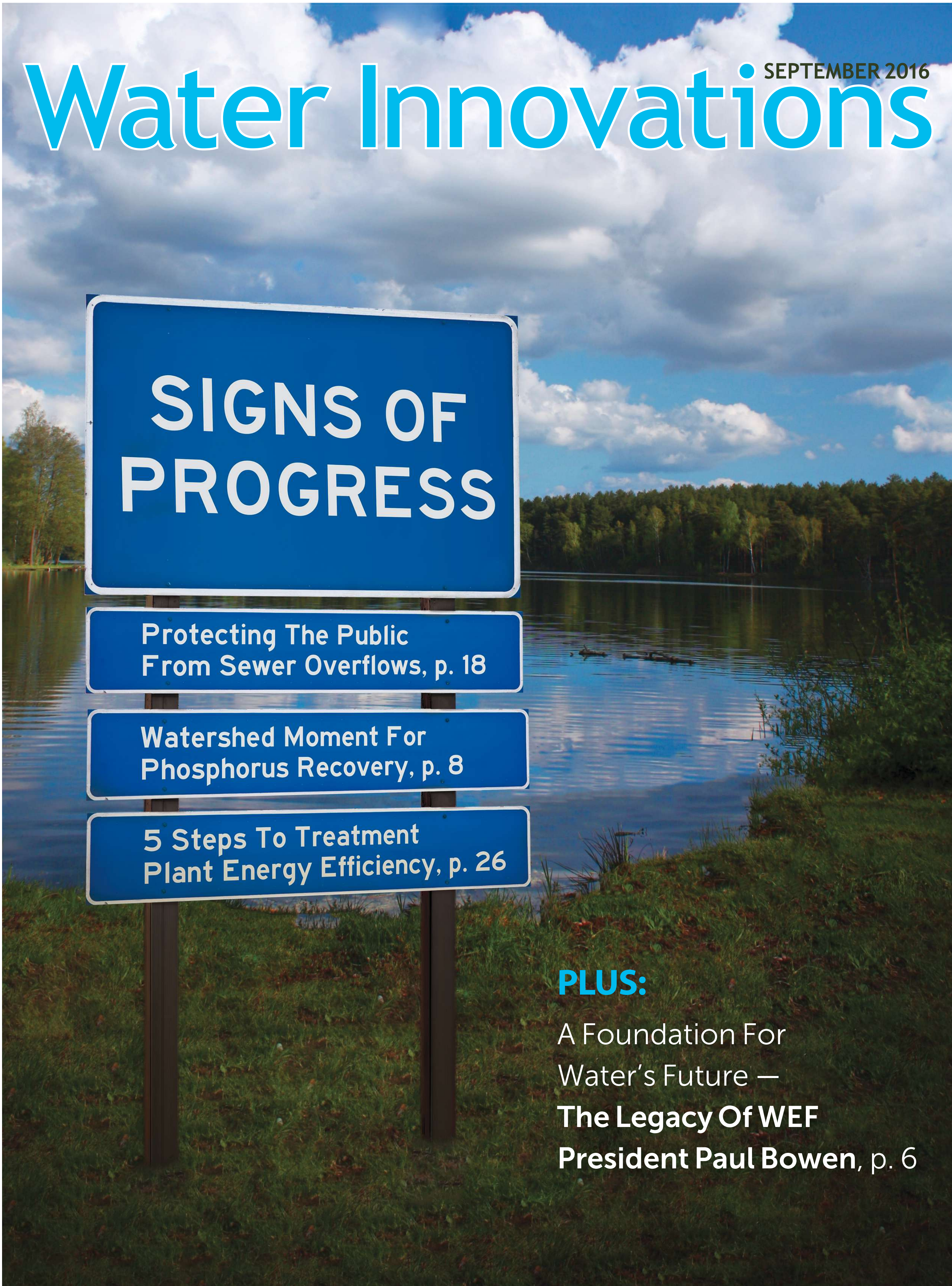

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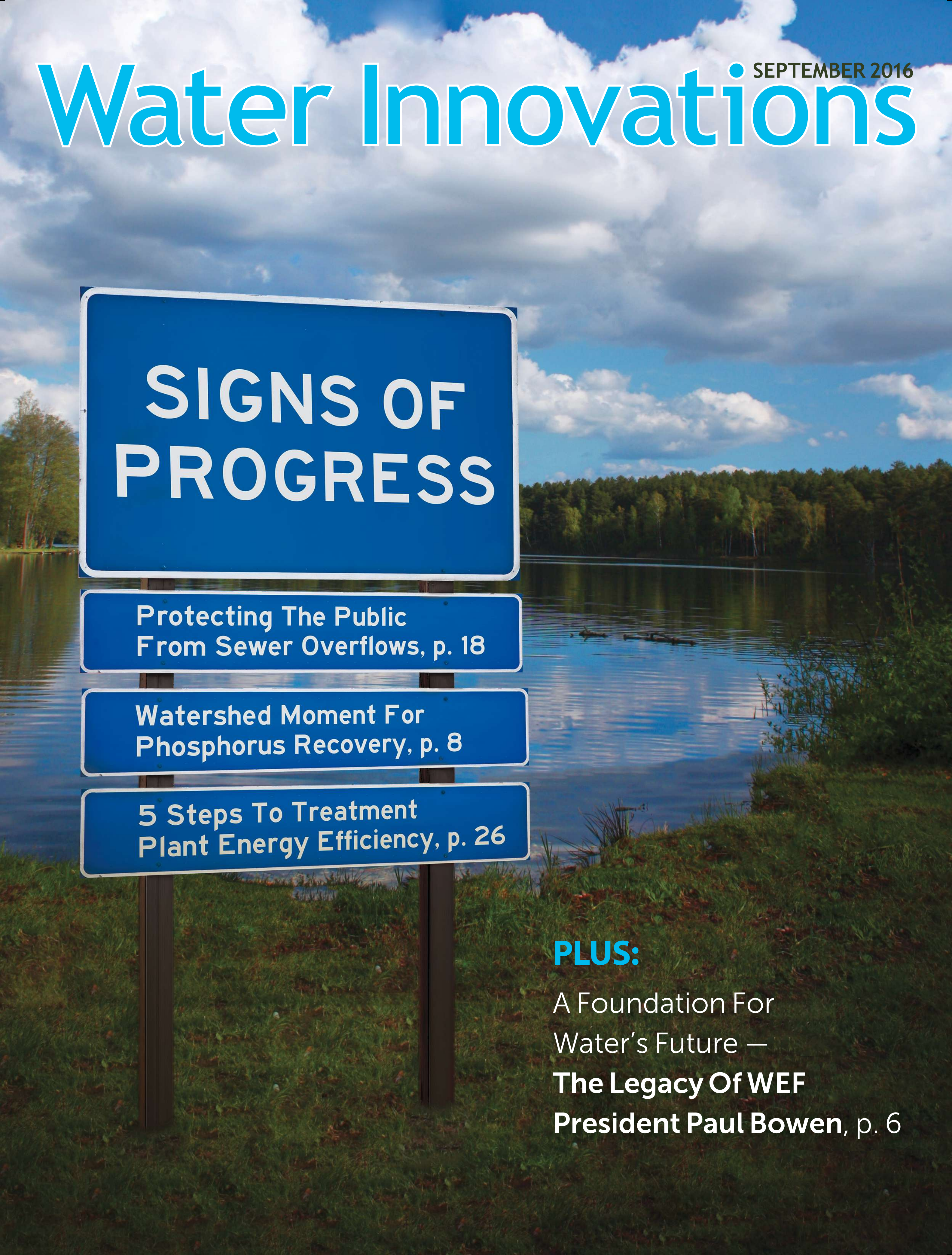

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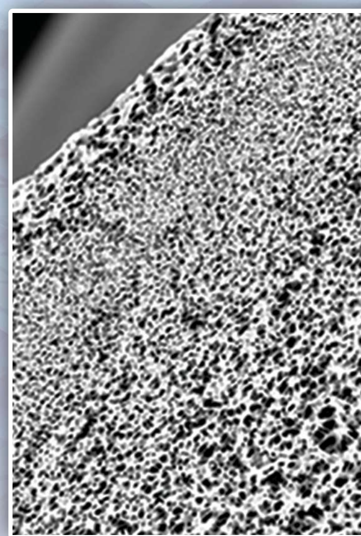

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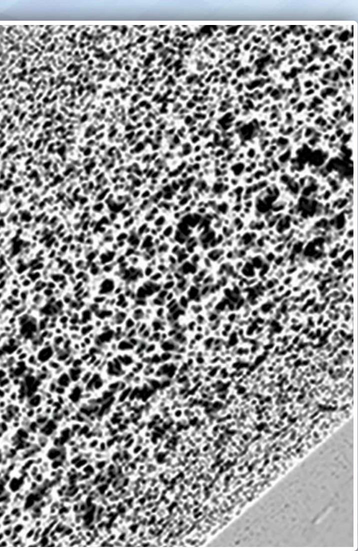

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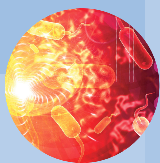

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EDITOR'S LETTER

By Kevin Westerling
Chief Editor, editor@wateronline.com

A Foundation
For Water's Future

The president of the Water Environment Federation discusses key organizational initiatives to improve the fate of the water/wastewater industry.

Paul Bowen wants to build a legacy. The director of sustainable operations at The Coca-Cola Company has served for the past year as president of the Water Environment Federation (WEF) and has successfully achieved a number of objectives, but most importantly he has forged a path for future success. His vision and methodology for meeting objectives, buttressed by performance metrics and accountability, have been embraced by WEF staff and will be sure to influence the organization's operations — as well as water industry professionals and water quality itself — for years to come.

"It's about setting goals, objectives, and milestones so that you know where you're going, how to get there, and how to measure your path to success," related Bowen. "It's about metrics."

This philosophy is embodied at WEF by the creation of a three-year business plan that will set a new organizational standard — and likely produce better results, as processes are evaluated and adjusted for effectiveness. It's an approach common in the private sector, where Bowen has already established a legacy at Coke; under his guidance, the soda giant is on course to be water-neutral by 2020.

Bowen ends his one-year term as president of WEF at the culmination of the 2016 Water Environment Federation Technical Exhibition and Conference (WEFTEC) in September, but his three-year plan ensures that his influence will endure. In fact, Bowen shared with me three initiatives of his tenure, detailed below, that he believes will have lasting impact.

The Three-Year Business Plan

"What the plan does is allow the organization — an organization that changes leadership every year — to maintain its direction and achieve the results we want without zigzagging course," Bowen explained.

