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New York Water Environment Association, Inc.

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Cover: A construction worker walks through a large pipe, looking for potential problems. Seeking out appropriate financing opportunities for water and wastewater projects can be a daunting task.

Photo credit: istockphoto.com, tolgart

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President's Message | Summer 2018



Summer always reminds me of just how amazing New York's water resources truly are. From the Great Lakes to Lake Champlain, to the Long Island Sound, Hudson River, Finger Lakes, Mohawk River, Genesee River and every river, stream, lake, pond and groundwater resource in-between, we are truly blessed. This time of year, it is not just those of us in the clean water industry who appreciate this, but people of all walks of life who interact with water in

so many ways.

It is fitting that our summer issue of *Clear Waters* covers a set of topics that are important to our environmental mission regardless of location, utility size or operational paradigm. In this issue we cover the broad question of how to finance capital and operating expenses in a way that leads to long-term viability and sustainability of the clean water enterprise, while at the same time protecting the environment and wisely spending public money for maximum benefit.

Without smart, flexible and well-developed financing alternatives, it would be impossible for any of us to build, manage, operate and maintain our water resource recovery systems and facilities. The members of NYWEA understand that this is a vital component of the work that we do every day. Our members also understand the critical need to do our work effectively and efficiently so that we can provide clean water and environmental protection in a

manner that is affordable to all. From this perspective, it is clear how important it is that NYWEA and our members collaborate on best practices, discuss funding and financing, and continually advocate to the public and our elected officials. Our efforts will go a long way toward making certain that financing systems evolve and grow in support of our ever-changing water resource needs. That is one of NYWEA's primary objectives and we hope the topics presented in the summer issue will facilitate those dialogs.

Whether you are interested in financing methods, maintaining state-of-good-repair, environmental consciousness, sustainability, public credit and bonding, affordability of water and wastewater services, asset management tools, flexible contracting and asset ownership means, or any combination of these, this issue has something for you.

I hope you enjoy this summer's *Clear Waters*!

Geoffrey G. Baldwin, PE BCEE
NYWEA President



Do You Want to Be NYWEA President in 2022?

If you are interested in a long-term, career-enriching opportunity, please consider applying for this important position. Being an officer is a rewarding experience, but it is also a commitment of five years (Vice President-Elect, Vice President, President-Elect, President, Immediate Past President).

When reviewing applicants, the Nominating Committee will take the following items into consideration (no one is expected to have all of these items in their resumé):

- Leadership skills
- Vision and managerial skills
- Active and viable state committee chair
- Active and viable state committee involvement
- Continuous membership tenure greater than 7 years
- NYWEA award recipient
- Chapter endorsement (in writing)
- Chapter representative
- Active member of Chapter Executive Board
- Chapter officer
- Regular attendance at state meetings
- WEF Board of Directors service

Nomination deadline is August 17, 2018.

All members are eligible to apply.



Please submit an electronic resumé with a cover letter that highlights any of the attribute areas listed to:

Patricia Cerro-Reehil, Executive Director, NYWEA
525 Plum Street, Suite 102, Syracuse, NY 13204
Ph: 315-422-7811 • Fx: 315-422-3851 • E: pcr@nywea.org



One Thing Leads to Another

The financing aspects of your community's largest capital investment is a top priority for all utility managers. The theme of this issue was developed over a year ago, when the seed was planted by a conversation I had with Richard McCarthy on green bonds at our Spring Meeting in Rochester, New York. It was timely and serendipitous to then receive an email from Ryan Connors who wanted to set up a meeting to discuss infrastructure funding. Clearly we were on the right path and decided to dedicate an entire issue to Utility Financing. One thing leads to another! It was about that same time that leaders from NYWEA and NYSAWWA were meeting with staff from New York State Environmental Facilities Corporation in Albany, where the idea was born to hold a joint Asset Management Specialty Conference in the fall of 2018. We are shooting for the stars on this conference and will have George Hawkins (former General Manager of DC Water) as our keynote speaker. As you might be aware, DC Water was one of the first utilities in the nation to finance a Century Bond. I'm sure we'll be hearing more about this from George at the conference, but it seems to me that a long maturing rate for bonds on water infrastructure makes good sense, and leveling out over time, both the expense and improvements for future generations is something we all wish our predecessors had done. Look for more information on this exciting specialty conference in *Currents* and online shortly. (<https://www.youtube.com/watch?v=KgAEe-FP4H8>)

Affordability of Infrastructure for Lower Income Residents

NYWEA is in discussions with representatives from the Natural Resources Defense Council on the issue of affordability. How do we make water infrastructure affordable for all? This is a complicated question that we don't yet have answers to, but we have members looking at it. According to the USEPA, each month Americans spend four times as much on phone and internet services than on water and wastewater services. See more on this at: <https://www.youtube.com/watch?v=iCAi8f0hjVI&feature=youtu.be>

This will be called into practice in some cities across the nation that are expected to pay over \$100/month for just potable water service.

Succession Planning

Now is the time to plan! I can't stress this enough. Work to make sure you are bringing in younger people to operate and manage your utility in the future! As we talk about infrastructure funding and asset management, we also have to bring into the conversation the critically important issue of attracting more operators into the workforce. We need to make sure our utilities have the *human capital* to do the job right! Make it a priority to plan now for the future.

Scholarship Program

NYWEA's scholarship program is one way the organization incentivizes environmental careers. With the financial success of this program, the Board of Directors in June approved \$60,000 in scholarship awards in 2018 to 13 deserving students. This brings the dollar amount of scholarships granted to over \$477,000 to 190 students. As we celebrate this program's 20th anniversary, our hope is that these students will indeed make a difference in water quality as they advance in their studies and move into their water careers. Many thanks to the Scholarship Committee members who dedicate their time to review applications and make this program a success!

Features of This Issue

Many thanks to the members of the Publications Committee for embracing this theme and helping to make sure we present a well-rounded viewpoint for our readers. We hope you find this magazine a useful tool to do your job better! On the lighter side of things you will find highlights from the Spring Technical Conference and some interesting and fun ways our industry recognizes its professionals.

Here's wishing you all a wonderful summer!

Patricia Cerro-Reehil, pcr@nywea.org

American Water Works Association
New York Section

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**Asset Management and Utility Finances
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MARK YOUR CALENDARS!

The Sagamore Hotel, Bolton Landing, June 10-13, 2018
NYWEA Spring Technical Conference & Exhibition
“Building and Operating the Utility of the Future”

Over 200 people attended NYWEA's Spring Technical Conference & Exhibition held at the Sagamore Hotel, June 11-13. Meeting attendees selected from 11 sessions covering topics such as Nutrient Removal, Ethics, Global Water Issues and Emerging Contaminants. Thirty-two exhibitors filled the Sagamore's Event Center where the Operations Challenge also took place. Many thanks to the members of the Program Committee, speakers, moderators, advertisers, sponsors, exhibitors and, most importantly, the attendees for making the meeting a success. See pages 52-53 for additional images from the meeting.



NYWEA President Geoff Baldwin welcomes everyone to the Opening Session of the Spring Technical Conference.



Left: The Opening Session panel discusses regionalization in the resource recovery market and the historic agreement between Albany and Saratoga counties. Shown (l-r) are Sally Rowland, NYS DEC; Dan Rourke, Executive Director Saratoga County Sewer District #1; Tim Murphy, Executive Director Albany County Water Purification District; Robert Ostapczuk, Arcadis; and Geoff Baldwin.



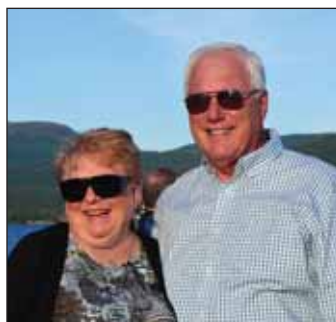
The Spring Technical Conference allows for an intimate learning experience with smaller class sizes and plenty of time for networking.



Left: Rosie Nogle of Buffalo Sewer Authority speaks about the history of the City of Buffalo's sewers, maintenance and CSO control.



Above: Christina Fortin, left, and Jean Malafronte



Right: Sean Morrison from Buffalo Sewer Authority

Left: Retired Exhibit Committee chair, Glen Vogel and his wife Pat visit with old friends.



L-r: Robert Butterworth, Tom Lauro and Tony Della Valle



Congratulations to the newly inducted members of the SSSSS!



