revenues and pressure to address aging infrastructure. Approximately 50 percent of U.S. infrastructure has been evaluated as poor to beyond planned life, according to latest EPA reports. And companies are looking for new, innovative ways to address issues such as aging pipes and leakage management. This has sparked an uptick in demand for innovative solutions to more cost-effectively manage billing and customer management, leakage rates, and energy consumption.

Water loss is a big concern, and states are attempting to increase regulations in this area. Water scarcity events have influenced the development of state-driven regulation targeting water loss.

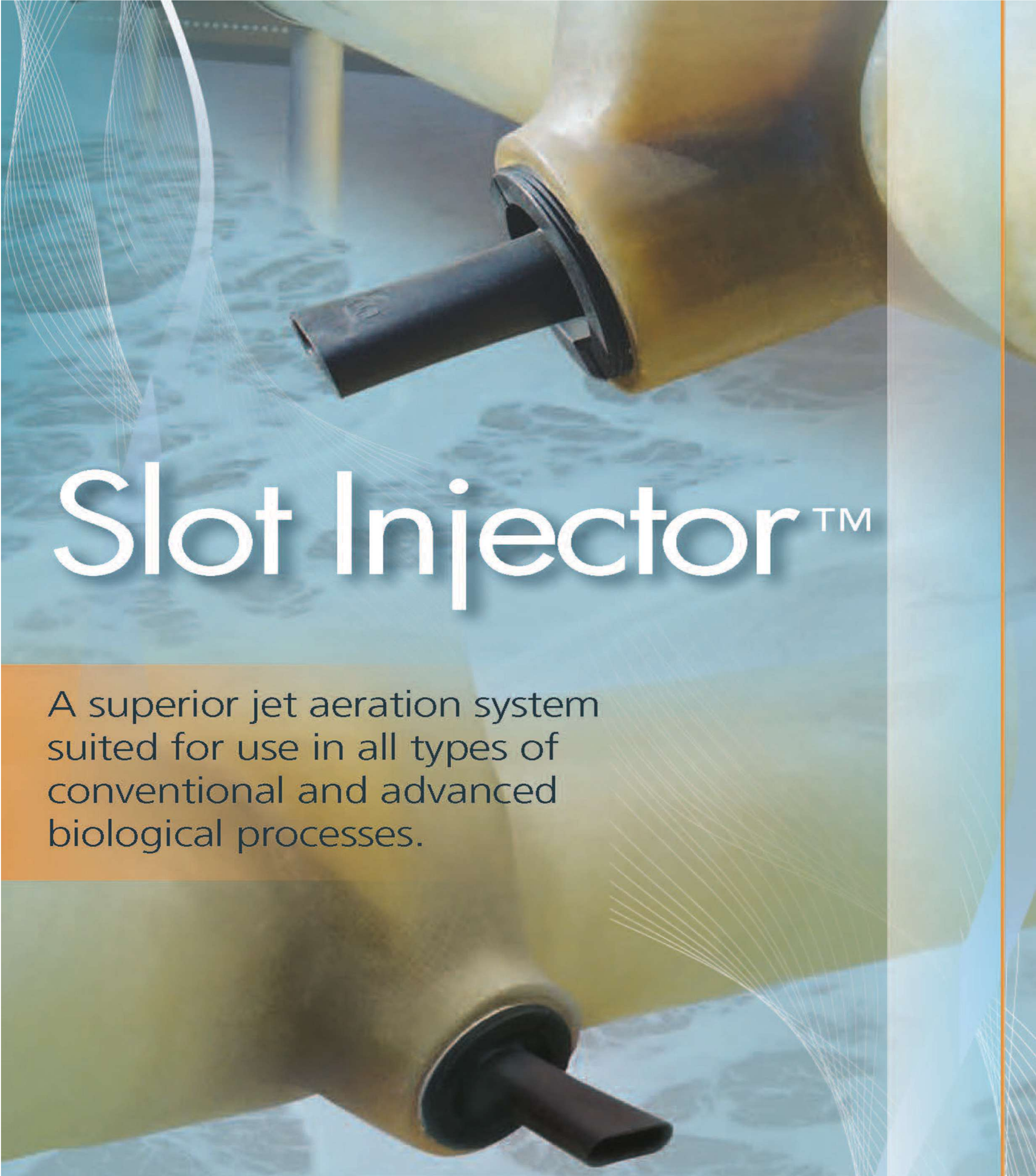
We have seen great advancements in the areas of Big Data and IoT, leading other industries, such as energy, to adopt these technologies. With pressing issues mounting, the water industry is now taking advantage as well.

U.S. Smart Water Forecasts



Can smart water technologies make a difference?
The short answer is yes. The results have been significant. In some cases, smart water solutions have halved nonrevenue water — leaks and billing errors — and reduced energy consumption from 20 to 40 percent. As much as 30 percent of water utility operating expenditures can be improved almost immediately through more dynamic and real-time system monitoring, according to Bluefield's analysis.

What are the fastest-growing segments?
Often the first step in U.S. utilities' smart water journey is through smart water meters —automatic meter reading (AMR) or advanced metering infrastructure (AMI). Meters will continue to represent the lion's share of forecasted expenditures at 82 percent from 2017 through 2026. The challenge, however, is that the data collected



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from these meters — if collected at all — needs to be managed and analyzed. This is where we see big improvements and opportunity.