The directives of the three-year plan are to:

- Develop an engaged membership that is representative of the multiple practice areas of the water environment industry.
- Provide a broad range of professional content and programming that is relevant and widely valued by the water sector worldwide.
- Generate an increased public awareness of the value of water, leading to increased funding to protect water quality.
- Establish the conditions that promote accelerated development of innovative technologies and approaches in the water sector.
- Operate a sustainable business that supports our mission and enables WEF to seize new opportunities in the emerging water sector.

Calling On Young Professionals

Bowen acknowledged the challenge of replacing the retiring workforce of the water industry, adding that "Millennials have a tendency to be less involved with organizations." To counter this and build for the future, he has led WEF's efforts to recruit young professionals (YPs) and convey the organization's value in a more concise and productive way. "We want to make sure that we get them thoroughly engaged to better convey the benefits that WEF can bring."

For example, WEF has partnered to help YPs and other professionals from the U.S. attend major water events in Germany and Singapore, and likewise brought foreign YPs to WEFTEC. "We're a global organization," noted Bowen. "We have partnerships with the German Water Association, the International Water Association, Singapore PUB, the Korea Water Association, the Japanese Sewage Works Association … so we're always trying to figure out better ways to integrate the membership and to add member value by these partnerships."

Part of the benefits package could also include education funding, according to Bowen. "We're looking at a scholarship program and how we can use that to further engage YPs at all levels, whether they're in consulting and need to go back to college or whether they're operators who need to go to school for their next license or certification."

Wastewater Utilities As Sustainable Businesses

Bowen also urges wastewater utilities to generate revenue by evolving into "wastewater resource recovery facilities." WEF has created guidelines for achieving this by publishing the *Energy Roadmap* and the *Nutrient Roadmap*, with the *Water Reuse Roadmap* set to debut at WEFTEC 2016. Next up, if Bowen's proposal is carried out, will be a *Sustainable Business Roadmap* for utilities.

He provided a number of examples of how wastewater utilities can draw revenue, including patenting and commercializing innovative processes, selling recovered nutrients as fertilizer (see our next story), recovering and monetizing precious metals, and selling treated water as a fit-for-purpose product to agricultural or industrial users, especially in water-scarce areas.

"The whole idea of generating revenue is to help with capital expenses, to offset potential rate hikes, and to provide education for employees as needed," said Bowen.

Spoken like a true public servant, despite his day job at Coca-Cola — or perhaps because of it — whichever hat he wears, Bowen seems destined to establish a positive legacy.

Measuring The Impact Of Phosphorus Recovery – From The Midwest To The Gulf Of Mexico

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) has taken the lead in transitioning its wastewater treatment plants to water resource recovery facilities, resulting in environmental, economic, and social benefits that stretch well beyond the Windy City.

By Allison Hirsch Fore

Beginning in May 2016, the world's largest wastewater treatment facility, the Stickney Water Reclamation Plant (WRP), became home to the world's largest nutrient recovery facility, and the impact of its cutting-edge technology will reverberate almost 1,000 miles away.

About The Stickney WRP

The Metropolitan Water Reclamation District of Greater Chicago (MWRD) owns and operates the Cicero, IL-based plant. Governed by a nine-member Board of Commissioners, an executive director leads almost 2,000 employees who maintain the Stickney WRP and six other plants, along with 22 pumping stations, 35 flood control and detention reservoirs, 560 miles of intercepting sewers and force mains fed by approximately 10,000 local sewer system connections, and 76.1 miles of navigable waterways. Stickney itself is home to nearly 400 employees.

The Stickney WRP serves 2.3 million people in a 260-square-mile area, including the central part of Chicago and 46 suburban communities. It encompasses 413 acres and treats up to 1 million gallons of water per minute, the equivalent of pumping two Olympic-size swimming pools.

On average, the Stickney WRP cleans 700 million gallons of water per day with the capacity to treat up to 1.44 billion gallons per day. The plant was constructed in two phases; the west side of the plant was placed into service in 1930, followed by the southwest portion in 1939.

From the time raw sewage enters the plant, it takes about 12 hours to process, clean, and release the water to the Chicago Sanitary and Ship Canal. The process has evolved since the MWRD was formed in 1889 as the Sanitary District of Chicago. From its first directive to eliminate pollution in Lake Michigan, the source of the area's drinking water, the MWRD's mission expanded to improving the local water environment through the construction of its many facilities and water treatment operations. The MWRD pursued and received statutory authority to provide stormwater management services for Cook County in 2004. In the ensuing years, the mission has evolved even further — to recovering critical resources from what was previously considered waste.

The Decision To Build A Phosphorus Recovery Facility

Excess phosphorus is the limiting nutrient in fresh water across the globe and can threaten to endanger the water environment. Phosphorus enters bodies of water from a number of sources, including urban water treatment facilities. Excess phosphorus in waterways can cause algae to grow and bloom, creating toxic conditions that threaten aquatic life and severely limit recreational enjoyment of lakes and rivers. As a result, the U.S. EPA has mandated that the state of Illinois reduce phosphorus runoff in receiving streams by 45 percent. By implementing nutrient-reducing technologies at its three largest plants (Stickney WRP, O'Brien WRP in Skokie, IL, and the Calumet WRP on Chicago's South Side), the MWRD will achieve 20 percent of the state's reduction goal by as early as 2017. As a water industry leader, the MWRD seized the opportunity to lead the nutrient-reduction effort. Accordingly, these factors led the MWRD to implement an effective phosphorus management strategy and hire Black and Veatch to construct the $31 million facility.

The Selection Of Ostara

The MWRD explored an array of nutrient recovery alternatives before selecting Ostara's Pearl® process. The Pearl process provides a closed-loop solution that recovers phosphorus and nitrogen to form a high-value fertilizer that generates revenue for wastewater treatment facilities while helping meet environmental regulations. Traditionally, when wastewater treatment plants remove phosphorus from their discharge stream, the nutrients are recycled into their system, creating struvite. Struvite not only clogs pipes and valves, which reduces flow, but requires costly maintenance. Although chemical additives can temporarily relieve struvite problems, it is a costly solution that also generates solid waste that requires disposal.

The MWRD installed three Pearl 10000 reactors with a production

One of the three reactors installed at the world's largest phosphorus recovery facility at the Stickney WRP.

capacity of up to 10,000 tons of a high-value, continuous-release fertilizer product per year that will be marketed and sold as Crystal Green®. Every ton of Crystal Green produced will be purchased by Ostara, which will share the revenues with MWRD from the sale of Crystal Green to buyers in the turf and agriculture markets; the MWRD expects the revenue to exceed operational costs. In addition, the facility will benefit from cost savings in chemicals, solid waste disposal, maintenance, and power. Following the successful commercial startup of this facility, the MWRD plans to implement WASSTRIP®, a process that turbocharges the nutrient recovery process and increases the amount of phosphorus recovered by more than 60 percent. As a result, the efficiency of the Pearl process will be further enhanced to decrease the magnitude of struvite scale formation and alleviate operational issues.

How The Nutrient Facility Tied Into Current Operations

Treatment at the Stickney WRP includes coarse screens, fine screens, grit removal, and primary treatment (gravity settling that removes readily settle-able solid material) followed by secondary treatment (activated sludge) and then discharge to the Chicago Sanitary and Ship Canal. For solids, primary sludge is screened and concentrated utilizing gravity concentration tanks, and waste activated sludge is thickened utilizing centrifuges. These solids streams are combined and anaerobically digested. Some of the digested sludge is currently sent to solids storage lagoons for aging. The remainder is sent to centrifuges for further dewatering (to approximately 25 percent solids). These solids are sent to multiple outlets: a pelletizer facility, farm land application, solids lagoons for aging, or solids drying areas for air drying. The aged solids from the lagoons are further air-dried on solids drying areas prior to beneficial reuse. Various recycle streams (centrates) from the many processes are returned to the headworks of the WRP.

The phosphorus recovery facility is tied into the recycle streams of the centrifuges. It will initially accept post-digestion centrifuge centrate, and at a later date when the MWRD has designed and implemented the WASSTRIP technology, the facility will also accept predigestion centrifuge centrate. The Pearl process can recover more than 85 percent of the phosphorus and up to 15 percent of the nitrogen from wastewater streams before they accumulate as struvite in pipes and equipment.

"To see the largest wastewater treatment facility in the world implement Ostara's system is proof to municipalities that there exists a viable and cost-effective solution to address their nutrient challenges," said environmental advocate and attorney Robert F. Kennedy Jr., an Ostara board member. "Having a solution to solve plant issues while addressing more global challenges affecting the nation's watersheds, without economic burden, is progress for the environment, ratepayers, and future generations."

The MWRD's new nutrient recovery facility is an example of how progressive technology can be implemented to transform a wastewater treatment facility into a resource recovery center, providing significant environmental benefits to the Chicago Area Waterway System and downstream to the Mississippi River and the Gulf of Mexico. The

The phosphorus recovered from the MWRD's Stickney WRP is converted into a continuous release fertilizer product called Crystal Green®.

fertilizer byproduct is both economically and environmentally viable. Removing phosphorus from the water and reusing it for agricultural production represents a significant shift in the wastewater industry from treatment to recovery for reuse.

"The MWRD is dedicated to becoming the utility of the future," said MWRD President Mariyana Spyropoulos. "Ostara's technology is a solution to managing the overabundance of phosphorus while creating a revenue stream through the sale of the fertilizer. This is a win for the environment and a win for Cook County taxpayers."

While the reduction of phosphorus in the water flowing downstream to the Gulf of Mexico is a major achievement, it is the local result that excites visitors and residents of Chicago on the one hand and agricultural communities on the other.

Interest in the Chicago River and area waterways is at the highest level it has ever been; in response, riverwalks are being constructed, economic development within surrounding neighborhoods is booming, and recreational use has skyrocketed. In the meantime, phosphorus is a valuable, but nonrenewable, resource; it is an essential element for plant growth, and high-yield agricultural production relies on a perpetual supply of it in fertilizers. Unfortunately, it is in dwindling supply due to the expansion of high-production agriculture worldwide.

To meet this important need, Ostara will market and sell Crystal Green to a global network of professionals in the agriculture, turf, and horticulture markets. Presently, Ostara is working to market Crystal Green to Illinois farmers, closing the phosphorus loop. The facility will have the production capacity to grow 1 billion pounds of potatoes — or 250 million bags of potato chips — annually.

"For Ostara, partnering with MWRD is a milestone in successfully scaling up our technology to serve the largest wastewater treatment facility in the world, providing a cost-effective and environmentally progressive solution to support their clean water mandate," said Ostara President and CEO Phillip Abrary. "We are proud to be part of a solution that will ultimately help protect the Mississippi River Basin and provide revenue to the District from the sale of the high value phosphorus fertilizer recovered to benefit ratepayers."