College roommates and now environmental professionals, Kathryn Serra and Vice President-Elect, Lauren Livermore



Jean Malafronte teaches children what happens to the water at a water resource recovery facility.



Many thanks to the NYWEA Capital Chapter Board members for all of their help in making the meeting a great success! L-r: Tim Clayton, Will Stradling, Chretien Voerg, Silvia Marpicati, Dan Rourke, Venessa Brabant and Jonathan Ruff.



Rich Fiedler enjoys the Adirondack surroundings.



Rick, center, and Pam Kenealy and Dave Barnes catch up during the President's Reception.



NYWEA Executive Director Patricia Cerro-Reehil talks to children from Bolton Elementary School.



Josephine and Leo Aparri



NYWEA members play Jenga on the veranda.



Tanya Jennings demonstrates the wastewater disinfection process to Bolton Elementary students.



The Operations Challenge get the full attention Bolton Elementary students.



William Nylic talks with Bolton Landing grade 3-5 students. Public Outreach was one of the focal points of the meeting.



Julie Barown shows students from Bolton Elementary how important the macroinvertebrates are in the digestion of bacteria.



Khris Dodson demonstrates how rain and run-off affects watershed management.

continued on page 52



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Funding Clean Water Infrastructure

Let's face it. Water problems are often money problems. Clean water infrastructure is expensive and deferred maintenance only makes it more so. While New Yorkers demand clean water, they also want affordable sewer and water rates.

We can be proud that for many years, New York has maintained a Clean Water State Revolving Fund that provides more low and zero-interest financing for municipalities than any other state. In 2017, New York's commitment to clean water rose to new heights with the \$2.5 billion Clean Water Infrastructure Act (CWIA). In 2017 alone, the Environmental Facilities Corporation (NYSEFC) matched loans with \$225 million in outright grants from the CWIA. For hardship communities with wastewater treatment needs, 25-percent grants were paired with zero-interest loans, saving communities over 40 percent over the cost of a typical 30-year loan. NYSEFC also distributed \$30 million in intermunicipal grants to promote the efficiencies associated with system mergers.

The CWIA allowed NYSDEC to dramatically increase funding for its Water Quality Improvement Project program (WQIP). In 2017, NYSDEC awarded over \$87 million for 95 projects, which included municipal wastewater infrastructure and disinfection, land acquisition for source water protection, salt storage, polluted runoff abatement, and municipal separate storm sewer systems. WQIP is part of the annual Consolidated Funding Application.

New York has also used its Environmental Protection Fund

(EPF) to support significant annual grants for priority municipal wastewater projects, as well as programs to address urban storm-water runoff and agricultural management practices. The EPF has been maintained at a historic high of \$300 million for three years. This program funds numerous holistic watershed basin programs. Portions of the EPF go to the Ocean and Great Lakes Initiative; Long Island Sound nitrogen reduction efforts; the Mohawk River Basin Program; the Hudson River Estuary Program; Soil and Water Conservation District capacity; and Long Island Sound recovery. The EPF also includes \$5 million annually to update drinking water source risk assessments and to otherwise help rapidly respond to sources of drinking water contamination.

To assist municipalities with initial engineering studies, NYSDEC and NYSEFC also offer Engineering Planning Grants. Last year, over \$3 million was awarded to 72 communities. Engineering firms are encouraged to help clients apply for these awards, which range from \$30,000 to \$100,000 depending on the project scope.

Funding infrastructure is just one aspect of protecting our water. Communities must also take care of their infrastructure. To support such efforts, NYSDEC and NYSEFC launched the \$3 million Municipal Sewage System Asset Management Pilot Program, which is detailed on page 12 in this issue of *Clear Waters*.

The amount of funding available presents a rare opportunity for municipalities. Don't miss out. Visit NYSDEC's and NYSEFC's websites to learn more.

– James Tierney, Deputy Commissioner for Water Resources
NYS Department of Environmental Conservation



Worker Safety is Smart Business Sense

Many business leaders continue to regard worker safety and health as an expense rather than an investment. This is upside-down thinking. Worker safety and health is a legitimate business cost, but one that has value and is inextricably linked with business initiatives.

Leaders of any organization have their business priority lists. Whether or not the organization is a public utility or a publicly-traded company, certain business values are shared. What organization does not think about productivity, cost containment, profit, reputation or customer service? Safety and health affect each one of these business and financial outcomes. Quantifying the financial effect takes a bit of pencil-work but models are out there. OSHA has its Safety Pays calculator that estimates the direct and indirect costs of an injury, and additional sales needed to recover the cost of that injury. Who would imagine that a simple fracture in a workplace accident could cost a company with a 3 percent profit margin over a million dollars? Show that little number to a business manager and they will start perspiring.

In times past, injuries may have been viewed as the cost of doing business but today there is no reason to keep a business afloat at the expense of the lives or health of its workers. The value of safety and health is not just about the dollar value. Over the last twenty

years, much of the value of safety has turned to the personal level. Employee engagement is the buzzword of the year but behind the phrase is the need to treat workers as true business partners. Employees who feel an organization is concerned about their safety are likely to be more engaged in the organization's success; morale is adversely affected by a lack of safety. Talented employees are likely to move on if they do not feel valued as an individual but only feel regarded as a human machine.

On the financial side, how are safety and health performance measured so that the business decision-makers can connect to the desired outcome? If employees leave, productivity decreases and hiring costs increase. As sustainability initiatives become increasingly common, researching OSHA statistics to evaluate a business partnership decision is gaining steam. If a business is known as a safety "bad actor," its image and brand are hurt. When injuries increase, insurance premiums and payouts increase. If deficiencies are found when an organization is audited by their governmental safety agency, fines come straight from the profits.

For municipalities, where budgets are always tight, the financial incentive for safety may be the money freed up for projects, which otherwise would be destined for higher insurance premiums or consumer costs. These performance measures are specific to the organization, but they can be determined.

– Eileen M. Reynolds, Certified Safety Professional
Owner, Coracle Safety Management

Green Bonds for Environmental Projects

by Richard N. McCarthy

Introduction

An increasingly popular instrument for financing environmentally beneficial projects is the “green bond.” The volume of issuance for green bonds has grown dramatically from \$10 billion in 2013 to \$81.4 billion in 2016, to over \$100 billion in 2017 according to the Climate Bonds Initiative (*Climate Bonds Initiative 2018*). According to Bloomberg New Energy Finance, the volume of issuance for 2016 was \$99.1 billion (*Bloomberg 2017*). Green bond issuance shows no sign of abating. Green bonds have been issued all over the world and in the United States. They have been used for a wide variety of purposes, from traditional green projects, such as water and sewer projects, to projects specifically targeted to reduce global warming (sometimes called climate change bonds). Below, we describe what green bonds are, assess the size and growth of the green bond market, describe the costs of green bond issuance and assess some of the pros and cons of green bonds.

What Are Green Bonds?

There is no national or international organization or agency that is the final arbiter of what a green bond is. To an extent, a “green bond” is a bond that its issuer says is “green.” However, there are a number of institutions, companies and organizations that have proposed definitions and criteria for green bonds, as well as processes for issuing and monitoring them in the future.

The original issuer of green bonds is the World Bank, which issued the first green bond in 2008. Since then it has issued \$10.05 billion of green bonds for 130 projects. It defines a green bond as “a debt security that is issued to raise capital specifically to support climate-related or environmental projects” (*The World Bank 2015*). The Investor Network on Climate Change (INCC) has a similar definition and adds the concept of transparency to its definition.

Another well-recognized and influential organization that has defined green bonds is the International Capital Markets Association (ICMA). The ICMA is an association of very large global banks whose stated mission is to promote resilient and well-functioning international debt capital markets, which are necessary for economic growth. It defines green bonds as “any type of bond instrument where the proceeds will be exclusively applied to finance or refinance eligible Green Projects.” In 2014, the ICMA published a set of Green Bond Principles, which it has updated several times (*ICMA 2017*). The purpose of the Green Bond Principles is to promote integrity in the green bond market through guidelines that recommend transparency, disclosure and reporting before and after issuance. The Green Bond Principles have four core components, including use of proceeds, process for project evaluation and selection, management of proceeds and reporting.

The Green Bond Principles set forth ten types of projects that address areas of environmental concern, including climate change, natural resource depletion, loss of biodiversity and air, water and soil pollution. Specifically, projects of these types include wastewater treatment, sustainable water and wastewater management, urban drainage systems and other forms of flood mitigation.