We are also seeing huge potential in two other areas: asset intelligence and leakage management. We predict that asset intelligence, including pipeline monitoring, asset condition inspections, and asset management will emerge as a key smart water segment as utilities seek efficiency under mounting pressure of operating and capital replacement budget stress. Over $2.7 billion will be directed towards asset condition assessment and pipeline monitoring through 2026, according to our analysis. Given the state of municipal infrastructure, there is a wealth of low-hanging opportunities for improvements.

At the same time, operating expenditures on leakage management will total $1 billion through 2025 as smart solutions for leakage management, driven by fixed-network acoustic technologies, satellite leak detection, and improved real-time network intelligence, capture increased market share.

“The bottom line is that the water industry has a huge need to be more efficient. And there are higher expectations than ever from customers that information networks be more sophisticated.”

WILL MAIZE
senior analyst, Bluefield

Which companies or utilities are leading the charge?

Smart water is bringing a wide range of new companies into the water industry from multiple sectors and value chain positions, which is fitting for an industry opening itself up to the massive potential.

Seizing on this burgeoning demand for solutions is an outside group of venture-backed startups seeking to leverage their data expertise, much of which draws from other industry applications. These data and analytics companies are looking to integrate disparate sources of data to optimize networks, track water quality, and generate insights for asset performance management. Their primary challenge, however, will be overcoming a credibility gap with demonstrated pilot projects and buy-in from municipal utilities. These companies are not new to data and IoT, but many are new to the water industry.

Since 2014, 42 acquisitions in smart water have exceeded $8.2 billion, reinforcing the growing confidence larger water companies are placing on water data and analytics as growth opportunities. We are seeing more diversified players like Honeywell, Trimble, and Xylem moving deeper into the sector.

Early-adopting utilities, including American Water and East Bay Municipal Water District, are leading the shift towards smart water technology adoption. Market leaders, including Mueller and Itron, have moved downstream into communications, data management, and analytics, while recent market entries via acquisition will further reshape the competitive landscape.

As a result, more than 40 companies in the U.S. are positioning to deploy state-of-the-art solutions to enable more advanced levels of system intelligence, real-time network visibility, energy efficiency, and customer management.

We can also look to Europe as a model. European utilities are really at the forefront in driving this space — in the areas of energy efficiency, smart meters, and leakage management.

What hurdles does the water industry face in adopting smart water technologies?

Culture. This is killer to innovation and improvements. For so long, out of sight, out of mind was the modus operandi for utility operators. Today, however, a combination of drought, water quality events in Flint and Pittsburgh, and customer expectations for real-time data and knowledge are increasing the demands on the utilities.

The solutions are not new, and water utilities also face some of the hurdles that other industries are confronting when it comes to Big Data and IoT. They must address key questions such as who owns the data — the utility, the homeowner, or the technology provider? What defines a smart utility? Which of these startups will be around in the next three to five years?

There are issues to be worked out, but we are not that far off from consumers being able to see water usage alongside electricity usage — all from their smartphones.

What would you say to skeptics who say smart water is just a fad?

I would say that just a few years ago there was only a handful of hardware players. But now the market looks entirely different. We are seeing larger, diversified companies enter the fray, utilities reshaping their mindset, and Silicon Valley applying data expertise. This combination has huge potential to change the way the U.S. water industry works.

Smart water is a big deal for the water industry and is here to stay. On the one hand, we are grappling with age-old issues of water infrastructure, pipes over 100 years old. At the same time, there are major technological advances that could revolutionize the water sector.

The bottom line is that the water industry has a huge need to be more efficient. And there are higher expectations than ever from customers that information networks be more sophisticated. I don’t see any of this going away. If anything, there will be more players entering the market and more investment in this space.

Where can our readers get more information on smart water?

Bluefield provides data and analysis across global water markets, and smart water is a key area of focus for us. In April, we released a new report, *US Smart Water: Defining the Opportunity, Competitive Landscape, and Market Outlook*, which is available for purchase and download from our website (www.bluefieldresearch.com) ■

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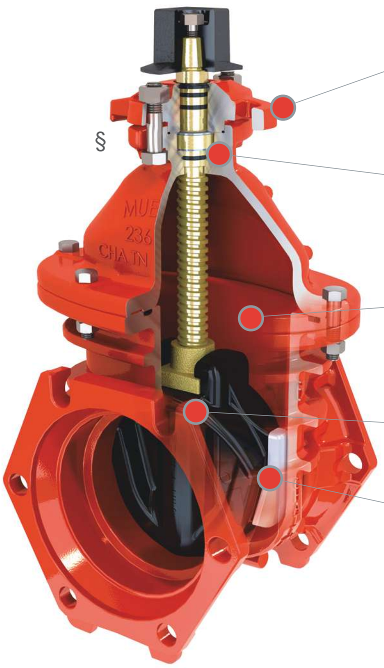

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Best Practices For Grit Sampling And Characterization

The science behind grit removal is an all-important but underserved aspect of wastewater treatment operations – until now.

By Hany Gerges, Ph.D., PE

Performance of grit removal units at water resource recovery facilities (WRRFs) (also known as wastewater treatment plants) has been evaluated by many wastewater practitioners and the subject of many debates in the wastewater industry for the last two decades. Lack of understanding of the nature of the grit and its settling velocity has led to unsatisfactory performance of many installations in recent years. In many situations, litigation was the only way to resolve a performance dispute between equipment manufacturer, the consulting engineer, and the end user.