By placing a critical eye on the bottom line, the MWRD's Stickney WRP has transformed a harmful consequence of its processes into a revenue-producing product. This investment in the phosphorus recovery facility will also go a long way toward protecting the entire planet, while influencing others to embrace this exciting technology.

Other Nutrient-Reducing Activities

The MWRD is taking a diversified approach to addressing nutrient removal from wastewater. In addition to the production of the Crystal Green product, the MWRD modified the wastewater treatment process at the Stickney WRP last year to incorporate a process called Enhanced Biological Phosphorus Removal (EBPR). The EBPR process carefully controls conditions in the aeration reactor to cause the microbiological organisms in the reactor to uptake more phosphorus than normal. When the organisms are digested in the anaerobic digesters, they release the phosphorus. The phosphorus then ends up in the Crystal Green product and in biosolids, which are applied to the land as a soil amendment, thus returning the phosphorus to the land. Although the EBPR process is complex to control, it is a more sustainable approach than traditional methods of phosphorus removal that use inorganic chemicals to bind to the phosphorus and remove it through precipitation.

Another approach to nutrient removal that the MWRD is pursuing involves the natural uptake of phosphorus and nitrogen from water to support the growth of algae through photosynthesis, utilizing the sun as its energy source. This same approach can be applied to wastewater treatment as a means to remove nutrients from the waste stream without the use of inorganic chemicals or energy-consuming aeration, which is the traditional means of nutrient removal. The algae can then be harvested and utilized as a raw material in the manufacture of a variety of products, such as biofuels and bioplastics, which will also reduce the reliance on petroleum. The algae can also be composted with biosolids and land-applied as a soil amendment, digested to produce biogas, or processed as aquaculture feed — all of which return the phosphorus to the nutrient cycle. The concept of using algae to remove nutrients from wastewater is not new. However, traditional approaches that use large algal ponds are not practical in an urban environment where land is scarce. As a result, the MWRD is conducting leading-edge research in this field to help make algae nutrient recovery technology a practical and sustainable approach to nutrient management for urban wastewater treatment plants.

Also underway is the implementation of AnitaMox™, a deammonification process that will significantly reduce the concentration of ammonia-nitrogen in a high-ammonia concentration sidestream at the Egan WRP in Schaumburg, IL. This process fosters the growth of specialized bacteria that convert the ammonia into nitrogen gas in a way that can save 2 million kWh annually in energy consumption versus the current ammonia treatment method that uses aeration. This process is a step toward the MWRD's goal of implementing deammonification technology for mainstream application. If successful, this process will completely change the way nitrogen is removed from wastewater and will conservatively reduce energy usage by 40 percent, saving 120 million kWh annually — the equivalent energy provided by 15 utility-scale wind turbines or enough energy for 4,500 homes.

Learn more information about the MWRD at www.mwrd.org; follow us on Twitter @mwrdgc or like us on Facebook. ■

About The Author

Allison Hirsch Fore has served as the Public & Intergovernmental Affairs Officer at the MWRD for five years. She has more than 20 years' experience in government communications, having also worked for the Illinois State Treasurer, Illinois General Assembly, Indiana Secretary of State, and Indiana Department of Environmental Management. She received her Bachelor of Science degree from Indiana University's School of Public and Environmental Affairs and Master of Arts degree from University of Chicago's School of Social Service Administration.

Modern Technology For Combating Bacterial Water Contamination

Mobile-enabled geographic information systems (GIS) herald a new age for bacterial source tracking, allowing increased stakeholder involvement, more informed decision-making, and enhanced water quality.

By J. Michael Trapp

Across the U.S., municipalities and industries are forced to deal with an increasing number of contaminated waterways. These impairments, including 303(d) listings and Total Maximum Daily Loads (TMDLs), stem from a variety of pollutants, including metals, sediments, organic chemicals, and trash. However, with each of these potential impairments presenting unique challenges, the most prevalent issue involves fecal indicator bacteria, which accounts for 13 percent of all impairments nationwide — or roughly 10,781 impairments. California is a prime example of the widespread nature of this issue. The state alone has 627 bacteria-impaired watersheds that comprise 26,000 square miles — or 16 percent of the state's land area.

Bacterial contamination is not only most prevalent but also one of the most complex types of contamination for which to develop and implement plans to achieve permit compliance. This is a result of the diverse nature of bacterial sources and sinks and their ability to reproduce in varied environments. To further compound the issue, the bacteria used for regulatory compliance are not the organisms that directly pose the public health concerns that regulatory permits are designed to protect. Rather, they are indicators of pathogens that epidemiology studies have linked directly to human health concerns. As a result, there has been a growing focus on research and innovation to develop technologies and tools to help managers and planners identify bacteria pollution sources, assess their relative health risks, develop new advanced treatments, and deploy GIS tools to help effectively place treatment.

Advances In Bacterial Source Tracking

Over the past decade, there have been significant advancements in the identification of sources of bacteria pollution in surface waters. Early efforts to reduce bacteria concentrations focused on wastewater discharges, as they frequently represent a major point source to a receiving waterbody that can be effectively managed. In many cases, the near-complete elimination of bacteria from these effluents was not sufficient to reach water quality goals, which left questions about the sources of the bacteria, particularly human sources, as they represent the greatest risk to public health.

To understand where the contamination is coming from, the field of microbial source tracking (MST) developed a toolbox of resources ranging from chemical tracers of human activities (such as optical brighteners or caffeine) to assays focused on the bacteria themselves. The earliest of these tools looked at ratios of fecal bacteria types and antibiotic resistance. More recent developments have provided genetic tools that are able to identify the specific host organisms of the bacteria and quantify an estimated contribution to the total load. The most common and widely used of the host-specific tests utilizes quantitative polymerase chain reaction (qPCR) technology to focus on the genetic code of the Bacteroides 16S rRNA gene. Small mutations in this gene have been found to be specific to populations of humans, birds (general avian, Canada geese, sea gulls, chickens), cows, pigs, horses, rodents, canines, and other common bacteria sources, which allow their discernment and quantification.

These tests have been successfully deployed in hundreds of source tracking programs around the country in either single-site temporal studies or across multiple watersheds to identify both host sources and geographical hot spots. This testing has been particularly successful in helping to identify failing septic tanks and leaking sewer infrastructure, as well as distinguishing other important sources to provide insight into their relative importance to the overall pollution load.

Cause of Impairment Group Name	Number of Causes of Impairment Reported
Pathogens	10,261
Nutrients	7,174
Metals (other than Mercury)	7,045
Organic Enrichment/Oxygen Depletion	6,464
Polychlorinated Biphenyls (PCBs)	6,061
Sediment	5,993
Mercury	4,479
pH/Acidity/Caustic Conditions	4,318
Cause Unknown - Impaired Biota	4,066
Temperature	3,069
Turbidity	2,910
Salinity/Total Dissolved Solids/Chlorides/Sulfates	1,904

Causes of Impairment for 303(d) Listed Waters

Quantitative Microbial Risk Assessment

Regulatory fecal indicator bacteria can come from many sources, representing a very different level of risk to public health. This is a result of the nature of the tests used, which focus on several species of indicator bacteria (e.g., E. coli, Enterococci, and fecal/total coliforms) as they are much easier to detect than the actual pathogens (bacterial and viral) that infect humans. While bacteria from human waste contains the highest concentration of human pathogens, and thus pose the largest threat for illness, other sources with high amounts of


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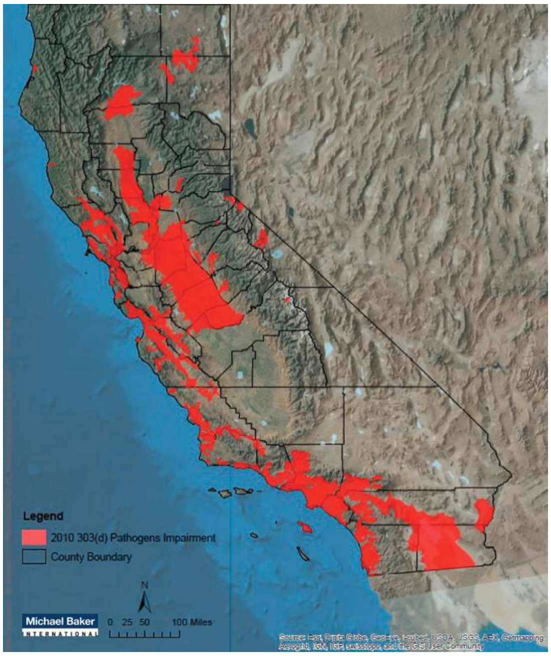


Map of 303(d) Pathogens Impairment in California (2010).

pathogens still pose varying risks to humans, including cow and canine waste and, to a lesser extent, bird waste.

Water quality standards were set based on the conservative principle that the indicator bacteria represent the worst-case scenario chance of infection. The protective manner in which these water quality standards were set means that in cases where impairment sources other than human are dominant, the same concentration of bacteria represents a different risk level. Recent research has also shown that many of these indicator bacteria can survive and reproduce in the environment and thus are not representative of new fecal pollution and pathogens inputs. Guidance from the EPA (2014) reflects this fact and allows a movement to bacteria standards that reflect rates of illness specific to a particular location.

Quantitative microbial risk assessment (QMRA) is the developing process that builds upon the understanding of site-specific source profiles determined in the MST process. QMRA can involve a number of steps, ranging from very precise sampling for determining pathogen concentrations to site-specific epidemiological studies. Data produced in this process are used to calculate a site-specific profile that determines an associated public health risk for different levels of bacterial concentrations. Based on this profile, a bacterial water quality standard can be set for that location that represents an acceptable illness rate and risk level.

New Bacterial Treatment Options

While treatment of bacterial point sources is fairly well understood, nonpoint source bacteria present a more complicated problem. Source controls should always be the first and most effective choice, but they are not always sufficient to meet targets. Therefore, additional measures are often required.

Low-impact development (LID) and green infrastructure that emphasizes infiltration are preferred best management practices (BMP). These LID BMPs focus on the removal of flows carrying bacterial pollution and thus represent a powerful tool for remediation of bacterial pollution and offer the added benefits of hydromodification and groundwater replenishment. However, infiltration is not always feasible due to underling soils or volume requirement. As such, other types of structural treatments have been developed and utilized with varying levels of success. Early treatment attempted to mitigate in-stream bacteria by adding ozone and chlorine directly to impaired waters to kill the bacteria; however, these methods were often ineffective and often introduced additional problems to the watershed. More recently there have been a number of commercially available products that claim to treat bacteria, particularly in stormwater during the collection phase. Many of these interface directly with the catch basin structure. Examples include fabrics treated with antimicrobial elements that attach to floatable excluders and bioinfiltration media designed to kill bacteria by physically breaking down cell membranes.