The Climate Bonds Initiative (CBI) (*Climate Bonds Initiative 2018*) is a self-described international, investor-focused not-for-profit. The CBI has developed the Climate Bond Standard and Certification Scheme (CBSCS) that it describes as “a screening tool for investors and governments which allows them to easily prioritize climate and green bonds with confidence that the funds are being used to deliver climate change solutions.” The CBSCS provides a process for

identifying and reporting on qualifying projects, for demonstrating internal processes and controls to assure bond proceeds are spent for qualifying project costs and for providing post issuance reporting at least annually on the expenditure of proceeds. In addition, the CBSCS sets forth types of projects and well-defined criteria that describe the characteristics of qualifying projects. The CBI has developed specific criteria for solar, wind, water, low carbon buildings, low carbon transport and geothermal. It is working on more sets of criteria in additional categories. The CBSCS is focused on mitigation of climate change.

The CBSCS includes a requirement for independent third-party certification of the issuer’s compliance with the CBSCS.

Moody’s Investor’s Service recently began providing Green Bond Assessment service. Moody’s defines green bonds as “fixed income securities, both taxable and tax-exempt, that raise capital for use in financing or refinancing projects and/or activities with specific climate or environmentally sustainable purposes” (*Moody’s Corporation 2018*). The Green Bond Assessment provides an evaluation of the bond issuer’s management, administration, allocation of proceeds to and reporting of environmental projects financed with the proceeds of the green bonds. Green bonds are scored in five key areas: organization; use of proceeds; disclosure on the use of proceeds; management of proceeds; and ongoing reporting and disclosure. The purpose is to enable potential investors to judge the relative likelihood that bond proceeds will be used for environmentally beneficial projects as designated by the issuer. The Green Bond Assessment ranges from Green Bonds 1, or excellent, to Green Bonds 5, or poor. Moody’s does not provide a definition of what “green” is. It does reference the Green Bond Principles as a frequently used guide for what kind of projects may be financed with green bonds.

Size of the Green Bond Market

The green bond market has expanded rapidly. The CBI tracks issuance in “labeled” green bonds, which it defines as bonds stated to be green by the issuer (in contrast to bonds that are for environmentally beneficial projects, but which the issuers have not designated to be green). Such green bonds may or may not have independent third-party review and may or may not address climate change.

According to the CBI, 2013 issuance of labeled green bonds totaled just over \$10 billion. Issuance increased to over \$36 billion in 2014, over \$42 billion in 2015, over \$82 billion in 2016 and over \$100 billion in 2017. Issuers include U.S. municipal issuers, sovereign governments, non-U.S. cities and provinces, U.S. and non-U.S. government agencies, state-backed entities, international development banks, corporations and commercial banks.

Bloomberg also tallies green bond issuance. Bloomberg has its own criteria for identifying green bonds. Bloomberg’s assessment of the size and growth of the green bond market is shown in *Figure 1*.

U.S. tax-exempt municipal green bond issuance has also grown rapidly from \$100 million in 2013 to \$6.685 billion in 2016 with \$4.457 billion in the first half of 2017 (*Figure 2*).

In total through June 30, 2017, 70 separate U.S. tax-exempt issuers had issued \$17.5 billion in green bonds (*Environmental Capital LLC 2017*). Green bonds have been issued by a wide variety of types of issuers, including states, counties, municipalities, school districts, colleges and universities and various agencies and authorities, such as water and sewer agencies.

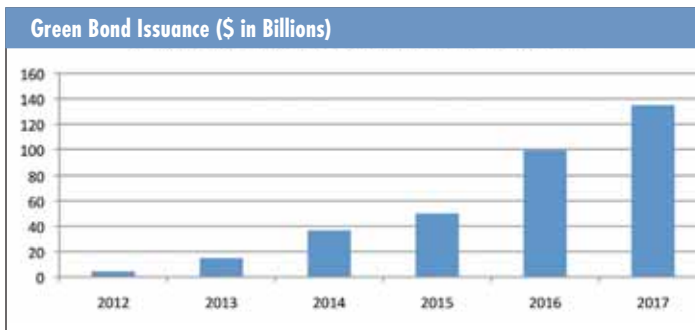


Figure 1. Green bond issuance, 2012 through 2017, using data from Bloomberg New Energy Finance. The 2017 data includes extrapolation, conducted in September 2017, from the end of the third quarter.

Environmental Capital LLC

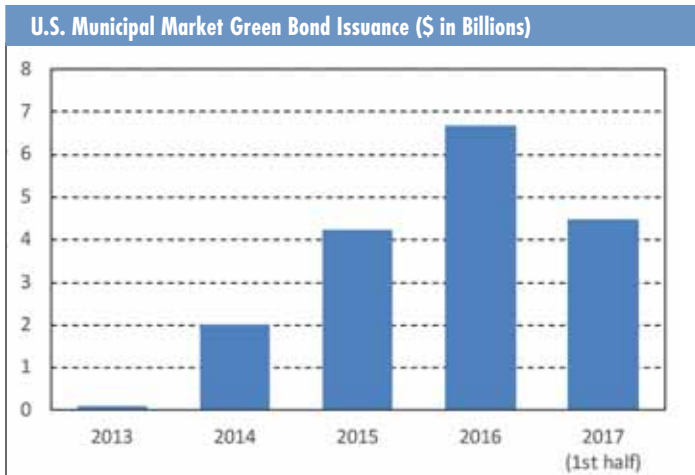


Figure 2. Tax-exempt green bond issuance in the U.S. municipal market. Par amount issued by year, 2013 through the first half of 2017.

Environmental Capital LLC

Benefits of Green Bonds

There are a variety of benefits that the proponents of green bonds have offered. These include reputational or branding benefits and financial benefits. Both issuers and third parties have commented that the issuance of green bonds is a demonstration of the issuer's commitment to environmental improvement and efforts to reduce global warming (AMWA 2017). The issuance of green bonds calls attention to the environmentally beneficial projects being financed.

On any financial benefits, the jury is still out. Some market commentators and issuers have stated that green bonds attract more and new investors. There are a growing number of investment funds that are specifically dedicated to green and socially responsible investing, so that this would seem reasonable.

Whether or not green bonds price better than non-green bonds (that is, sell at lower interest rates for otherwise comparable bonds) has still not been demonstrated. The CBI issued a report in November 2017 (*Climate Bonds Initiative and the International Finance Corporation 2017*) in which they find some evidence of advantageous comparative interest rates, but nothing conclusive.

In September 2017, HSBC Global Research published a report that concludes that "there is little evidence that green bonds price tighter (have lower interest rates) than non-green bonds in primary market" (HSBC Global Research 2017). They also found that "there is mounting evidence that some green bonds trade inside non-green bonds in the secondary market" in the developed market (that is at lower comparative interest rates than non-green bonds when compared to recognized interest rate benchmarks).

There is no evidence of which we are aware that suggests that

green bonds price differently than comparable non-green bonds in the U.S. tax-exempt market.

Costs of Green Bonds

There are very few costs of issuing green bonds, especially if the issuer self-certifies its bonds as green bonds. For issuers that desire to use one of the green bonds processes described earlier, the largest cost is the time and attention required of management. Time must be taken to understand and adopt a process and then to follow it. If the issuer desires third party review and certification, there will be the cost of the report provided. For larger issues, those costs do not seem onerous.

Summary

Green bonds are an increasingly popular vehicle for raising funds for environmentally beneficial projects. Green bonds have been used for a wide variety of international and domestic projects that combat climate change and for projects with other more traditional environmental benefits. The market has grown rapidly. Many issuers and observers see green bonds as providing benefits, such as a heightened focus on and awareness of the environmental good produced by green bond projects and their issuers. While investors seem enthusiastic about green bonds, this has not yet manifested itself in an interest rate advantage for green bonds over traditional bonds. However, the green bond market is still young and subject to new developments.

Richard N. McCarthy is the President of Environmental Capital LLC. He may be reached at rmccarthy@encapllc.com.

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New York: A State of Good Repair?

by Carrie E. Smith

New York regulations require that municipal wastewater infrastructure be maintained in a state of good repair. Lack of planning and adequate funding, however, is often cited as the cause of infrastructure failure. Such failures often result in enforcement actions and costly expenditures, which could have been avoided had the system been maintained. The state-wide need for repair and replacement of aging infrastructure led to the development of the Municipal Sewage System Asset Management Pilot Program (the Pilot Program). On May 10, 2017, the New York State Department of Environmental Conservation (NYSDEC) and New York State Environmental Facilities Corporation (NYSEFC) launched the Pilot Program to develop asset management programs with ten municipalities across New York (Table 1). The Pilot Program provides NYSDEC and NYSEFC an opportunity to learn the principles of asset management and identify the necessary components of an effective asset management program.