While the wastewater industry has generally made great progress in the area of treatment technologies, very slow progress has been realized in the area of grit removal. Recent advancements in design of biological treatment systems have led to very low effluent nutrient concentrations from WRRFs, yet the industry is still struggling to define best practices for designing effective grit removal systems.

There are many current grit removal systems in the marketplace that can remove a wide range of grit particle sizes, but their removal efficiencies vary widely. Some can effectively remove the very fine particles, while others remove the heavier particles but are less effective at removing the fine ones. The decision of which particle size to remove should be site-specific and depends on many factors, among which are the size of the WRRF, the variability in the incoming flows, the downstream liquid processes and their ability to capture escaping grit, and the adverse effect of uncaptured grit on equipment and liquid and solids handling processes. Selecting grit removal systems that remove the very fine particles without consideration of these factors will lead to overbuilding of unnecessary units that may not be utilized most of the year. On the other hand, selecting grit removal systems that remove only the heavy particles could lead to an undersized system and unsatisfactory performance most of the year.

What goes in has great bearing on wastewater treatment equipment.

The most effective grit removal system for a specific WRRF removes only the grit that would cause problems for the downstream processes at this facility all year round.

Getting Grit Right

The most effective grit removal system for a specific WRRF removes only the grit that would cause problems for the downstream processes at this facility all year round. The first step in selecting this system is for the wastewater practitioners to determine the nature and quantity of the grit the facility receives. In other words, practitioners need to determine grit particle distribution and estimate the amount of fine grit versus heavy grit in the incoming flows to select the appropriate grit removal system.

To determine the amount, nature, and distribution of grit particles, industry-standard grit sampling and characterization techniques should be applied. Until recently, there was no industry-standard, peer-reviewed, or widely accepted reference for techniques used in sampling and characterization of grit. In 2014, a task force was formed by the Water Environment Federation (WEF) to study the topic and make recommendations to address the issue. The task force developed and published the first grit sampling and characterization manual, *Guidelines for Grit Sampling and Characterization, 2016*. The publication was based


Input raw water pipeline travels to the solid contact clarifier tank.

on industry consensus and prepared and coauthored by industry experts representing utilities, consulting engineers, equipment manufacturers, and academia. It provides the wastewater practitioner with background information that is essential to understand the grit removal process, including removal from liquid streams, washing of grit slurry, and recovery of organics. It clearly identifies the roles and responsibilities of all parties interested in the characterization and sampling of grit, including WRRF staff, consulting engineers, testing companies, and equipment manufacturers. With full understanding of the roles and responsibilities of each party, future grit removal systems will be more efficient and cost-effective, and legal litigation could be avoided.

The publication covers in detail all sampling techniques that have been used over the last decades. It provides a full description of each method, including safety requirements, testing preparation, sampling locations, sampling equipment, sampling procedures, and collection of samples. It also provides the practitioner with a thorough comparison between the different sampling techniques.

In the characterization chapter, full description and discussion of both dry and wet sieve analysis are presented. The publication addresses all aspects of grit characterization, including pretreatment, determination of settling velocity using different techniques, and state-of-the-art techniques for characterization such as particle imaging.

Out With The Old, In With The New

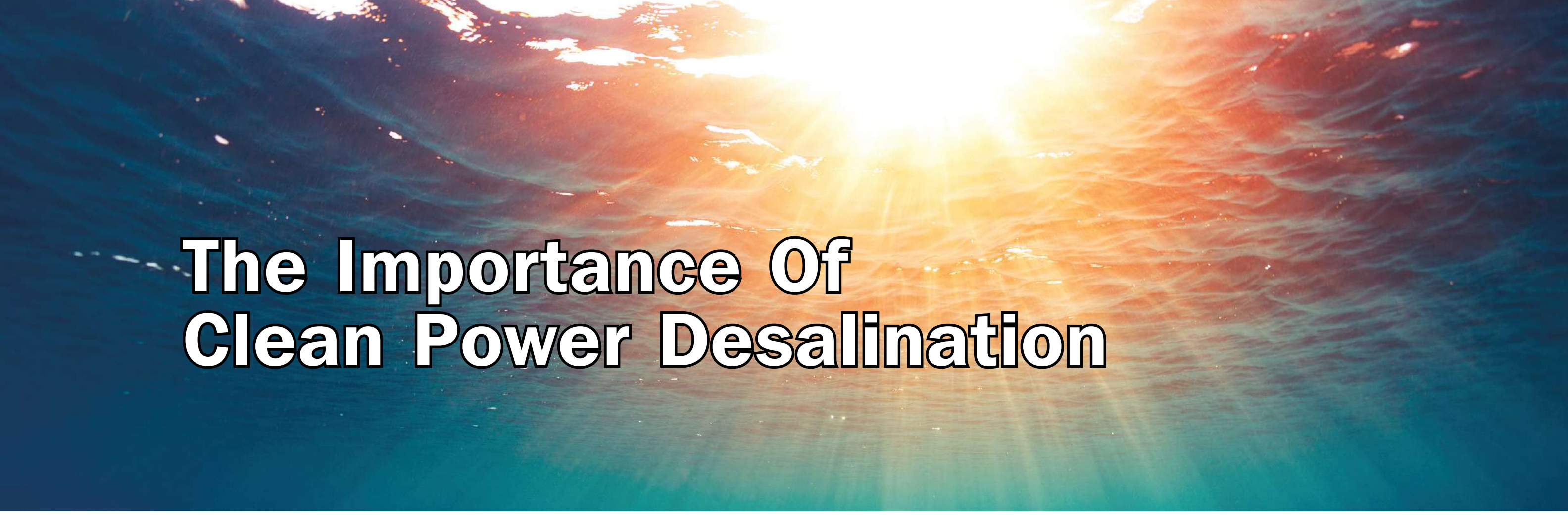
Until recently, grit characterization was conducted by performing sieve analysis of dry samples of the grit (dry sieve analysis). A decade ago, wastewater practitioners didn't differentiate between dry and wet sieve analysis, and grit was characterized based on grit particle size (or mesh size), regardless of the settling velocity of the particle. It was assumed that grit particles are all round, have a specific gravity of 2.65, and that the settling velocity will depend on the size of the particle. Wilson (2007) and McNamara et al. (2009) challenged that assumption and argued that "actual" grit particles settle at much slower velocities than dry particles with a specific gravity of 2.65. The argument was that grit particles, while traveling in the collection system, entrain or get covered with a layer of fats and oil that cause the particles to be lighter and their specific gravity to be less than 2.65. However, when particles are placed in the oven as part of the dry sieve analysis procedures, the fat and oil layer is removed. Recent work at many treatment plants proved that the grit particles have a settling velocity slower than what had been predicted assuming a specific gravity of 2.65.