GIS Innovation And Mobile Accessibility

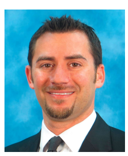
The advancements in understanding the host sources, relative risks, and geographical hot spots have produced a wealth of knowledge for use in the decision-making process for dealing with bacterial pollution. That said, this data can be overwhelming if not organized in an easily digestible and relatable manner. Thankfully, the water and planning industries are in the midst of an information technology and mobile revolution. Today we are blessed with a number of desktop and mobile tools that focus on improving water quality and allow decision makers, policymakers, engineers, planners, and the general public to collaborate in an effort to achieve the shared goal of improving water quality in an impaired local watershed.

Central to this technological revolution are geospatial planning tools that build on GIS. Many different data layers are able to be observed simultaneously in the office and in the field on mobile devices to understand the interplay of sources with their surroundings. These new mobile-enabled GIS systems are designed to capture, store, manipulate, analyze, manage, and present a host of spatial and geographical data in real time. The available tools extend beyond accessibility to the technical elements, offering a look at the feasibility and costs of a watershed retrofit to help make informed decisions, apply for grants, and jumpstart long-term ideas based on current and future watershed concerns. iWATR (www.iwatr.com), for example, allows users to deeply understand their surrounding waterways by identifying potential sites for BMP, suggest BMP options for local impairment, estimate treatment volumes, and ultimately project costs for construction and lifetime maintenance and usage.

Summary

While bacterial contamination presents an important challenge to protecting the beneficial usages of our nation's waters, there is an ever-growing toolkit of cutting-edge applications to meet them. If the past decade's trend is any indication, technologies on the horizon will continue to revolutionize how we look at this problem. As technology advances and our reliance on mobile tools continues to increase, the GIS data available to all stakeholders will keep pace to help incite a more-educated population that understands the issues and works together to ensure we live in a world with clean and safe waterways. ■

About The Author



Dr. J. Michael Trapp is a Project Manager for Michael Baker International in Southern California, focusing on water and sediment quality. He earned his Ph.D. from the University of Miami in marine and atmospheric chemistry and has experience conducting research on the fate and transport of aerosols, nutrients, metals, and bacterial contaminants.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Public Notice: Best Practices For CSO Alerts

Photo Credit: Raritan Riverkeeper

Jersey Water Works, a new collaborative, works to catalyze best practices in combined sewer overflow (CSO) reduction and notification in New Jersey.

By Kirstin McPolin

When Emilio DeLia lived in the Country Village section of Jersey City, NJ, Newark Bay was right across the street, offering unfettered access to the lower Hackensack and Passaic rivers. Every time he put his canoe or kayak into Newark Bay, he paddled by at least a couple of combined sewer system outfalls, where sewage can discharge into waterways during rain events. He has even weathered an active combined sewer overflow, but because he is a seasoned paddler, such discharges did not stop him from going out on the river. Even though DeLia is an advanced kayaker, he knows the importance of good information in helping to keep recreational water users safe. "People have the resource of this waterfront literally feet from their homes, so public information about combined sewer overflows is vital," he said.

There are 213 CSOs in New Jersey where raw sewage flows directly into waterways after rainstorms, threatening human health and the environment. In areas served by a combined sewer system, storm and wastewater flow through the same pipe to a sewage treatment facility, but during heavy rains some of the pipes aren't able to handle the additional volume of water, so rather than have sewer pipes back up into homes and streets, the system sends a portion of the combined stormwater and wastewater into local waterways without its going through a treatment plant first. Contact with the untreated water can cause illnesses ranging from ear and skin infections to meningitis and encephalitis.

Required By Height Of Summer Season

In July 2015, the New Jersey Department of Environmental Protection (NJDEP) issued new permits to combined sewer system operators. The permits required that, by January 2016, public signs be posted near combined sewer discharge locations, or outfalls. All New Jersey operators have taken this first step. The permits also required that combined sewer system operators be able to notify the public of overflow events via a telephone hotline or website that can provide up-to-date information regarding CSO occurrences. These public notification systems were required to be in place by July 1, 2016.

Although public notice of CSO occurrence was required as of July 1, such notice is only as good as the data and information provided. Combined sewer system operators use any of several different types of detection methods — modeling, monitoring, or observation — to determine whether CSOs have occurred. Modeling uses predictive mathematical calculations based on watershed and rainfall information. Monitoring uses equipment installed at the outfall that collects real-time water flow information that can be downloaded and analyzed. Observation, usually employed in smaller communities, uses visual checks of the outfall done by staff.

New Jersey Starts To Come Online

One group in New Jersey took the lead on implementing CSO notification systems prior to the July 1 date. The North Hudson Sewerage Authority (NHSA), which serves Hoboken, Union City, Weehawken, and West New York, has 10 combined sewer outfalls along the Hudson River. The authority's Waterbody Advisory System provides the public with real-time information related to CSOs into the Hudson River. An online color-coded map alerts the public in real time when a CSO occurs, based on level sensors in the sewer system that monitor and report overflow inci-

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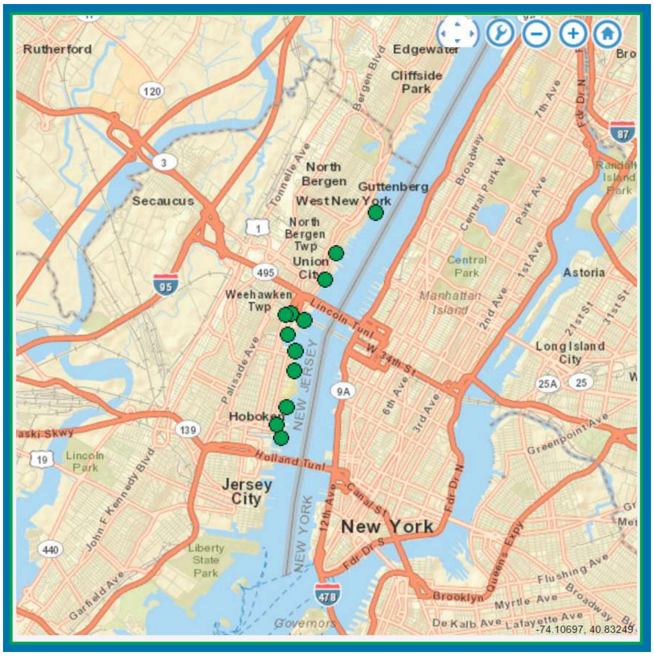


NHSA's color-coded CSO map

dents. Each circle depicts one combined sewer outfall and changes color with the conditions: Green indicates no overflow, red indicates there has been CSO activity and serves as a warning that contact with the water within 100 feet should be avoided, and purple indicates when a monitoring unit is offline. By selecting the colored circle and clicking on the dispatch tab, users can see the status and end date and time of the most recent CSO event. "Our public notification system is real time, simple to access, and easy to understand," said NHSA Executive Director Dr. Richard J. Wolff. "With increasing recreational activity on the Hudson River, it's important that people know when to avoid the areas around the outfalls, and our system enables them to do just that."

The Camden County Municipal Utilities Authority (CCMUA) has taken a different approach than real-time monitoring. It uses modeling with predictive mathematical calculations to identify under which storm conditions outfalls could be predicted to overflow. When such storm conditions occur, CCMUA will put a notification on its website warning of the likelihood of CSOs.

The Passaic Valley Sewerage Commission (PVSC), which has the state's largest wastewater treatment plant, also uses a model to predict when CSO events will overflow. This modeling is based on meteorological data. If the model shows that rainfall amounts will produce enough volume to cause a combined sewer outfall to discharge, the utility will flag the portion of the waterbody belonging to that CSO permittee as having a possible CSO event. According to PVSC, its CSO notification functionality was to be available on its website by July 1. The CSO Notification page will be accessible from PVSC's website and the websites of the other participating CSO permittees via a link, and will be updated hourly.

Lessons From Chicago, New York City, And Washington, D.C.

In Chicago, the Metropolitan Water Reclamation District of Greater Chicago has developed a CSO Notification Plan for overflows into waterways, as required by the Illinois Environmental Protection Agency. The district maintains a list of interested parties' emails, to which it sends alerts of CSOs into Lake Michigan. Citizens may sign up on the district's website for these alerts. In addition, the district provides a map (updated daily) on its website that shows CSO events as a color-coded graphic with the waterways either blue (no overflow) or red (an overflow has occurred within the previous 24 hours). However, the website clearly states that the information is only updated daily, not in real time. Further, it states that not all outfall locations are equipped with monitoring equipment, so some CSOs may be occurring but not be shown.

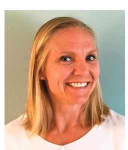
New York has a public notification of CSOs in its CSO Wet Weather Advisory program that has been operational since January. In 2013, New York passed the Sewage Pollution Right to Know Law of 2013, which required that discharges of sewage be reported by combined sewer system operators to the New York Department of Environmental Conservation (DEC) within 2 hours and to the public and municipalities within 4 hours. On the DEC's website, people can sign up to receive alerts by email, text, or phone, and DEC alerts them to the date and time of discharge, the location, expected duration, and the steps being taken to contain it. However, New York's system is not without flaws; it largely relies on modeling estimates, and the alerts have reportedly been hard to sign up for.

To notify river users of CSO events, Washington, D.C. has installed CSO event indicator lights at two points: the Potomac River at Rock Creek and the Anacostia River at the South Capitol Street Bridge. When these lights are lit red, there is an active CSO event; when lit yellow, there has been one in the past 24 hours; and when unlit, there is no event. By 2025, the District of Columbia Water and Sewer Authority expects to reduce CSOs into the Potomac and Anacostia rivers by more than 95 percent. Sewer and stormwater pipes will be separated in order to eliminate several CSO outfalls and use the remaining outfalls for stormwater only.

A First Step In The Right Direction

In New Jersey, much more remains to be done to eliminate the problem of combined sewer overflows. The NJDEP permits require municipalities and wastewater treatment plants to develop, within the next four years, long term control plans that evaluate their sewage infrastructure options and propose steps to improve them. Public notification of CSO events is a vital first step. ■

About The Author



Kirstin McPolin is an environmental attorney and writer. Passionate about policy and legislation, she is currently working on water infrastructure issues for Jersey Water Works, a collaborative effort of many diverse organizations and individuals who embrace the common purpose of transforming New Jersey's inadequate water infrastructure by investing in sustainable, cost-effective solutions. When Kirstin isn't writing, she can be found on her stand-up paddleboard with her husband and three kids.