Municipality	Facility
Town of Bethlehem	Dinmore Road Wastewater Treatment Plant
Town of Carmel	Carmel Sewer District (CSD) Nos. 4, 5, 6 and 7
Village of Dolgeville	Dolgeville Wastewater Treatment Facility
Village of Greenport	Greenport Wastewater Treatment Plant
Village of Honeoye Falls	Honeoye Falls Wastewater Treatment Plant
Onondaga County	Oak Orchard Wastewater Treatment Plant
Village of Vernon	Vernon Wastewater Treatment Plant
Washington County	Washington County Sewer District No. 2
Village of Westfield	Westfield Water Pollution Control Facility
City of Yonkers	Sanitary Sewer System

Using \$3 million in funding provided by NYSEFC, the Hudson River Estuary Program, and the Oceans and Great Lakes Fund, the State hired Barton & Loguidice, D.P.C. to provide engineering services for the Pilot Program at no financial cost to the participating municipalities. Key project tasks include asset inventory, assessment, and replacement; levels of service; risk analysis; O&M expenditure programs; five-year Capital Improvement Plan; sewer rate study; long-range funding strategy; and asset management plan development. These project tasks follow the principles of the U.S. Environmental Protection Agency's asset management guidelines (USEPA 2008), including the "Five Core Questions Framework". The municipalities are also receiving training and access to IBM® Maximo®, an enterprise asset management software, for use during the Pilot Program.

At the end of the Pilot Program, the municipalities will have a better understanding of what they own, its condition, and how they can better plan future investments to ensure their wastewater infrastructure remains in a state of good repair. Each municipality will have an electronic record of its assets to refer to when planning maintenance or investment strategies (Figure 1, Figure 2 and

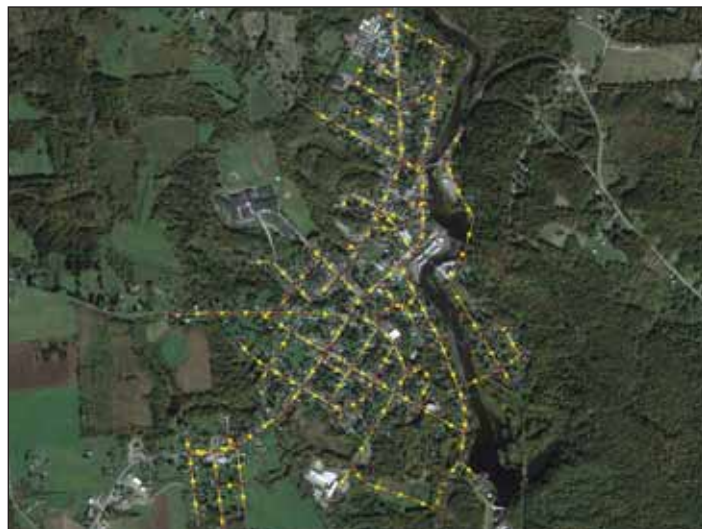


Figure 1. A GIS map of collection system and manhole locations for the Village of Dolgeville represents one form of electronic data available for municipal use. Barton & Loguidice, D.P.C.

Location Code	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
RF	Water Resource Recovery Facility					
RFHW	Headworks					
RFHWSC	Coarse Screening					
RFHWST1	Influent Structure No. 1					
RFHWST3IP	Influent Piping, Upstream MH to Influent Structure No. 1					
RFHWST1SC-1	Manual Bar Rack					
RFHWST1SC-2	Mechanical Bar Screen, Influent Structure No. 3					
RFHWST1EF	Effluent Piping System, Influent Structure No. 1 to Raw Sewage Pump Station					
RFHWIF	Influent Pumping					
RFHWIPS	Raw Sewage Pump Station					
RFHWIPST1	Tank, Raw Sewage Wet Well					
RFHWIPST1DF	Diffusers, Raw Sewage Wet Well					
RFHWIPAP	Air Piping, Raw Sewage Pump Station					
RFHWIPSB	Blower 1, Raw Sewage Pump Station					
RFHWIPSSR	Scum Piping System, Raw Sewage Wet Well to Pump Nos. 1-3					
RFHWIPSP	Raw Sewage Pumps Suction Piping System, Raw Sewage Wet Well to Raw Sewage Pump Nos. 1-3					
RFHWIPSPV1	Plug Valve 1, Raw Sewage Pumps Suction Piping System					
RFHWIPSPV2	Plug Valve 2, Raw Sewage Pumps Suction Piping System					
RFHWIPSPV3	Plug Valve 3, Raw Sewage Pump No. 1					
RFHWIPSPV4	Plug Valve 4, Raw Sewage Pump No. 2					
RFHWIPSPV5	Plug Valve 5, Raw Sewage Pump No. 3					
RFHWIPSP1	Pump No. 1, Raw Sewage Pump Station					
RFHWIPSP2	Pump No. 2, Raw Sewage Pump Station					
RFHWIPSP3	Pump No. 3, Raw Sewage Pump Station					
RFHWIPSPD	Raw Sewage Pumps Discharge Piping System, Raw Sewage Pump Nos. 1-3 to Plant Bypass, Grit Bypass or Vortex Grit Removal System					
RFHWIPSPV1	Check Valve 1, Raw Sewage Pump No. 1					
RFHWIPSPV2	Check Valve 2, Raw Sewage Pump No. 2					
RFHWIPSPV3	Check Valve 3, Raw Sewage Pump No. 3					
RFHWIPSPV4	Plug Valve 1, Raw Sewage Pump No. 1					
RFHWIPSPV5	Plug Valve 2, Raw Sewage Pump No. 2					
RFHWIPSPV6	Plug Valve 3, Raw Sewage Pump No. 3					
RFHWIPSP	Effluent Piping, Raw Sewage Pumps Discharge Piping to Plant Bypass, Grit Bypass or Vortex Grit Removal System					
RFHWIPSPV1	Gate Valve, Vortex Grit Removal System					
RFHWIPSPMH	Manhole					
RFHWBP	Plant Bypass					
RFHWBEP	Effluent Piping, Plant Bypass					
RFHWGR	Grit Removal					
RFHWGRBP	Grit Bypass					
RFHWGRBEP	Effluent Piping, Grit Bypass					
RFHWGRBEPV1	Gate Valve, Grit Bypass					
RFHWGR	Vortex Grit Removal System					
RFHWGRGSP	Influent Piping System, Vortex Grit Removal System within Grit Building Enclosure					
RFHWGRGSPV1	Plug Valve 1, Vortex Grit Removal System, Unit 1					

Figure 2. This example of a process-based location hierarchy for the Village of Westfield provides the municipality with easily accessible asset information. NYSDEC

Figure 3). The overarching goal of the Pilot Program is to test and improve NYSDEC's Municipal Sewage System Asset Management Guide (the Guide). The Guide (NYSDEC 2015) outlines the benefits of asset management and includes some of the components that should be considered when developing an asset management pro-



Figure 3. Photographs are another means to monitor municipal assets, such as this condition assessment of the RBC tank cover at Carmel Sewer District No. 4. NYSDEC

gram. Through the Pilot Program, the State will identify practices and considerations necessary to create and maintain a sustainable asset management program. This information will then be used to update the Guide and improve the guidance available to all municipalities across the state. It is anticipated that asset management will be a component of NYSDEC's permitting and compliance

strategies. The Pilot Program will inform the State how asset management may be used to support or direct these strategies.

Aging wastewater infrastructure is an issue that many municipalities are grappling with. Through the Pilot Program, the State is taking the lead to address these issues while soliciting local input. Asset management programs provide municipalities, as well as the State, with effective strategies to address infrastructure needs. By implementing asset management practices, municipalities can develop long-term strategies that protect ecosystems and public health, while avoiding enforcement actions and associated penalties, minimizing long-term ownership costs, and maintaining economic competitiveness through improved prioritization and decision making. Although New York is investing a historic amount of money in upgrades to wastewater infrastructure, there is a need for long-term planning and investment to ensure these assets remain in a state of good repair.

For additional information, including an electronic copy of the Guide, please visit <http://www.dec.ny.gov/chemical/101419.html>.