The publication also includes equations for calculating the quantity of grit received and removed by the WRRFs for liquid and solids streams. It discusses the sand equivalent size of grit particles and conversion of actual size to equivalent size and its relationship to settling velocity. It also presents current challenges and knowledge gaps, future research, and requirements for grit removal.

Guidelines for Grit Sampling and Characterization not only sets the rules for performing grit sampling and characterization, it also paves the road for achieving optimal grit removal through innovative technologies built on the accurate estimation of grit quantities and full understanding of its fate — making it a "must have" for every wastewater practitioner. ■

About The Author

Hany Gerges, Ph.D., PE, has more than 26 years experience in wastewater treatment engineering. His experience has included evaluation, optimization, and design of wastewater treatment plants, including headworks and grit removal technologies. He has also served as HDR's technical advisor for many national and international wastewater authorities in the area of headworks and grit removal. Dr. Gerges is HDR's technical director of wastewater optimization services, based in the Walnut Creek, CA office. He was one of the primary authors of *Guidelines for Grit Sampling and Characterization* (WEF, 2016; www.wef.org).



The Importance Of Clean Power Desalination

Desalination giveth and taketh away – at least typically, due to its drain on energy-related resources (including water itself). But there is a better, smarter way.

By Kate Zerrenner

When it comes to future water supplies, arid regions and states are constantly looking for solutions. And much of the country's population growth is happening in the Western and Southwestern states, regions that are prone to dry conditions under the best of times and have only recently been coming out from the shadow of drought. To compound the issue, climate models predict drier, hotter conditions in these states. Naturally, these areas are turning to desalination — a proven water supply technology.

But there is a hidden cost to desal: energy. Lower-quality brackish groundwater supplies require expensive and energy-intensive treatment prior to use. In fact, the most common process consumes approximately 10 times as much energy as traditional surface water treatment. To illuminate desal's high energy-intensity, take Texas: The state only desalinates 2 percent of its municipal water supply, but this small proportion represents nearly 10 percent of public water utilities' statewide power demand.

Then there's the vast amount of water needed to create that energy in the first place. Roughly 90 percent of the power generation in the U.S. is from fossil and nuclear energy sources, which use a lot of water to produce and deliver energy. For example, power plants in Texas consume roughly 157 billion gallons of water annually — enough to meet the needs of over three million people each year.

By using water-intensive electricity to power traditional desal, we are using water to make water, which makes little sense in our drought-ridden Western U.S. If desalination is to play a role in protecting our water, we need to create plans and policies that are thoughtful about reducing the technology's energy footprint.

International Inspiration

Both Australia and Israel have integrated energy use and pollution impacts into desal planning.

In response to water shortages, Australian cities have turned to seawater desal, which is even more energy-intensive than brackish desal. As a result of public concern over high energy-use and pollution, desal facilities in Perth and Sydney constructed policy and business agreements to conceptually couple grid-connected wind farms to offset the desal plants' carbon emissions. And within the last few years, wave energy-powered desal has come online in Western Australia.

Israel, which gets up to 75 percent of its potable water through desal, has spearheaded some of the most energy-efficient desal technologies available. The country is home to some of the world's biggest desal plants, which use tools like on-site power generation and smart, flexible pricing to keep energy-use efficient.

The Future Of Desal

These are the innovations of the future: coupling desal with low-water renewable energy, like solar and wind, and more energy-efficient desal processes. Pairing renewable energy with desal, in particular, presents an opportunity to transform low-value products (brackish groundwater and intermittent electricity) into a high-value product (treated drinking water).

By integrating renewables with desal, the two sectors might be able to help mitigate each other's challenges. For example, the high energy requirements of the desal process are a major cost factor and potential limitation of its deployment. Powering desal with wind and solar photovoltaics (PV), both of which have very low marginal energy costs and use negligible amounts of water, allows for freshwater production from low-water fuel sources with predictable energy costs. And since many desal plants can be operated intermittently or with prescribed ramp-up periods, the water sector can take advantage of the variable availability of renewables.