Kansas City's Billion-Dollar Smart Infrastructure Challenge

Missouri's largest city is betting that the next generation of water distribution pipelines – smarter, stronger, and highly sustainable – is well worth the investment.

By Jennifer Rusch

In 1838 the city of Kansas City, MO, was born within the heart of the nation. Deemed the crossroads of the world, Kansas City's legacy of innovation began with a smart grid of water and wastewater infrastructure systems designed to withstand the gritty nature of the times ahead.

Nearly 150 years later, some of Kansas City's original infrastructure still serves the city's modern pioneers. Kansas City is now the most connected "smart city" in the world, thanks to a network of strategic data, technology, and transportation investments along a 2.2-mile corridor in the heart of downtown — not far from the city's original foundation along the banks of the Missouri River. Underneath Kansas City's Smart City corridor lies a national innovation — miles of water infrastructure that is strategically selected and managed through the use of over 150 years of water-main data.

2012 was a pivotal year for Kansas City. Extreme drought conditions during the summer months resulted in a record number of water main breaks, which emphasized the city's need to replace aging water infrastructure. That same year, the American Water Works Association (AWWA) issued a staggering report, highlighting a $1-trillion need to address the nation's critically aging water infrastructure. There was no question that Kansas City, along with other cities across the nation, was being challenged to address a backlog of aging water mains. Ready to rise to the challenge, city leaders sought a strategic and data-driven solution for residents.

"Kansas City is committed to investing in innovative solutions to meet exceptional challenges," said City Manager Troy Schulte. "In 2012, the need to invest in the city's water system was critical, but rate fatigue for residents was a serious concern. Strategic use of data led to the development of the city's first water main replacement program and one of the first examples of Kansas City's transformation toward leading Smart City initiatives."

Pipe Performance: Past, Present, And Future

Using as-built information dating back to 1870, KC Water Services' Chief Engineering Officer Andy Shively and his team cataloged the age, pipeline material, and break history of each pipe segment. The city then ran a business risk assessment to determine which segments of pipe were most likely to break and, most importantly, which of those aging pipe segments would have the greatest impact on the city's public health and transportation networks. The program provides added value by matching the 100-year asset life of the product.

Kansas City's 100-year water main replacement program replaces 1 percent of the city's water infrastructure with ductile iron pipe, and specifications include the use of zinc coating. The product and the city's water main replacement program are strategically designed to address the city's water infrastructure challenge in a way that delivers the highest return on investment.

"Kansas City is a model of innovation and sustainability," says Gregg Horn, VP of technical services for the Ductile Iron

Andy Shively, chief engineering officer at City of Kansas City, MO

Pipe Research Association. "Andy is the first person I am aware of in the United States to specify zinc coating for ductile iron pipe. This type of innovation works to extend the service life of an already superior and sustainable product by successfully addressing the pipe's number-one enemy — corrosion."

The ductile iron pipe selected by the city of Kansas City has a 100-year lifespan. By specifying the use of zinc coating on the pipe, Kansas City hopes to extend the useful life of the infrastructure well beyond a century. Four years into the program, Kansas City is already realizing the value of the citywide investment through a record low number of water main breaks.

"Andy is one of a few visionary leaders in the industry. From the beginning, he insisted that Kansas City would not sacrifice the future for a shortcut today," said Tom Crawford, VP and general manager for McWane Ductile Ohio. "Kansas City has a 100-year vision that leverages every cent invested to eliminate infrastructure burdens for future generations."

By specifying the use of zinc coating on the pipe, Kansas City hopes to extend the useful life of the infrastructure well beyond a century.

Sustainable = SMaRT

Kansas City's water infrastructure investment is not only strategic — it is also literally SMaRT. The city's 100-year water main replacement program uses only SMaRT-certified ductile iron pipe. In 2012, the Institute for Market Transformation to Sustainability awarded the ductile iron pipe industry with certification as a gold-rated SMaRT product. The certification was based on a number of factors, but most notably because the pipe's material is made from 98 percent recycled material, and the manufactured ductile iron pipe itself is recyclable. Ductile iron pipe is one of only two products in the buried infrastructure industry to achieve this certification.

"Ductile iron pipe earned especially high marks for recycled content, exceedingly long life, and for the industry's commitment to conserving energy and controlling emissions," said Horn.

Zinc-coated, SMaRT-certified ductile iron pipe

"The pipe has added value because it takes considerably less energy to pump water through the larger inside diameter and smooth interior lining of ductile iron pipe."

SMaRT certification for the product has enabled the ductile iron pipe industry to quantify its impact on the environment. Since 2012, Kansas City has installed 120 miles of SMaRT-certified ductile iron pipe or the equivalent of 6,500 recycled vehicles. According to calculations published by the U.S. EPA, the energy savings made by this investment are equivalent to the electrical consumption of 4,579 homes for an entire year.

"Sustainability is the implementation of smart solutions that transcend generations," said Shively. "Our analysis shows that the age and material of a pipe segment critically impact the lifespan of the pipe. The product that we install today matters. Making smart decisions today will protect future generations from paying for existing infrastructure challenges."

The Billion-Dollar Challenge

This year, Shively publicly issued and took on a $1-billion challenge. His charge is to find and implement strategic and sustainable solutions which will provide $1 billion in savings over the next 10 years.

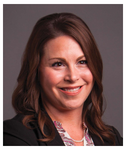
"Kansas City is investing $1.78 billion in water and sewer infrastructure over the next five years. It is critical that we make the most of this investment," said Shively. "We now have more data and more technology than ever before, and I believe the engineers of today have a responsibility to leverage those resources and avoid past mistakes. My billion-dollar challenge is a promise to Kansas City, and it is a call to the stewards of our system to bring forward the innovative and strategic solutions necessary to save our residents $1 billion."

In Kansas City, the $1-billion challenge is already gaining momentum. In order to accept the challenge, professionals must provide sustainable solutions that have an immediate cost savings and that also have a long asset life.

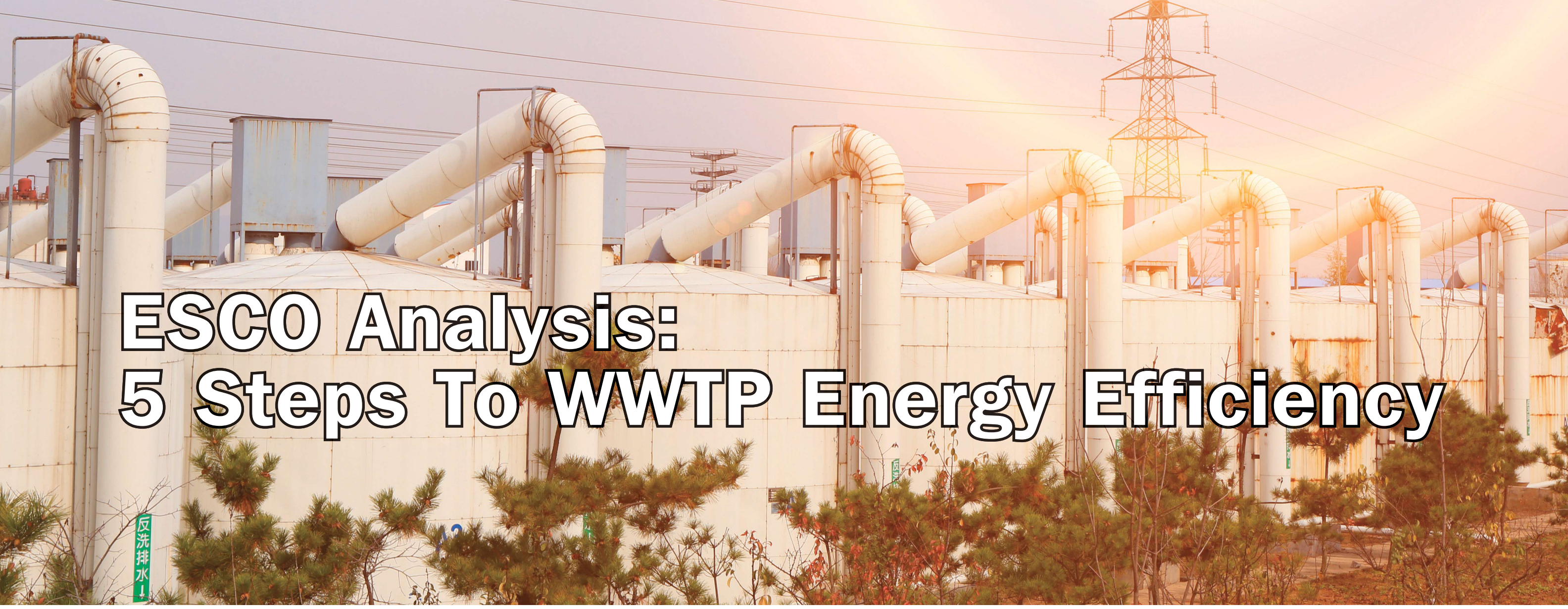
"Kansas City has already taken the $1-billion challenge," states Shively. "I encourage 999 other cities across the nation to join the challenge, so that we can eliminate $1 trillion in debt for the infrastructure investment facing our nation today. This crisis will only be remedied through the commitment of every public servant across the nation to find long-term solutions, not short-term remedies."

For more information on Kansas City's water main replacement program, visit www.kcwaterservices.org. ■

About The Author



Jennifer Rusch is a strategic marketing professional at Burns & McDonnell, specializing in communicating complex infrastructure programs in relatable and understandable ways. She lives and works in Kansas City, Mo.



ESCO Analysis: 5 Steps To WWTP Energy Efficiency

How do energy savings performance contracts work? An energy services company (ESCO) breaks down the process and shares recent results from a participating wastewater treatment plant (WWTP).

By Ben Johnson

Wastewater treatment plants are a relatively untapped opportunity in the world of energy efficiency. Although these energy costs represent the largest controllable expense for municipalities that provide water or wastewater services, efficiency measures have not been adopted as quickly as they have been in other industries. However, the fact is that wastewater efficiency projects can have a significant impact on municipal governments, given that these plants account for 30 to 40 percent of a city's total energy consumption. At the same time, there is much need for updated infrastructure at these plants. Many plants are more than 20 years old and use technology that is outdated and inefficient.