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Addressing Customer Affordability through Integrated Asset and Financial Management Planning

by Zachary Green, Mike Borchers and Robert Ryall

Introduction

Water and sewer utilities that have aging infrastructure are seeking to renew their systems by employing a structured asset management approach to address a range of affordability challenges that result from increased capital investment. Political pressure to not increase rates may emerge in those communities where rate increases have a significant impact on customers. In other communities, normal financial and regulatory drivers such as debt limits, tax increase caps, consent decrees or even requirements for asset management planning may result in conversations about affordability. As more communities acknowledge affordability concerns with respect to water and wastewater rates and seek to address them, one relevant question is how, exactly, affordability should be defined and analyzed.

While the USEPA guidelines use the Residential Indicator, which is the Cost Per Household (CPH) divided by the Median Household Income (MHI), as one measure for assessing affordability, there is increasing recognition that other benchmarks may be needed for communities to provide a more complete picture of how water and wastewater costs are impacting their customers. National associations including the Water Environment Federation (WEF), bond rating agencies and others provide a range of perspectives on how affordability benchmarks could evolve to ensure affordability is appropriately addressed in a more comprehensive manner.

Our experience shows that utilities can better address infrastructure replacement and affordability challenges through integrated financial and asset management planning that incorporates multiple affordability considerations. This approach can provide a more effective way for utilities to address infrastructure challenges while balancing rate increases and associated affordability concerns.

The Challenge

In the wake of the Great Recession of 2007 through 2009, interest rates are beginning to recover from historic lows. Yet even at these low rates, and with debt service spread across multiple generations of customers, the capital requirements of U.S. water and wastewater infrastructure needs are daunting. The American Water Works Association (AWWA) estimates that \$1 trillion is needed for potable water pipe network investments (*AWWA undated*). USEPA estimates that \$137 billion is needed for water treatment, storage and source of supply investments, as well as an additional \$271 billion need for investments in wastewater and stormwater infrastructure (*USEPA 2011*). Together the bill for these investments comes to approximately \$1.4 trillion, which is equivalent to about 7 percent of the entire U.S. economy in 2017. These national condition assessments suggest that, historically, water and wastewater rates have lagged behind the needed investment. As a result, ratepayers have been conditioned to expect a level of value that does not support the renewal and replacement of essential infrastructure.

State governments, such as Florida, Michigan and New Jersey, are also beginning to tie loan fund program participation or financial incentives with the development of utility asset management plans. These requirements can include the development of long-term funding plans that cover financial planning and address

community affordability and sustainability, as well as environmental, social and economic viability. The New York State Department of Environmental Conservation (NYSDEC) is currently undertaking a Municipal Sewage System Asset Management Pilot Program. While this program could amend existing asset management guidelines for state wastewater utilities, NYSDEC has not at this point indicated that the study will yield any statewide requirements. Nevertheless, the existing NYSDEC Municipal Sewage System Asset Management Guide includes a long-range funding strategy component. This component and others could be revised once the pilot program is complete.

Thus, given the need for greater infrastructure replacement combined with requirements to conduct financial and asset management planning, utilities are challenged to develop a process that effectively meets these requirements while maintaining affordable rates. (*See article on page 12.*)

The Status Quo

Traditional asset management and capital planning approaches go a long way toward helping communities understand and prioritize capital investments. However, even when a rigorous asset management plan is developed, too often it is decoupled from a utility's financial planning process and broader stakeholder input.

Traditional asset management and capital planning approaches should undertake the following five steps:

- 1) Inventory assets.
- 2) Determine level of service requirements.
- 3) Assess asset condition (probability of failure) and criticality (consequence of failure).
- 4) Calculate risk scores to prioritize asset investments.
- 5) Develop long-term funding, asset management and capital improvement plans.

This approach will answer the questions, "Where should I invest, in what order?" and "How will I pay for this?" When revenue increases are required, too often utilities are not well equipped to determine or communicate whether a bill is affordable for its customers.

USEPA's guidance on affordability for wastewater and Combined Sewer Overflow (CSO) services was issued as part of "The Guidance for Financial Capability Assessment and Schedule Development" in 1997 (*USEPA 1997*) as well as the "Financial Capability Assessment Framework for Municipal Clean Water Act Requirements" in 2014 (*USEPA 2014*). This guidance, often presented with caveats acknowledging certain shortcomings, prescribes that municipalities undertake analyses to understand the economic impact of investments made to maintain compliance with water quality mandates (*Figure 1*). Specifically, the Residential Indicator compares the wastewater system's CPH for a residential customer to the community MHI. A community's wastewater service affordability is generally considered highly burdened when the annual CPH as reflected in the residential wastewater charge is greater than 2.0 percent of MHI. However, when the Residential Indicator analysis is combined with other indicators such as net debt to full market property value, or bond ratings, a broader perspective of overall affordability of

The Basics: Measuring Water Service Affordability		
Measure	Residential Indicator = $\frac{\text{Cost per Household (CPH)}}{\text{Median Household Income (MHI)}}$	
Definitions	CPH = $\frac{\text{Residential Share of Total Service Costs}}{\text{Number of Households in Service Area}}$	
	MHI = The middle value of income within an ordered series of residential household incomes for a given population (i.e. \$0...Middle Value...Highest Value).	
Benchmarks	Service	EPA Residential Indicator Upper Bound for Affordable Services
	Wastewater and CSO (Combined)	2.0%
	Water Supply	2.5%

Figure 1. USEPA’s 1997 guidance on water service affordability contains three basic elements: measures, definitions and benchmarks. Arcadis

wastewater service and a community’s ability to comply with Clean Water Act mandates is achieved. With respect to a Residential Indicator for drinking water service, the USEPA has also stated that a similar threshold of 2.5 percent would apply, resulting in a combined water service Residential Indicator of 4.5 percent.

Two 2017 studies that employed USEPA’s Residential Indicator tell very different stories about how affordable water services are in America today. One study looked at affordability nationwide using a combined water service cost (including water, wastewater and stormwater) of \$0.01 per gallon of water consumed and average monthly consumption of 12,000 gallons per household, or a cost of about \$1,440 per household per year. The study results suggest that if the five-year historical rate of growth in combined water service costs through 2014 continued for the next five years, then the share of households exceeding the USEPA’s 4.5 percent residential indicator threshold would balloon from 11.9 percent to 35.6 percent (Mack and Wrase 2017). The other study relied upon analysis of data from utilities serving 45 million people across eight states, which determined that 5,000 gallons per month was a more reasonable water consumption estimate (Irvin 2017). Using this lower monthly consumption estimate and the same rate of \$0.01 per gallon produces annual, combined water service costs of \$600 per year per household. This would suggest that less than 1 percent of U.S. households currently have unaffordable combined water service rates. So, does America have a present or looming widespread water affordability crisis, or isolated challenges for specific communities? The answer of course lies within the unique characteristics of each community that faces significant water-related infrastructure improvements.

While the study variables from national affordability analyses can sometimes deviate greatly from those of a given community due to socioeconomic and other factors, the scale of the U.S. water infrastructure investment gap and associated rate increases will inevitably pose challenges for the most vulnerable populations in many communities. Further, broad affordability assessments based on MHI suffer inherently from several flaws as detailed in the “Affordability Assessment Tool for Federal Water Mandates” (USCM, AWWA & WEF 2013) issued by WEF, AWWA and the United States Conference of Mayors (USCM) in 2013, namely:

- MHI is an overly simplistic measure of a community’s ability to pay, particularly when concentrations of vulnerable populations cluster at economic extremes, which is increasingly the case; or,

for example, when renting or public housing is prevalent.

- MHI does not account for trends in community composition that are fluid in time.
- MHI does not account for the variable cost of other household expenses across communities.

Alternatives to USEPA’s Residential Indicator

Several groups, including WEF, AWWA and USCM, developed a report that suggests several improvements for applying the Residential Indicator as a measure of affordability. The suggested improvements include applying the indicator by: economic quintile; vulnerable population type; neighborhood; or reviewing other economic indicators such as the unemployment rate, percentage of households receiving public assistance, percentage of households participating in existing affordability programs, or percentage of households with high housing or nondiscretionary expenses.

Additionally, bond rating agencies have included other elements such as:

- A Percent-MHI affordability target of 2 percent, (compared to the USEPA’s 4.5 percent) for combined water services (Fitch 2017).
- A review of the level of delinquencies and a preference for rate flexibility rather than subsidization (Moody’s 2015).
- A switch to Median Household Effective Buying Income (MHEBI) as the Residential Indicator denominator, which is median taxpayer income from wages, interest and other forms of income less taxes and other wage deductions (Standard and Poor’s 2016).