Texas Forging A New Path

The 2015 Texas Legislative Session passed a bill that required

If desalination is to play a role in protecting our water, we need to create plans and policies that are thoughtful about reducing the technology's energy footprint.

the state to analyze using solar and wind to desal brackish groundwater on state-owned lands. The study, conducted by the Webber Energy Group at the University of Texas at Austin, found many areas had brackish aquifers and wind and/or solar potential. From the 1,445 sites studied, 193 were technically feasible as well as economically — i.e., the estimated cost of water produced by desal was not higher than the local water price. Further, the study's authors conceded that many more sites could potentially be viable if weighed against future water scarcity under climate models, which were not used here. And, if the price of solar continues to drop — as it is expected to — more sites could become feasible.

Solar power could be crucial to desalination's future.

Another interesting component of the study found that many oil and gas operators are located near the state-owned sites in the study, and those operators typically pay much higher prices than wholesale water prices. Desal plants potentially could sell water to the companies at a lower price, creating a new revenue stream associated with these sites.

The next step in the process is to start piloting one or more of the identified sites and begin developing renewable-powered desal.

Drought-ridden regions and states have to think creatively about how to support growing populations in areas with less available water. Conservation must always be the first step, but innovative water supply technologies are also part of the solution. Desal is not a new process, but it is an energy — and water —hog. If we thoughtfully think through the integrated approach of low-water energy and water supply, we can work for a sustainable future. ■

About The Author

Kate Zerrenner leads the Environmental Defense Fund's Texas and national energy-water nexus efforts, as well as develops and implements strategies to promote energy and water efficiency in Texas. While breaking down financial, regulatory, and behavioral barriers, Kate works to advance clean energy options that reduce climate change impacts, water intensity, and air pollution.

Smart Wastewater Networks, From Micro To Macro

The journey to "smart" has proven more challenging for wastewater networks than for potable water, but real-world impact is imminent. Learn what potential awaits the industry at monitoring's latest frontier.

By Oliver Grievson

What does it mean for a wastewater network to be "smart"? What is the wastewater industry hoping to achieve by going on a "smart" journey? It is a subject that has rattled around the water and wastewater industries for many years, and yet most of the focus has been on the potable water network side of the business, where the obvious gain is reducing non-revenue water. However, in the past few years the value of acting more "intelligently" in the wastewater network — nay, the wastewater system — has come more to the forefront as the value of taking a similar journey to our potable water colleagues comes to bear.

The question is, where do we start? The wastewater network is a complex system, as it has multiple inlets and multiple outputs (if you take storm overflows into context). The answer from some of the water and sewerage companies (WASCs) and consultants working with them has been to take a number of different approaches, as we have recently heard at a number of conferences and workshops in the area of "smart wastewater networks."

Starting Small And From The Ground Up

The major problem is in understanding the exact problem and from where it comes — and in so doing, devising a strategy for its resolution. Is the problem related to … ?

- Flooding of both internal and external properties
- Pollution incident detection and management
- Alarm handling and response
- Blockages and sewer misuse
- Asset reliability and the cost of running the network
- Sewer capacity and storm overflows

In truth, it is a combination of all of the above, and there are various teams in all of the WASCs handling different aspects of what has to be done to protect the customer and the environment.

One of the major issues is that of sewer misuse, be it from fats, oils, and grease (FOG) to the wonderful aspects of what people throw down the supposed "wet bin." Any network technician in the industry will talk about FOG and unflushables as a major problem that has been attributed to 50 percent of all pollution incidents and 66 percent of all flooding incidents for one of the UK's WASCs. The solution is, of course, education and working with customers to understand the consequences of putting the wrong thing down the drain. Despite this, there are technological solutions to the problem as well. A recent Sensors for Water Interest Group (SWIG) workshop heard from one engineer his vision of building the technological solution up from the bottom by using a combination of pump reversal modules that reverse the pump to clear blockages on an automatic basis, restarting pumps, and providing flow meters to detect whether a pump is actually working or not. The effect is to increase technician visibility of what is

> *The major problem is in understanding the exact problem and from where it comes — and in so doing, devising a strategy for its resolution.*

going on in the network and enable technicians to be more effective in their diagnosis of issues, thus protecting the customer in a more efficient manner, while also protecting technician health and safety by ensuring they are not called out to a false incident in remote areas in the middle of the night.

And Getting Bigger …

Working on the small scale has its value, but it won't resolve all situations; there is a place for increased monitoring in the wastewater network, with the major benefit being protection of the environment. This is where the Event Duration Monitoring program comes in. It is one of the focuses of the WASCs this asset management period (AMP). It stems from a Ministerial Direction that promised the monitoring of the "majority" of storm overflows by 2020. The knowledge about these assets and their performance has been questioned, and the subsequent impact on the environment is a big question that the Minister and the Environment Agency wants answered in order to find out the inherent problems that lie in the wastewater collection network. Over the next few years, teams of people will install thousands of monitors prioritized so that the highest-impact areas are completed first to monitor when, where, and for how long spills from the wastewater network are happening.