Faced with competing pressures to cut costs, modernize, and meet growing regulatory requirements, municipalities often struggle to make all the improvements needed, given today's budget restraints. But the city of Riverbank, CA, found a cost-effective way to improve plant efficiencies and reduce site utility bills, while also providing much-needed upgrades to aging equipment. This article takes a closer look at how the city achieved all its goals simultaneously.

Energy Efficiency Overhaul

Riverbank is a small city with just over 23,000 residents. It operates its own WWTP, which has an average flow of 1.67 MGD, and conducts primary treatment only through aerated lagoons, using percolation ponds rather than discharging the effluent. The primary treatment is accomplished in four treatment ponds through the use of surface aerators to provide oxygen for the biologic process. Once the sewage is adequately treated, it is transferred to the percolation ponds through the opening of sluice gates or weir gates.

The plant was primarily operated manually with limited dissolved oxygen control in the treatment ponds and intermittent use of the transfer pumps. Lights were controlled through photocells and ran only at night. Electricity is the only utility on-site, and data was collected from Modesto Irrigation District for the plant's electric meter, which showed an annual utility spend of $367,137 for 3,458,190 kWh. In addition, the existing treatment ponds used constant-speed surface aerators to provide oxygen for the biologic process. Typically, only two of the four treatment ponds were used at a time, and not all of the surface aerators would be in operation at any given time. These aerators had low oxygen transfer efficiency and thus required excessive horsepower to deliver the appropriate amount of oxygen to the biologic process.

The city hired Schneider Electric to evaluate its WWTP for energy savings opportunities. The project consisted of replacing the surface aerators with submersible fine bubble diffusers and blowers with variable frequency drives (VFDs). It also included the installation of a SCADA (supervisory control and data acquisition) control system to provide better control and visibility into the plant's processes, particularly controlling the dissolved oxygen level in the treatment ponds.

The solution replaced 12 surface aerators with Parkson's Biolac Treatment System, which uses moving aeration chains with suspended fine bubble diffusers, motorized and controlled air valves, blowers, and an automated control system. Four 60-hp blowers with VFDs were installed to provide air to this system and are controlled to maintain a dissolved oxygen set point in the treatment ponds.

While this solution was chosen to maximize energy savings, there are also several maintenance benefits from changing system types. For example, subsurface aeration reduces the buildup of sludge in the treatment ponds. Currently, when the sludge

Subsurface aeration system with suspended fine bubble diffusers buildup reaches a certain depth, the treatment ponds need to be taken out of service, dredged, and then have the sludge hauled away to a dump site. This happens every 12 to 15 years but is very costly for the city. Additionally, the new system is modular and upgradeable, so if plant flows increase, the system can be added on to. Or, if new permit requirements are enforced, a tertiary treatment system can be added to the existing system to increase the levels of treatment.

Five Phases Of Energy Analysis

In order to determine the energy and utility savings that would be seen from this project, a five-step process was used including:

Benchmarking

The first step in the analysis was to benchmark the WWTP's energy use to identify the magnitude of energy savings available. Monthly utility bills from August 2010 through September 2012 were collected to determine the annual energy consumption of the plant. Monthly operating reports were also collected, which showed the plant's daily flows and loadings. This data was then compared with industry benchmarks to identify the potential savings opportunity. Based on these comparisons, it was apparent that Riverbank's WWTP was using more energy than needed. In fact, the opportunity to save 50 percent or more in energy was anticipated based on analysis.

Baseline Utility Analysis

The next step was to create a utility baseline. The two years' of energy and demand usage from the monthly billing data were compared year to year to identify any anomalies or changes in operation. In addition, 15-minute interval data was collected from the electric meter for the most recent 12 months. This data was analyzed and found to be very consistent between the days in a given week or month, except when maintenance activities occurred. The utility rate was also evaluated, using a tariff simulation to verify that the rate structure was understood.

Baseline Energy Analysis

An energy baseline of the plant was then created to ensure operations were understood. Operational information was collected through interviews with plant operators as well as analysis of utility data, which showed that plant energy usage decreased from the first year to the second year.

The interval data was very helpful, as it also provided insight into the operation of the plant and how the loads were being controlled. The plant operated at a nearly constant load throughout the day with an approximate 110 kW increase in load between 2 a.m. and 8 a.m. Upon further analysis, the base load corresponded to seven of the surface aerators operating at a time, while the increased load corresponded to nine of the surface aerators operating. It was also noticed in the interval data that only eight of the surface aerators were typically running between 2 a.m. and 8 a.m. on Sundays. Additional deviations from the base load were noted in other days, which corresponded to when transfer pumps were being used to transfer the effluent from the treatment ponds to the percolation ponds or when maintenance activities took place.

Once the operation of the plant was understood, a baseline energy model was created that estimated a 24-hour profile of electric demand of the surface aerators, transfer pumps, headwork motors, and miscellaneous loads. The resultant loads were summed up and compared with the utility baseline.

Post-Retrofit Energy Analysis

Next came an estimate of the energy usage of the WWTP once the proposed retrofit took place. Savings came from two primary sources. First, since the fine bubble diffusers had much higher oxygen transfer efficiency than the surface aerators, the horsepower requirements for the blower motors were greatly reduced from those of the surface aerators. Second, since the VFD speed on the blower motors would be controlled to a dissolved oxygen set point in the treatment ponds, the power draw on the motors could be even further reduced from the peak for which they were designed.

Savings were determined using two approaches. The first approach was to calculate the energy (kWh) savings. The hourly profile for the WWTP from the model was binned into the three time-of-use periods for each month. The difference between the baseline energy use and the post-retrofit model use was then calculated using the minimum method to determine the energy savings, ensuring savings are not overestimated for any of the data points. The energy savings for this project were estimated to be 2,593,087 kWh per year or 74.98 percent of the baseline.

The second approach was to calculate the demand (kW) savings. Because demand is easily impacted by small variations in flow rates, it is difficult to accurately project the savings that will actually be seen on utility bills from the demand component. For this reason, a conservative approach was used to determine the expected demand savings. The demand savings for this project were estimated to range between 268 kW and 326 kW, depending on the month. This is equivalent to 41.75 percent of the baseline demand values.

Post-Retrofit Utility Analysis

The final step in the analysis was to determine the financial value of the energy and demand savings from this retrofit. The savings values calculated previously were run through the tariff simulation to determine the expected utility bill after the retrofit took place. The difference between the baseline cost and this calculated cost is the anticipated savings. The dollar savings for this project were estimated to be $240,129 per year or 65.4 percent of the baseline costs.

A financial analysis for this project was done to show how quickly this retrofit would pay for itself in utility bill savings. The city wanted to have a project that would pay for itself within the life of the equipment being installed — an average of 15 to 20 years. The final project cost for this retrofit was $3.9 million, which gave a simple payback of 16.5 years.

Surface aerator in operation

The procurement method used by the city to complete this work was an energy savings performance contract (ESPC). In an ESPC, the customer will typically take out a loan to pay for the project. They will contract with an energy services company (ESCO), who will be paid for the implementation of the work, and, in turn, will guarantee that the customer will see the savings that were estimated on their utility bills. If savings are not achieved as promised, the ESCO will be liable to write the customer a check for the difference. Riverbank chose this procurement methodology because they did not have the up-front funds to pay for the plant upgrade. Additionally, they wanted the fixed-price contract that comes with an ESPC and the guarantee of utility savings, so they could be sure to have the funds available to pay off the loan.

Conclusion

The project with the City of Riverbank and Schneider Electric has proved to be a successful partnership whereby the city received an upgraded WWTP, which resulted in a significantly reduced electric utility bill. In order to support the financial analysis and guarantee associated with this project, a detailed and innovative approach to estimating energy savings was developed. While not every WWTP will have the same magnitude of opportunity as this one, it is a great example of how a city can mitigate risk, upgrade its plant, become more efficient, and utilize utility savings to pay for it. It also shows how energy efficiency gains can be achieved without a reduction in the quality of operations. ■

About The Author

Ben Johnson is an energy engineering manager for Schneider Electric's Energy and Sustainability Services group. He's been with the company for 10 years and has worked as an energy analyst, project development manager, and energy team lead. He is a Professional Engineer, Certified Energy Manager, Project Management Professional, and LEED AP. He received his Bachelor of Science degree in mechanical engineering from Arizona State University and is currently working on his Master's of Science degree in engineering management at California State University, Long Beach. He can be reached at ben.johnson@schneider-electric.com.

U.S. Power Profile Shift Sparks Water Opportunity

The power sector looks to zero liquid discharge and taps municipal reclaimed water as a water reuse strategy.

By Erin Bonney Casey

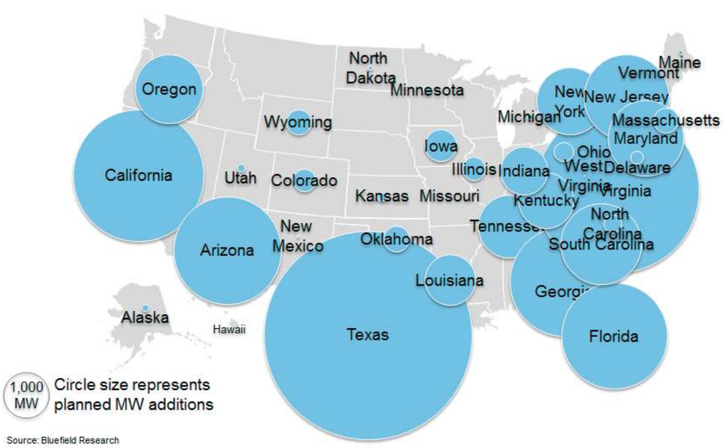
From an installed base of 72 zero liquid discharge (ZLD) systems and 67 power plants utilizing reclaimed water across the U.S., Bluefield Research is seeing an increasing trend toward reuse in the U.S. power sector as companies look for new water management strategies. ZLD, a water treatment process in which all wastewater is purified and recycled, helps conserve water supplies and manage wastewater flows. The power sector is increasingly looking to ZLD systems to meet regulatory challenges and reduce water use in water-stressed areas. On the other hand, reuse of municipal reclaimed water can provide a drought-proof and cost-effective water supply source for water-hungry power plants.

Use of ZLD systems, installed to expand on-site water reuse and eliminate concerns about wastewater discharge, is expanding, although they are still somewhat of a niche play. Currently, the 72 U.S. power plants employing ZLD systems have a total combined capacity of 22,000 GPM (119,000 m^3/day). New thermal power plant additions from 2016 through 2025 are expected to total 38 gigawatts (GW), mostly through the addition of natural gas-fired plants. The U.S. power sector is evolving toward greater adoption of combined-cycle gas plants — a substitute for decommissioned coal plants — and sparking growth opportunities for water solution providers. The Mid-Atlantic and Midwest, regions that historically have relied on coal, are shifting to gas-fired plants, with large-scale capacity additions planned to compensate for the scheduled retirement of coal plants.