When the findings of such advanced analyses do uncover at-risk populations exposed to affordability challenges, utilities are faced with the task of balancing cost recovery for necessary infrastructure investments with their customers’ ability to pay. There are customer assistance programs that use tools (e.g., targeted rebates for delinquent accounts) to offer relief for vulnerable populations in many communities. However, these tools can sometimes result in administrative complexity, lack of participation, reactive rather than proactive relief, or persisting delinquency rates. Utilities are beginning to innovate in this area. Some, such as the City of Philadelphia’s Water Department, are considering or implementing income-based billing strategies in lieu of traditional programs. In Philadelphia, tax returns and pay stubs will be used to cap combined water and sewer rates for qualifying customers at specific levels:

- 2.0 percent of monthly income for households living at 0 to 50 percent of the poverty level.
- 2.5 percent of monthly income for households living at 50 to 100 percent of the poverty level.
- 3.0 percent of monthly income for households living at 100 to 150 percent of the poverty level.

Lessons Learned

As noted above, the concept of what is affordable within the water industry is a work in progress. Just as each wastewater and water system differs from community to community, each community will have its own unique challenges with respect to affordability. Arcadis’ project experience in the Northeast has revealed that incorporating financial planning into asset management and capital planning processes (Figure 2) improves community understanding and yields a practical and timely evaluation of affordability that can be quantified through modeling. In recent integrated financial and asset management planning engagements with medium sized

continued on page 16

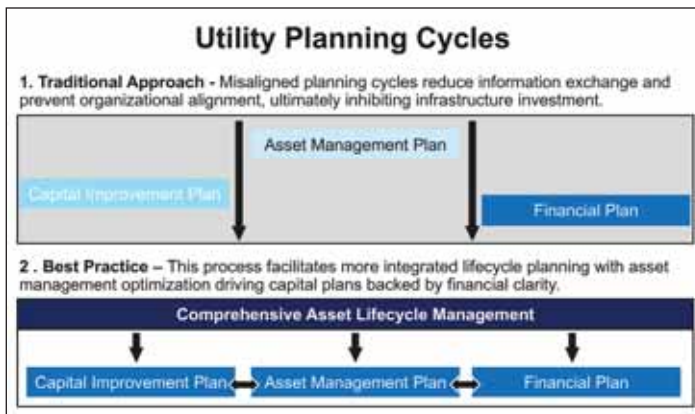


Figure 2. Traditional utility planning cycles can be disjointed. A better approach would create planning cycles that are concurrent, coordinated and aligned. *Arcadis*

utilities, Arcadis has uncovered three key lessons learned that we wanted to share with the NYWEA community:

- 1) Many utilities have not undertaken affordability analyses, even at the most basic level using CPH as a percent of MHI.
- 2) Often, top-line affordability analyses reveal that even double-digit rate increases early in planning cycles do not necessarily vault communities into scenarios that would be deemed unaffordable based on the USEPA Residential Indicator, though it may become clear that vulnerable communities are at risk once more advanced metrics are applied.
- 3) Utilizing enhanced affordability metrics provides greater insight on how water-related improvements will impact customers. Use of these enhanced affordability metrics can provide a

basis for developing utility customer assistance programs. Integrated planning that brings together community leaders, utility management and other stakeholders can help build water related financial knowledge, improve modeling inputs, align messaging, and enhance strategic thinking. This ultimately sets a strong foundation for successfully implementing projects that achieve regulatory compliance, while balancing community affordability concerns.

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Sustainable Utility Management Using Workshop in a Box

by Steve Grimm

Sustainable utility management. It seems many are talking about it. But what does it mean? How do you achieve it? Simply put, a sustainable utility is one that plans responsibly today for tomorrow's needs. It provides a desired level of service to its customers at a fair and reasonable cost. So many municipalities with water infrastructure are facing challenges to their sustainable livelihood. How they got to this point is not really that important. What is important is how they approach their sustainability deficiencies, and the steps they take to improve overall utility sustainability.

There are many tools that can be used to achieve utility sustainability. Asset management plans are one such tool. Asset management is the practice of managing infrastructure capital assets to minimize the total cost of ownership and operation. Asset management focuses heavily on the financial aspect of sustainability.

Workshop in a Box

The *Rural and Small Systems Guidebook to Sustainable Utility Management*, aka "Workshop in a Box" (WIAB), is another tool available to aid municipalities to improve overall water and wastewater utility sustainability. Developed jointly by the United States Department of Agriculture, Rural Development (USDA-RD), and the United States Environmental Protection Agency (USEPA), WIAB is a self-evaluation tool used to address these 10 key management areas:

- Product quality.
- Customer satisfaction.
- Employee and leadership development.
- Operational optimization.
- Infrastructure stability.
- Operational resiliency.
- Community sustainability and economic development.
- Water resource adequacy.
- Stakeholder understanding and support.
- Financial viability.

Used in conjunction with a committee approach, the WIAB process can be used to evaluate a utility system's performance in the 10 key management areas as well as aid in developing and implementing a plan to improve lower performance areas. This article will outline the WIAB process used by the New York Rural Water Association (NYRWA) in assisting municipalities in improving overall utility sustainability.

The First Steps

The first, and admittedly most difficult step in the process, is to

find an interested, willing, and enthusiastic utility system. This is far easier said than done. It may take upwards of a year of repeat visits and lobbying the elected officials before a utility system finally decides to move forward. The end result is well worth all the time and effort put into convincing the elected officials to move forward with developing the plan.

Once an interested utility system is found, the next step is to create a sustainability committee. The committee should consist of the NYRWA as facilitator, the chief elected official of the municipality (Mayor or Town Supervisor), the Village or Town Clerk, an additional municipal board member, the treatment plant Chief Operator and, perhaps most importantly, two district residents. The last two members of this committee are critical to the success of the process. These members represent the public, the people who will ultimately support and fund the utility. These members are valuable assets to the committee. They bring the concerns and comments of the other district residents to the table. They can also be your greatest advocates.

These members can inform their peers of the issues facing the utility and what is being done to improve performance without the perception of political bias that might be associated with an elected official.

The first, or kickoff, committee meeting is a general informational meeting; future meetings are scheduled once a month for no more than two hours each. In the kickoff meeting, goals are discussed and the WIAB process is explained. At the end of the meeting the committee members are given their first homework assignment. In preparation for the next meeting, each member is to complete the self-assessment worksheet. The members are encouraged to complete the self-assessment as individuals, not as a group. Gathering individual opinions to the 10 key management areas is the goal for this exercise.

At the next meeting, the completed self-assessment worksheets are discussed. Committee members should not be surprised if this process takes almost the entire two-hour meeting, possibly longer. A lively discussion of the individual committee member's ratings and rankings of the 10 key management areas is what guides development of a master assessment sheet, which is the basis for the system management improvement plan development.

Once the self-assessment worksheets have been discussed and a master assessment sheet developed, the key management areas with the lowest performance ratings can be addressed. An improve-



Key areas for a sustainably managed utility that are discussed in the *Rural and Small Systems Guidebook to Sustainable Utility Management* (USDA-RD and USEPA, 2018).

Developing a Plan of Action

Once the self-assessment worksheets have been discussed and a master assessment sheet developed, the key management areas with the lowest performance ratings can be addressed. An improve-

ments worksheet is used to document the reasons why the management area was rated as low performing and what would be needed to achieve high performance. Potential challenges that may be encountered, as well as changes the utility would need to make, are also identified.

The final step in the process is developing the draft system management improvement plan. Using the information from the improvements worksheets, a specific improvement action plan for the key management area to be addressed is developed. This plan outlines the action(s) to be conducted as well as the objectives that action will address. Timelines and milestone benchmarks are established and a review process to track progress is initiated. The draft system management improvement plan is then presented to the municipal board for approval. Once approved, the plan is ready to be implemented.

The process to develop a system management improvement plan typically takes between eight and 10 meetings. The forms and guidance provided in the WIAB program makes this a relatively easy process and the end result is a plan, developed by the utility, for the utility, that is easy to understand and implement.