The first monitors have been installed and a year's worth of data collected, and approximately 12 percent of combined storm overflows (CSOs) warrant further investigation based upon their current performance and, depending upon the results, drive further investment within the network infrastructure. The need for the future is to see what impact any schemes have on the holistic environment, what improvements can be made, and what impact this has on the holistic water environment and the quality of future discharges from our wastewater treatment works.

… And Bigger

Taking a step on from the monitoring of the network, the next question that has to be asked is what we can do to provide a more strategic management of the wastewater network. It is an approach that has been taken in Europe for many years. The multiple reports by UK Water Industry Research (UKWIR) and Mouchel (now part of WSP | Parsons Brinckerhoff) on active system control describe in detail what work needs to be done and what has been done in other countries. A great example of this is in Denmark, where high-speed modeling techniques have been used to provide overall management of the wastewater network so that it can be managed more effectively.

Another example is the work that was done in the Southern Water region of the UK. The Eastney project used a combination of modeling techniques and rainfall radar as part of a solution to mitigate the risk of flooding within the area. Part of a much wider solution that includes green infrastructure, the smart wastewater network gives the company advanced warning of what will happen moving forward, informing decisions on methods of operation for the pumping station, which is a critical part of the overall wastewater treatment system.

The individual parts of this project form building blocks to what the smart wastewater network is made up of (in a simplified way):

- Weather radar and modern rain gauges;
- Sewer level monitors;
- A centralized sewer network model capable of fast simulation; and
- Communication and telemetry systems to tie it all together.

If there is a weakness, it may be the quality of the weather radar systems, but this Data-as-a-Service (or DaaS) is a solution that others within the water industry are looking at — a couple of years ago, high-quality X-ray fluorescence (XRF) weather radars were investigated by the University of Delft, and weather data and prediction has become a data service within the water industry. The impact of weather radars, coupled with data from rain gauges, will allow for predictive models to determine how the "smart network" can help the industry manage flows.

The Future Of Smart Wastewater Networks — A Holistic Approach

The ultimate aim of a smart wastewater network is to help the industry to make better-informed decisions about how to operate the wastewater system by facilitating the flow of wastewater through the entire system, all the way from the customer's toilet, through collection, into treatment, and out to reuse or recycle in such a way that we optimize not just the cost of the whole process but the impact that it has on both people and the environment.

Operationally, this comes from limiting incidents and events such as pollutions and flooding to either zero (the brave aim of the future) or as near to zero as we can possibly get. This can be achieved, and we are seeing water companies take this approach now with a number of different technologies — from a simple "Customer Flood Alarm"

that warns of rising levels in areas of known problems so that issues can be dealt with according to priority, to systems that stop pump blockages and warn of problems via pump-reversing, monitoring of pump currents, and using flow meters to give a true picture of what is happening.

The strategic direction is looking at the much wider, more-encompassing systems, and the advantage here is to limit the capital build of detention tanks in the network and storm tanks within the treatment works. The best case of this was in Barcelona, where a smart wastewater network was constructed for the Olympics in 1992. The alternative was a vast detention tank under the center of the city, and the smart wastewater network approach was the considerably cheaper option.

The impact of weather radars, coupled with data from rain gauges, will allow for predictive models to determine how the "smart network" can help the industry manage flows.

From a holistic point of view, the treatment works must be brought into the equation too, and it is at this point of bringing together two aspects of the industry — network and treatment, where the real savings can be made by controlling the flow of water through the whole system and limiting the environmental impact of the wastewater systems — that we can truly get more for less.

So, what does this wastewater system of the future look like?

In normal day-to-day conditions, the smart wastewater network of the future controls flows, flattening out the flows that are received at the wastewater treatment works. It monitors how much time sewage spends in the network, aiming for a completely flat flow profile at the treatment works with regular, automated flushing cycles to ensure that the sewer stays as debris-free as possible, controlled by sewer level monitors to pick up unusual levels that might highlight blockages starting to develop. Various tools are used to keep the problems at bay, such as pump-reversing and flow monitoring to ensure that the flows keep moving and pumps don't block. Where problems are starting to appear and hot spots start to develop, an alert is triggered to look into potential sewer misuse. CSOs from the system are dry.

Flows pass forward to the treatment system, where the relatively uniform flows enable efficiency of treatment and virtually eliminate the need for treating peak flows. This enables a uniform production through the process, which further improves the treatment efficiency.

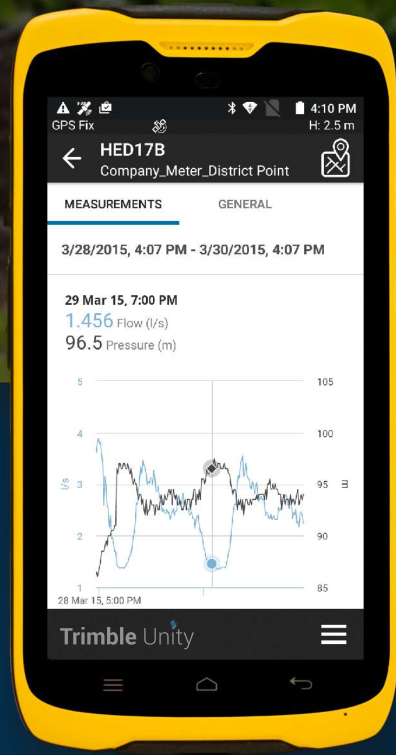
The intelligence of the system kicks in with the prediction of rainfall events. If the system were to predict that the sewer in its current state can't manage all of the flows within a six-hour period, it could recalculate and ramp up flows so that the required capacity of the sewer is available with an appropriate safety margin. The flows are managed and held within the sewers. The CSOs are still dry. If the rainstorm continues longer than predicted and causes a potential problem at a customer's premises, an alert is triggered in the control center, and a team is allocated to resolve the issue for the customer so that an incident is mitigated or avoided.