New gas-fired plants are also increasingly looking at ZLD technology for reuse as a means of reducing their water footprint and complying with regulatory shifts. In Texas, California, and Arizona, which are water scarce, planned thermal power capacity additions total 16 GW, 42 percent of the total. Companies will be looking at new water management strategies for new thermal plants to secure the necessary cooling water and boiler feed supplies for plant operation. For example, the largest ZLD installation at a power plant in the U.S. is at the Duke Energy natural gas-fired combined-cycle (NGCC) plant in Arlington Valley, AZ. Installed in 2009, the system has a flow rate of 3,600 GPM (19,620 m3/day). The ZLD system allows the plant to reuse water in this extremely water-stressed region.

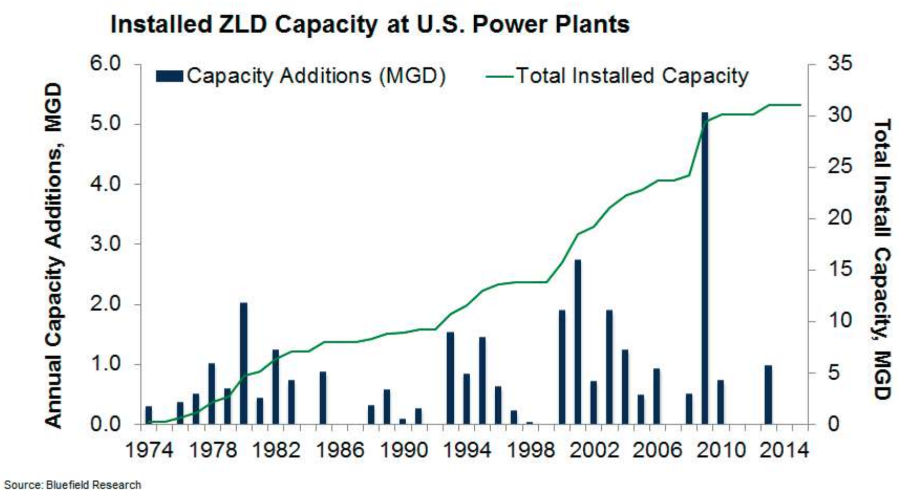
Additionally, the new *Steam Electric Power Generating Effluent Guidelines* passed by the U.S. EPA in 2015 will force wastewater treatment retrofits at coal-fired plants not slated for retirement. This follows a series of regulations aimed at reducing air pollution and prompting the installation of flue-gas desulphurization (FGD) units, which moved some of the removed toxins into the wastewater stream. ZLD systems can provide a solution for operators looking to clean effluent from FGD units.

Planned Thermal Power Additions By State



Most power capacity additions are planned for the Mid-Atlantic and Midwest states, reflecting the ongoing shift from coal to natural gas.

Power Sector Advanced Water Treatment Technology Adoption



The power sector is increasingly looking to ZLD systems to meet regulatory challenges and reduce water use in water-stressed areas.

Greenfield Power Plants Drive Municipal Wastewater Reuse

In addition to on-site reuse utilizing ZLD treatment solutions, power plants are increasingly turning to reclaimed municipal water for a drought-proof water supply and associated cost savings. New plants, whose cost structures allow innovative water solutions more than retrofits, are expected to tap into municipal wastewater for drought-resistant water supplies.

Currently, 26 percent of the new capacity is proposed in four water-stressed states — Texas, California, Arizona, and Florida — where utilities and independent power producers are already under pressure to more heavily weight water supply risks to operations. Currently, 67 U.S. power plants utilize reclaimed wastewater from municipal wastewater sources, which is expected to rise. For example, Covanta recently installed GE's water reuse technology at the 90-MW Delaware Valley waste-to-energy facility. Elsewhere, the Turkey Point nuclear power plant in Florida has signed an agreement with Miami-Dade to utilize up to 340,000 m^3/day of reclaimed water for cooling tower use at the expanded facility. The agreement will provide cost savings to plant owner Florida Power and Light (FPL) in the form of lower water rates and will help Miami-Dade preserve its stressed potable water supplies.

Panda's Water Strategy Highlights Range Of U.S. Drivers

Panda Power Funds' recent progress toward the second of two new gas-fired power plants in the Chesapeake Bay basin highlights the focus on reuse strategies, including ZLD. Panda's proposed Mattawoman Power Project in Brandywine, MD is an 859-MW combined-cycle generating station planned for commissioning in 2017. While Mattawoman awaits public comment, the 778-MW Stonewall project in Virginia is under construction and planned for 2017.

Both of Panda's plants will employ innovative water management strategies for water supply and wastewater management. They will use municipal reclaimed water for supplies and install ZLD systems to treat produced wastewater and recycle it on site. The Stonewall plant will use reclaimed wastewater from Leesburg, VA for cooling water, while the Mattawoman plant will draw reclaimed water from the Piscataway Wastewater Treatment Plant (WWTP) in Accokeek, MD.

The growing influence of regulations surrounding the Chesapeake Bay region is also impacting power development in seven Mid-Atlantic states. Signed in June 2014, the Chesapeake Bay Watershed Agreement has compelled Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia to address water quality, including industry impacts on the basin. Not exclusive to power, industrial development in the region going forward will be forced to meet tighter nutrient (nitrogen and phosphorus) limits.

Competitive Landscape For ZLD Solutions Dominated By Three Key Players

While GE, Veolia, and Aquatech have deployed the large majority (99 percent) of U.S. systems, new capacity additions, particularly in water-stressed regions (e.g., Western U.S. states), is driving greater competition. Companies deploying membrane treatment technologies — ultrafiltration (UF), reverse osmosis (RO), and evaporators to concentrate plant brines — are best positioned to move into this market. An increasing number of ZLD solutions providers, both domestic and foreign, are looking to break into this market as power plants increasingly embrace innovative water management strategies. ■

About The Author

Erin Bonney Casey is a senior analyst in Bluefield's Advanced Water Treatment and Desalination practice. Erin is on the Water Environment and Reuse Foundation's Project Advisory Committee on Current Use and Trends of Reuse in the Hydraulic Fracturing Industry. Prior to joining Bluefield, Erin worked at Brown Brothers Harriman as a business analyst. She also has international experience with Grameen Research, focusing on Latin American economies and tax laws. Erin has a BA from Bates College and a Masters from Oxford University in Water Science Policy and Management. Erin is based in Bluefield's Boston office.

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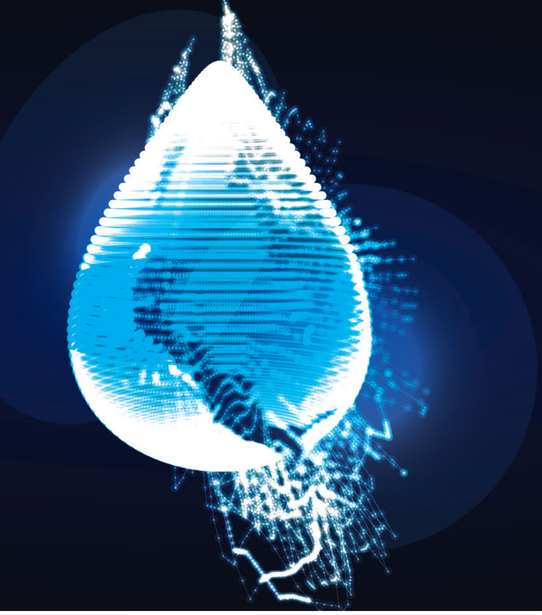
Advanced Metering Infrastructure (AMI) Brings More Reliable Water Operations Clearly Into Focus



Learn about the advantages and implementation of AMI from experts who are making "smarter water" a reality.

By Michael Sullivan and Carey Hidaka

Water is a precious resource, often taken for granted in some parts of the world, while other regions struggle with life-threatening scarcity. Water conservation is a critical aspect of sustainability in communities worldwide, and smart technology can often be found at the forefront of transformative change and improvement.

Our planet is becoming smarter: The growth in the adoption of instrumentation, widespread system interconnectivity, and intelligence through Big Data are enabling the creation of "cognitive" systems that combine processing of all types of data with machine learning to improve the world around us. This cognitive era is opening up new avenues for communities and businesses to improve operations and act more responsibly when it comes to sustainability by making it easier to sort through all the complexity and improving engagement across the entire value chain. Even organizations that have not been traditionally consumer-focused are seeing more connectivity and engagement with their end users. In this cognitive world, systems such as water, energy, and transportation are progressively becoming more dependent upon understanding and encouraging positive behavior by end consumers. And by understanding what drives individual behavior organizations can tap this powerful potential to become more proactive, using data as the driver to provide new operational insights, predict problems before they occur, and operate more efficiently. For water and wastewater utilities, these steps help to improve vital water systems globally and address industry challenges associated with aging and failing infrastructure, drought, water quality deterioration, and an aging and retiring workforce.

Making The Case For Measuring Usage

Smart metering solutions can automate the collection and transport of meter information, allowing utilities to extract meaningful customer usage data to understand actual resource usage. For example, during times of stress on the distribution system, advanced meter management can be an important source of data to read meters rapidly and more frequently to gain a better understanding of customers' usage and make informed decisions about operations during times of high demand or shortages. Advanced meter infrastructure can also help utilities:

- Improve reliability and response time to address pressures from regulatory bodies and the market.
- Increase workforce productivity and safety by automating tasks and limiting the amount of onsite work required.
- Identify and locate outages quickly to speed time to response.
- Improve resource planning.
- Motivate customers to limit resource usage.
- Enable time-based billing to help reduce peaks, reward customers for off-peak use, and provide incentives to reduce peak consumption.
- Facilitate a more interactive relationship with utility consumers by enabling home area networking.
- Enhance operational awareness throughout the energy value chain, providing significant operational and planning benefits.

Smart metering also allows utilities to realize significant operational efficiencies and cost savings. Smart meters can automate certain time-consuming maintenance requests and minimize field meter work orders, which can reduce operating costs over a range of activities such as meter reading, distribution system maintenance, and managing against system failures.

Advantages Of Data Analysis

Smart meters no longer just measure consumption — and they are not an isolated system to themselves. Today, they are complementing a variety of novel sensing technologies and being woven into the Internet of Things to drive new insights.

Beyond the obvious benefit of cost efficiency, meter data can be analyzed to understand usage consumption and detect anomalies such as leaks, malfunctioning of meters, or theft. After introducing specific meter data, utilities can quickly identify leaks and immediately intervene, giving them the upper hand to reduce water loss, cost of refunds and legal expenses, and offer improved quality of service. Additionally, low consumption alerts can help detect theft or meter faults.