The Value of the WIAB Process

NYRWA has been using the WIAB in conjunction with the committee approach for over three years. Four wastewater systems have developed and implemented utility management improvement plans, and a fifth has recently started the process. In all five instances, committee members all had similar reservations going into the kickoff meeting and completing the self-evaluation worksheet. The elected official and board member did not know anything about wastewater treatment. The residents of the sewer district did not know anything about wastewater treatment or internal affairs. Each member was unsure of their effectiveness on the committee. The NYRWA facilitator explained that it was their opinions on the key management areas that mattered, not necessarily their complete knowledge. If, after reading the WIAB guidance material, the committee members were still unsure, they were advised to leave that part of the worksheet blank. At the next meeting, when the members began discussing the self-evaluation, those that were unsure began to understand, and their opinions and comments were incorporated into the process and eventual plan.

In another instance, a sewer district resident committee member commented on how much he was paying for sewer service. Several meetings later that same member stated, "We haven't been funding this thing properly since day one!" That was a huge breakthrough. That member became a major advocate for the utility and was able to reach other sewer district residents in a way that an elected official never would.

That is the benefit of using a committee approach. Each committee member's opinion is heard, discussed and incorporated into the improvement plan. It truly is a utility management improvement plan developed by the utility, for the utility.

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Protecting Your Assets: Do Your Environmental Due Diligence

by *Stuart J. Spiegel*

Phase I Environmental Site Assessments (ESAs) are performed for a myriad of reasons by entities considering a real property acquisition. A Phase I ESA is one of the first steps to protecting a real property asset, by ascertaining the “presence or potential presence of any hazardous substances or petroleum products” on the property prior to purchase (*ASTM E1527-13*). Created to protect a potential buyer from federal Superfund liability, a Phase I ESA helps to establish the “innocent purchaser,” the “contiguous purchaser,” or the “bona fide prospective purchaser” legal defense under the Superfund program. Moreover, the buyer is also protected from the transactional costs of dealing with contamination after the fact, even if the buyer retains liability after the property acquisition.

The ASTM Standard Practice E 1527-13 is the industry standard of practice for performing a Phase I ESA. The process consists of records review; site reconnaissance; interviews with people familiar with the property; and evaluation and report preparation. The output of a Phase I ESA report is the identification of “recognized environmental conditions” (RECs) as defined in the standard practice (*ASTM E1527-13*).

Why does a municipality or municipal agency/authority need to perform a Phase I ESA when it gets involved in a property? Municipalities and municipal agencies/authorities may buy, lease or be gifted property to fulfill a wide range of public interest goals,

such as: water and wastewater pipelines and treatment plants; water storage facilities (towers and reservoirs); convention centers offices; arenas and stadia; transportation centers; libraries; parks; schools; and fueling stations for fleet vehicles.

Advantages to Performing a Phase I ESA

A municipality often has a public benefit goal in its real property interests; the potential presence of environmental liabilities has often been of lesser import than achieving those goals. However, this is an outdated philosophy – municipalities are not eager to take on costs in an era when budgets are strained. So, there are advantages to performing a Phase I ESA that accrue to both Superfund liability protection and to budgetary economics (*Table 1*).

To the observant, a municipality is no different than any other property owner or developer; it needs to protect itself from the liabilities that may arise with environmentally contaminated properties.

No property is ever too innocent looking to warrant a Phase I ESA, even farmland. In one instance, after negotiating a long-term access and right-of-way agreement for a pipeline across a farm, a municipal agency performed a Phase I ESA. The results indicated that waste had been disposed on the farm along the pipeline route. The terms of the access agreement unfortunately left the agency

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Forgotten underground storage tanks are one of many potential concerns that a Phase I ESA may find on a subject property.

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Table 1. Advantages to Performing a Phase I ESA for Municipal Entities.

Superfund-Related Advantages	Budgetary Economic (Cost) Advantages
<ul style="list-style-type: none"> • Innocent purchaser defense • Identify RECs • Prioritize issues for additional study • Implications for land use and operations 	<ul style="list-style-type: none"> • Provide leverage for reduction in purchase price • Provide opportunity to integrate remediation into site development = reduction of costs • Reduce “surprises” that can interfere with development schedules and budgets • Dispel rumors and innuendo

with the liability if it excavated and exposed the waste material. With little time to seek an alternative, the project was delayed at additional cost.

Some of the advantages outlined in *Table 1* deserve some additional clarification; this will be a refresher for the more experienced readers and a primer for others. These represent the types of issues that commonly arise and apply to both municipal real property interests and private entities.

The “Innocent Purchaser” Defense

This is the key motive for the Phase I ESA process. The buyer is establishing that “all appropriate inquiry” – more Superfund terminology! – has been performed to identify existing contamination so that the seller can be made to retain liability, while the buyer avoids that liability. This also buttresses a major recommendation made to prospective buyers by environmental practitioners: Don’t agree to accept the seller’s Phase I ESA report as your own, even if you can obtain a reliance from the seller’s consultant.

A seller may perform a divestiture Phase I so that they can become aware of issues that a buyer might find, and address some in advance of the buyer’s due diligence. But the seller’s interests are not yours. More important, you are giving up the opportunity to direct your own due diligence. When buying a house, would you accept an inspection performed by the seller? Same answer here. You as the buyer do not know what directions were given to the consultant, what steps were performed, or what information was considered inconsequential and omitted from the report. While you may be saving \$2,000 to \$3,000 by not performing your own Phase I ESA, is it worth the consequences to your project not knowing what the seller’s Phase I may have missed?

For example, it is not unusual for a site visit to be performed when there is snow cover, and this fact may be overlooked in the

report preparation. Snow cover makes it difficult to observe stained soil, stressed vegetation, visibly protruding pipe ends, or other surface features. In one instance, snow cover prevented a good site reconnaissance at a former auto dealership property. The seller initially did not see the necessity for – or want to allow – a follow-up site visit. But during a follow-up visit in the spring, a pipe was observed sticking a foot out of the ground, where heavy snow cover had made it effectively invisible. Further investigation discovered that it was connected to an underground storage tank (UST) that had reportedly been removed 10 years previous. Moreover, it still had fuel in it.

In another case, a municipal college had leased a building and property at the edge of campus to the Department of Defense for a 50-year period. Before accepting the property back at the end of the lease, the college had a Phase I ESA performed of the building and property. Several RECs were identified, which were addressed in the close-out phase of the lease with the Department. Accepting the property back without the Phase I ESA information would have resulted in the college potentially being forced to bear sole responsibility for the costs to address these issues.

Not to play lawyer, but reliance on a seller’s Phase I isn’t worth much as a practical matter. The original work was performed for the seller, who may have had a different perspective than that of the buyer, whose idea for a future use may not be addressed in the seller’s Phase I. Not only that, should a party look to the seller’s consultant for damages in a negligence or other lawsuit, the consultant’s insurance may not come near addressing actual liability costs.

Implications for Land Use and Operations

Findings of a Phase I ESA may include institutional controls or limitations on land use. Contamination residuals may have been left in place, or not remediated to regulatory thresholds, by agreement with state or federal agencies. The presence of these residuals



Practices related to above ground tanks should be scrutinized carefully for release potential, now or in the past. *OBG*



Validate indications of former structures against maps of known site structures and their past uses. *OBG*



Even minor uncontained releases can result in a liability over time.

OBG



Where there is no daylight between bulk storage units (of any kind) and the ground, tank condition cannot be visually assessed.

OBG



Signage indicates either a general caution, or an indication of a past incident.

OBG

Although not explicitly required by the ASTM Standard Practice (ASTM E1527-13 2013), there are some simple steps that municipalities, as well as other users, should expect to be performed by its consultants. An example is an internet search. Past owners, operators and the address of the site should be searched using two different search engines and at least 10 result pages (10 listings each, or 100 for each search engine). Since search engines each use their own algorithms, findings may be different from different search engines.

What might you find? In this author's experience for one site: newspaper articles about a fire in a building and the release of chemicals to soils by water from fire hoses; another article about drums that had been found one morning several years previous on the subject property; and a story in a local magazine detailing the process activity in a former manufacturing building that had been vacant for two decades. Useful information all and unreported by the property owner.

The searches are consistent with wording in the ASTM Standard Practice that directs that the practitioner search for information that is:

- (1) Publicly available.
- (2) Obtainable from its source within reasonable time and cost constraints.
- (3) Practically reviewable and uses listings in publicly available records.



This "solution" may be an indication of generally weak maintenance practices and the potential for releases to the environment.