This is a fictional, *potential* system of the future, but what we have heard at the various workshops and conferences is that this is a future that in reality isn't that far away. The technology exists, from sewer alarms and pump-reversing systems to the potential for network flow monitoring, event-duration monitoring, and customer flood-protection alarms. Taking a step up in complexity, weather radar systems, network model, and active control systems also exist. Finally, analytics and visualization systems exist as well, enabling the vast amount of data that is inevitably produced to be shown in a way that can be understood and acted upon.

It's a system that is starting to be developed by some water companies, and more recently we have seen the development of the factory approach famously mentioned in a STOWA (Dutch acronym for the Foundation for Applied Water Research) report on wastewater treatment works of 2030. "Production efficiency monitoring systems" have worked out fantastically well for energy, water, and nutrient factories, and the extension of this approach to the wastewater network is just another step to a "smart industry" future. ■

About The Author

Oliver Grievson is the wastewater flow and quality instrumentation specialist at the Foundation for Water Research, the director of the Sensors for Water Interest Group, a member of the ICA special interest group of the International Water Association, and founder of the LinkedIn Group "Water Industry Process Automation & Control" — all in addition to his duties as a flow compliance and regulatory efficiency manager.



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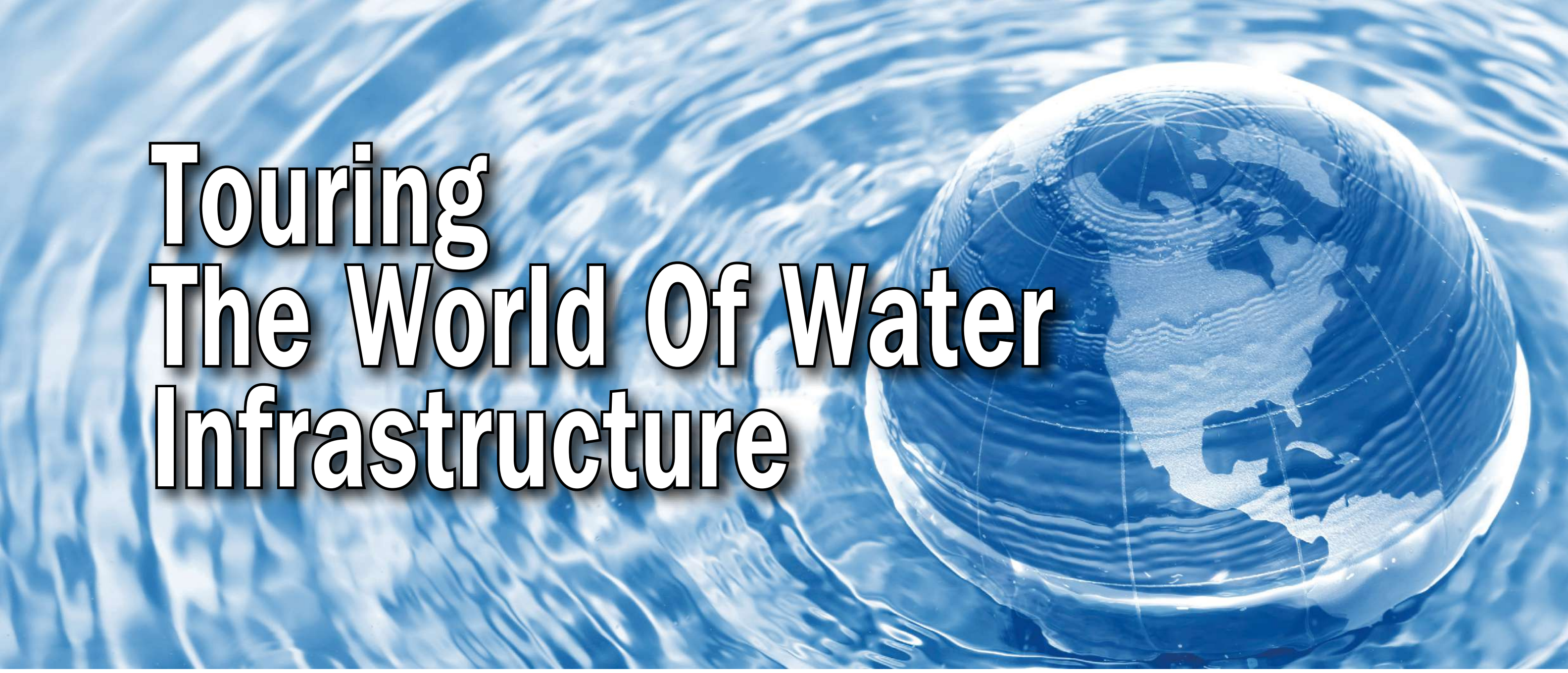

Touring The World Of Water Infrastructure

An ambitious, globe-trotting program invites attendees to learn from the infrastructure accomplishments and challenges of the world's premier riverfront cities. With water becoming an increasingly valuable resource and the world's drinking and wastewater infrastructure in peril, what can these metropolises teach us?