Perhaps most importantly, alerts for abnormal usage in the public and private sectors can reduce careless water usage in places such as schools, sports centers, hospitals, and municipality-owned institutions, which help utilities and individuals play an active role in monitoring water usage and consumption, thereby bringing awareness to the scarcity of water.

Implementation Of AMI

Following the decision to roll out an advanced metering infrastructure, utilities will benefit from taking purposeful strides toward implementation. The three phases of implementing AMI include:

- Pre-project planning and product selection: Put a regulatory strategy in place, develop business cases, create a preliminary work plan, and schedule and begin technology selection.
- Pre-deployment preparation: Refine the business case and regulatory process, begin meter testing and pilots, finalize technology selections, and begin business process design.
- Full deployment: Test and introduce a fully-integrated systems solution that can enable more corporate benefit than a simple meter-reading solution.

Conclusion

As the need to preserve water becomes more closely tied to the widespread use of data analytics and utilities, by extension, their end users will become more aware of the solutions available to create pervasive use of AMI. Once this infrastructure gains ground among large and small utility companies alike, they will be empowered to better manage their water usage and costs by providing more timely and detailed water usage information to customers. Smart metering takes us one step closer to a more strategic way of doing business and bridging the gap between technology and valuable and vulnerable resources. ■

About The Authors

Michael Sullivan is the Global Solutions Sales Leader for IBM Smarter Water Management Solutions, a cross-brand business focused on incubating and growing a portfolio of solutions to help better manage water delivery and treatment systems, water efficiency, and natural water resources. As a member of IBM's Smarter Cities Leadership team, he leads a worldwide team of researchers, technical experts, and business development executives who leverage IBM's information management, advanced analytics, technology services capabilities, and global network of ecosystem partners to deliver water management solutions for government, utility, and enterprise customers across the world. Mr. Sullivan has over 20 years of experience in executive positions leading innovation, brand development, and launching emerging businesses. He earned an MBA with a dual concentration in Marketing and Finance from Vanderbilt's Owen Graduate School of Management and holds a BA in Psychology from Dartmouth College.

Carey Hidaka is a leader in Smarter Water Management business development and has managed IBM Smarter Water Management projects in the USA, working with clients to uncover smarter applications in the water/wastewater industry. Mr. Hidaka has 33 years of information technology experience and also practiced for nine years as a consulting engineer and PE, focusing on water resource planning and water and wastewater treatment plant designs and implementations for public and industrial sector clients. He has an MBA from the University of Chicago, an MS in Environmental Engineering from the University of Illinois at Urbana-Champaign, and a BS in Civil Engineering from the University of Colorado at Boulder. He has published work in the journal *American Water Works Association*, *IBM Journal of Research and Development*, *International Water Association*, and *World Water*.

The Journey Toward A Sustainable Biosolids Handling Process

A Kenosha, WI wastewater treatment plant leveraged innovative upgrades to become more sustainable – and save $750,000 per year.

By Ed St. Peter and Michael Kopper

The Kenosha Water Utility has long been a forward thinker for sustainable technology and solutions in the water and wastewater industry — in fact, on the very leading edge. In 1997 it installed what was then the largest water microfiltration purification system in the world. The installation put Kenosha ahead of regulatory requirements concerning surface water and disinfection byproducts without the use of pretreatment chemicals.

Like many plants in the U.S., Kenosha's collective wastewater infrastructure was also aging. The plant first went online in 1940, with the addition of secondary treatment in 1967 and upgrades to expand capacity in 1987. More recently, due to aging infrastructure as well as an effort to combat ever-rising natural gas and electric utility costs and landfill disposal fees, the Kenosha Water Utility began to explore emerging technologies as a means of becoming more energy independent by looking to transform "waste to energy" while also reducing the volume of biosolids in need of disposal. When it came time to make critical upgrades, Kenosha set out with the confidence to venture into a state-of-the-art wastewater treatment process. That decision is already paying off.

Meeting Complex Integration Challenges

In all, the project would have to deliver a cost-effective and eco-friendly solution to biosolids handling, processing, and disposal. But the task was anything but simple. The biosolids handling process was to be the biggest project at the plant since the 1980s and called for a range of new technologies and their integration to:

- Increase the generation of methane gas from the anaerobic digestion of sludge.
- Generate electricity from the methane gas to produce greater than 500 kW of continuous power for the plant.
- Use the electricity generated to offset peak energy pricing during high-demand periods.
- Use electric and thermal energies to dry the biosolids to reduce the volume of biosolid cakes to 90 percent.
- Reduce the volume and cost of biosolids that are land filled.
- Produce high-quality biosolids that meet the criteria for Class A Biosolids for beneficial reuse.
- Recover and utilize waste heat as the main thermal energy supply for the facility.

At the same time, the new process and individual technologies would have to maintain the existing effluent quality and not increase the ambient noise level, odor, or particulates beyond the area of the plant.

Steps To Becoming More Sustainable

Over the years, initial portions of the biosolids handling process underwent rebuilds or upgrades. These included the grit system in 2009, bar screens in 2010, and three of four final clarifier drive units with the final tank being completely rebuilt in 2015. As is typical for municipal contracts, a design-bid-build model was used to complete these upgrades. But to meet the goal of becoming energy efficient while drastically reducing biosolids disposal, a design-build approach was solicited for the latest major biosolids overhaul due to the complexity of the project and varying technologies necessary to accomplish the monumental task at hand.

In the request for proposal (RFP), the design/builder was tasked with preparing of the design, assisting Kenosha with all necessary permits, procuring, constructing, and installing all components, integrating of the new system with the existing plant supervisory and control data acquisition (SCADA) network, and startup and commissioning. Centrisys, a U.S. manufacturer of decanter and thickening centrifuges and dewatering systems, was awarded the contract along with J.F. Ahern, CD Smith, and Pieper as the contractors, and Donohue & Associates as the consulting engineer.

The proposed plan would incorporate some technologies never before used in North America. One of the biggest challenges was procuring and integrating the varying technologies. Also adding to the complexity was the need to generate enough biogas production to meet energy-resource needs. While some biogas would be recovered through primary sludge, Centrisys offered a solution to generate additional biogas needed through waste-activated sludge (WAS). The solution came by way of sister company

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The centrifuge room at the Kenosha Water Utility

CNP-Technology Water and Biosolids Corporation's PONDUS thermo-chemical hydrolysis process (TCHP), which uses chemicals and thermal energy to hydrolyze the WAS stream to achieve biogas production.

Another critical step was the addition of a second THK 200 thickening centrifuge — one for primary sludge thickening to complement the one already installed (in 2013) for WAS thickening. Combined, the thickening technology would work to reduce the liquid volume within the sludge stream and thicken the sludge before entering the primary anaerobic digesters. This thickening technology would yield a concentration of 7 percent solids compared to the 3 to 4 percent solids produced by the older dissolved air flotation thickening (DAFT) system. With thicker sludge, less water would be sent to the digesters, reducing the number of tanks needed from six to three, lowering heat and energy costs.

Combining these technologies, a pair of combined heat and power (CHP) cogeneration units from Kraft Power Corporation is powered by the biogas. Prior, the electricity needed to run the equipment at the treatment plant was purchased exclusively from the local utility. Any heat needed for the operations had to be provided by boilers using either natural gas or biogas as a fuel source. With the generators, each unit is capable of producing 330 kW of electrical energy and 422 kW of thermal energy. The electricity produced is being used to power the new system and supply excess electricity to the main plant power network for use elsewhere throughout the plant. Based on the design, the new system will eventually consume approximately 340 kW of electricity, leaving the remaining balance of 320 kW for reuse elsewhere at the plant and moving toward a longer-term goal of providing supplemental power to the rest of the plant.

The thermal energy will feed the TCHP, the belt dryer, and the central plant's heating loop. Based on current plant loadings, the TCHP will consume 245 kW of thermal energy, while the dryer will consume 590 kW, leaving the remaining balance of roughly 10 kW for the central plant's heating loop. The goal through optimization is that the dryer will consume less than the rated 590 kW of thermal energy, leaving additional heat for the central plant's heating loop.

Meanwhile, a biogas conditioning system was brought in to reduce maintenance and increase the longevity of the combined heat and power cogeneration units. This technology removes moisture and siloxane from methane gas in the digestion stage in preparation to fuel the CHP system.

The other major goal at hand for achieving greater sustainability was to realize an eco-friendly Class A Biosolids designation while lowering disposal volume. Prior to the overhaul, dewatered biosolids were manually loaded into a truck and disposed of at a local landfill. To meet this goal, a compact belt dryer by Sülzle-Klein was also installed. With the new dryer, dewatered material leaving a dewatering centrifuge is dried using the waste heat from the cogeneration units as the thermal supply. The dryer achieves all the requirements of Class A material, including temperature, duration, and moisture content.

A Greener Tomorrow

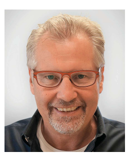
While each technology plays a critical role individually, it is their unique integration that has worked to bring this forward-thinking project to life. The additions and upgrades are in the midst of a year-long optimization process. With the additions and upgrades finished in the fall of 2015, the optimization period is targeted for a fall 2016 completion.

Today, the plant stands to save $750,000 annually with an anticipated return on investment of just eight years. The majority of those savings are attributed to energy reuse. Kenosha is currently pursuing options for the beneficial reuse of its biosolids, which potentially include land application on local farm fields, additive to the city's yard-waste compost product, fuel supplement at a local coal-fired power plant or other incineration process, or contract operations with an outside firm for distribution. The city is currently in the process of getting the final biosolids product reclassified as Class A Biosolids with the Wisconsin Department of Natural Resources.

"We're proud to take a stance in the management of our wastewater treatment facilities that is fiscally responsible to our ratepayers but also supports long-term sustainability for ecological balance," said General Manager Ed St. Peter. "It goes to show that with the right critical thinking, commitment, and steps, sustainability can be achieved cost-effectively. We're very proud that the Kenosha treatment system demonstrates such a balance." ■

About The Authors

Ed St. Peter is general manager of the Kenosha Water Utility (Kenosha, WI), and has been with the utility for his entire 45-year career. Along with being a leader in the municipal water and wastewater field, Ed believes his greatest accomplishment is the exceptional staff with which he has surrounded himself.



Michael Kopper is the founder and CEO of Centrisys Corporation, leading a global team in dewatering and process innovation problem-solving for municipal, manure management, and industrial wastewater applications.