By Peter Chawaga

Water has long played a critical role in how the world's greatest cities were formed and how they grow into the future.

With an understanding of just how crucial that relationship is, AECOM, an infrastructure design and construction firm, and Asia Society, a nonprofit focused on education about the continent, centered the inaugural year of its "Imagine 2060" program on the world's urban waterfronts.

The overall program, which will be conducted for three years and travel around the world, wants to motivate leaders in urban design, infrastructure, and public policy to think about the long-term infrastructure needs of their respective cities.

"AECOM and Asia Society identified five key lenses through which to consider each city's future state," said Sylvester Wong, an AECOM vice president and its head of buildings and places for the Philippines. "It is the effective balance of well-being, economic development, culture, mobility, and innovation in project delivery, which lie at the heart of any city's success. Using these lenses, AECOM and Asia Society will ensure the key insights are collected and shared between the cities and the participants."

All five of these lenses could easily describe the importance of renewed focus on a city's relationship to water, particularly those with waterfronts. With that in mind, the first year of Imagine 2060 will visit Manila, Sydney, Los Angeles, New York City, and Hong Kong under the title "2017: At The Water's Edge."

"Seafronts and riverfronts are the birthplace of most of the world's urban conurbations," Wong said. "As cities have grown, their relationship with water has grown, as an essential potable resource, as a mode of transport, as access to trade. But also as a threat, from flooding and climate change, to a conveyance of pollution."

Exploring Manila

The program began with a visit to Manila. The city's history provided an ideal starting point to examine the role that water plays on city infrastructure.

"Water surrounds Manila on three sides. Water-related experiences and quality touch the lives of everyone in the city," said Wong. "By re-embracing Manila's identity as one of Asia's most relevant waterfront economies, Manileños have an

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opportunity to articulate a unique position and trajectory in the global economy."

Crucial to this vision, however, is a focus on water and wastewater treatment.

"Quality of potable water from its reservoirs is impacted by flooding and storms and quality of waterfronts from pollution," said Wong. "Currently, only 8 percent of Manila's population is connected to the sewer system, which puts major pressure on rivers and oceanfronts to deal with sewage. With a vision that harnesses waterfronts and an urban population that continues to boom, Manila must be bolder in its plans to refresh and expand its capacity to clean and treat water."

Around The World

While each stop on the Imagine 2060 tour has its own relationship to source water and its own unique challenges for drinking and wastewater, they share the need to refocus on infrastructure in order to grow into the future.

Sydney, for instance, faces questions over who should protect the resource.

"Sydney is renowned as a community that celebrates life on the water and the evolution of its waterfront … [and] is filled with lessons in regional and multijurisdictional institutions and the challenges of advancing and stewarding a shared resource," Wong said.

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Los Angeles is, of course, plagued with water scarcity problems and questions about its iconic river.

"Los Angeles' own history sprang forth from the epic diversion of water from the north for cities and agriculture, and today the Los Angeles River is both a barrier and a seam stitching together the sprawling megalopolis," said Wong. "Efforts to revitalize that river's edge, combined with the evolution of the working industrial waterfronts all along the coast, are today key springboards for L.A.'s future."

New York City presents a high-level example of the importance of water and wastewater resiliency in the face of emergency.

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"New York is one of the leading harbors in the world, also enabled by a revolutionary water infrastructure during its early days," Wong said. "Surprised and stunned by the impact of Hurricane Sandy, its future lies not only in coping with the stresses of aging water and transport infrastructure, but also in better preparation for the acute shocks of climate change."

Post-Hurricane Sandy, New York City Transit employees pump water out of the Cranberry Street Tunnel, which carries trains between Brooklyn and Manhattan underneath the East River. (Credit: Flickr/ Metropolitan Transportation Authority of the State of New York)

The last city in the tour will provide a glimpse into a city's infrastructure that AECOM sees as an international model.

"The final stop of the series takes us to Hong Kong, which is an exemplar of how to embrace its waterfront identity over the past 40 years," Wong said. "The city has developed some of the world's most impressive infrastructure, including undersea tunnels, typhoon-resistant rail bridges, territory-wide treatment conveyance systems, and storm and slope management that continues to evolve."

End Of The Tour

As something of a grand tour, hitting some of the world's most prestigious waterfront cities, the inaugural Imagine 2060 program has an ambitious agenda and an even loftier, overarching goal: to change the way the world thinks about water and wastewater infrastructure.

While it might not be realistic to expect such diverse cities to change overnight nor for attendees to influence their own cities' infrastructure on a revolutionary level, 2017: At The Water's Edge certainly marks a step in the right direction.

"As the program and conversation evolve, we hope for participants to be inspired by the enabling relevance of all forms of water, as resource, as place, as identity," Wong said. "We hope that attention to the quality of our most precious resource is recognized as an enabler not only of a healthy, mobile, connected community, but also of a competitive, investible, sustainable city." ■

About The Author

Peter Chawaga is the associate editor for *Water Online*. He creates and manages engaging and relevant content on a variety of water and wastewater industry topics. Chawaga has worked as a reporter and editor in newsrooms throughout the country and holds a bachelor's degree in English and a minor in journalism. He can be reached at pchawaga@wateronline.com.