OBG

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Open battery storage is more an employee hazard than a release issue, especially in high traffic areas. OBG

may make the property unsuitable for the anticipated land use by the municipality. For example, a park may have been constructed on top of fill material. While an adequate soil cover prevents public exposure to the material in the fill, excavation to install a wastewater transmission line through the fill material would be an unacceptable risk that may be disallowed. A Phase I that identifies these site limitations can be important to an intended municipal use.

Provide Leverage for Reduction in Purchase Price

As with purchasing a house, the presence of conditions that impact the market value of the property usually are used in negotiations to drive a more favorable purchase price. This is no different than municipal needs. At purchase, this property will fulfill a need, but also will become an asset in the municipal portfolio. And an asset it should be, not a liability. Therefore, information from a Phase I report can be the first step to establishing a true current value for the property, reflecting the cost of Phase II testing or remediation, and whether it will be necessary to establish the extent of contamination, or validate its absence. Consider USTs at a property to be acquired for municipal reuse. Knowing these tanks are present, removal and remediation costs can be estimated, and the purchase price negotiated down to drive the purchase to closure.

Provide Opportunity to Integrate Remediation into Site Development

Public reuse of former brownfield sites provides an obvious community benefit. That reuse may require demolition of existing structures or regrading the site before new construction ensues. For example, based on the findings of its Phase I ESA, a municipality determined that if it purchased a site for a new school, remediation of some residual contaminants could be much more inexpensively accomplished after the demolition of site structures. The structures would no longer bar access to underlying soils, and heavy soil-moving equipment that is already on-site for regrading could be used for the efficient removal of contaminated material.

Reduce “Surprises” that Can Interfere with Development Schedules and Budgets

Liability costs aside, being forewarned may be important to project planning. As one example of the value of the process, the foundation for a municipality’s new multi-use center was being excavat-

ed when strong petroleum odors were detected emitting from the sidewalls of the excavation. It was found that although structures had been demolished to make way for the new development, USTs had not been removed. A Phase I ESA likely would have suggested verification of their removal and appropriate remediation, but the municipality declined to perform a Phase I ESA prior to site acquisition and construction. Instead, construction crews waited idle for several days while the issue was addressed. In the middle of the construction schedule, this delay turned out to be an expense much greater than that of a pre-construction Phase I ESA.

Dispel Rumors and Innuendo

It is not unusual for there to be unsubstantiated rumors about former activities at a site. It’s important to investigate them, if only due to the occasional truth that may be behind these stories. In other cases, innuendo can make an impression in the community that prevents intended site development. For example, one town had acquired a property for use as a school that had previously been a motel. There were vague reports in the community of the hazardous waste disposal at the site, potentially making it unfit for its intended use without significant remediation costs. In the initial review of documentation, there was no substantiation to these claims, which provided no detail as to the timeline, types of material(s) or location(s) where they had been deposited.

Further review of aerial photographs, and an extensive site reconnaissance using metal rods to search for former excavations found no indication supporting the allegations. Again, given the sensitivity of the proposed use, Phase II activities, consisting of shallow soil borings concurrently with structural borings, were used to observe whether soil disturbances had occurred; none were found. Since the existing on-site well was to be used as a potable source for the new school, the well water was comprehensively tested as well; findings were negative. The rumors of hazardous waste disposal at the property were concluded to be just that – rumors. So, in this case a Phase I ESA required support from follow-up Phase II activities to confirm the site’s suitability for a sensitive land use.

Phase I is Just the Beginning

Lastly, always remember that a Phase I ESA is the floor, not the ceiling, for the environmental due diligence effort. That means that there is no such thing as a “partial” Phase I ESA. This term is meaningless from a standard of practice perspective and opens the municipality to both liability and inability to assert an innocent purchaser defense. This term should also send prospective consultants running in the opposite direction; since the idea of a “partial” Phase I ESA is meaningless, it exposes the consultant to liability as well.

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USEPA's LCR: Impacts on Credit Ratings Pending for Municipal Water Providers

by Allison Clark, Rachel Grossman and Eva Rippeteau

The U.S. Environmental Protection Agency's (USEPA's) proposed revisions to 40 CFR Part 141 Subpart I, the Lead and Copper Rule (LCR), are expected in draft form later this year and could have significant implications for water utilities. The original LCR dates back to 1991 and has been amended several times. Recent incidents exposing high concentrations of lead in municipal drinking water systems (notably Flint, Michigan) have garnered both national and international attention and have further prompted the USEPA to revisit and update the LCR.

Lead

Although both lead and copper are addressed in the LCR, lead exposure has had a demonstrably more negative health impact than copper. A USEPA white paper published in October 2016 describes the widespread prevalence of lead in municipal drinking water. The severe cognitive and developmental implications on exposed children constitutes a public health emergency. In concert with industry experts such as the American Water Works Association (AWWA) and the National Drinking Water Advisory Council (NDWAC), among others, the USEPA has announced a comprehensive list of regulatory options under consideration for amending the LCR. These include potential operational changes such as reducing lead from source water, as well as the possibility of mandating the replacement of both public and in-home, private lead service lines (LSLs).

The removal of LSLs appears to be the largest, most far-reaching proposal within the LCR, requiring the most asset allocation among utilities. Currently, as many as 10 million residences nationwide could be targeted for LSL replacement.

Copper

The LCR also addresses modifications to the requirements for elevated copper levels, as copper enters drinking water through the corrosion of household plumbing. The copper LCR revision is primarily concerned with detection and sampling methodologies. Some LCR stakeholders have expressed concerns that elevated levels of copper may be missed using current LCR sample site selection criteria, as literature has shown differences in copper and lead leaching patterns. The NDWAC recommends a more aggressive, site-specific and parameter-based water sampling strategy in order to identify the most impactful and effective remediation plans of action.

The AWWA concurs with the NDWAC recommendations, and further asserts in their March 2018 commentary that "the marginal return in public health benefit must be sufficient to warrant new triggered requirements under the LCR." (AWWA 2018, p. 36). This guidance seemingly seeks to relieve pressure on already overburdened utilities as well as emphasize the need for measured programs based on quality samples and sound evidence. At a minimum, the updated LCR will likely expand sampling, expenditure, outreach and monitoring cost requirements.

AWWA Recommendations

In March 2018 the AWWA provided four key recommendations to water systems requiring lead and copper mitigation. They are:

- 1) If absent, develop an LSL inventory.
- 2) Propose and commit to a long-term plan to remove all identified service area LSLs.
- 3) Implement controls to reduce lead and copper corrosivity of water prior to reaching customer homes.
- 4) Engage in public outreach to customers about the risks and costs of LSLs.

LSL ownership begins at the private-property line, therefore most of the costs could be borne by the property owners. The current, full cost of LSL replacements, inclusive of both system-related and private property costs, is estimated to be up to \$80 billion nationwide. Questions remain as to how LSLs will be identified and who will assume replacement costs.

LCR Implementation and Credit Ratings

The impact of eventual LCR implementation on utilities whose publicly issued debt is rated by Fitch Ratings, Inc. (Fitch) is yet to be seen. However, given the cost estimates and number of homes affected, Fitch expects that the operational and capital requirements will be substantial. Fitch will continue to evaluate the credit profile of an entity that issues public debt (known simply as an issuer) based on our criteria as outlined based on our criteria (*Table I*). In general, and in following with AWWA's four recommendations, Fitch expects issuers will likely retain strong, stable credit ratings if they are aware of or are actively investigating their lead or copper service line inventory; have a plan for LSL remediation or replacement; and are communicative with customers about costs and capital needs.

Fitch Water & Sewer Rating Criteria

The strong fundamentals inherent to municipal water and sewer utilities – their essential service provision and general ability to

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Municipal bonds, used to finance public projects, are issued by state and local government entities. A bond rating is an indication of the credit quality of a bond.

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set rates to increase revenue – have produced favorable financial margins and strong protections for bondholders. However, every issuer faces different challenges and demands. While credit analysis must be quantitative, it must also be qualitative. Examples of quantitative measures include assessing leverage, capital, and financial trends and decisions. Examples of qualitative measures include understanding the managerial, operational, regulatory, political and idiosyncratic challenges a utility faces.

Fitch’s criteria for assigning ratings to water and/or sewer revenue bonds is comprised of four key parts, as shown in **Table 1**. Revenue defensibility addresses the ability of a utility to generate cash flows and willingly set rates necessary to support its operating needs. As issuers become more aware of the capital needs required to meet LCR requirements, it will be imperative for issuers to increase rates to meet new costs. Issuers with existing rates that are considered affordable by Fitch will have greater rate-raising flexibility than those with relatively higher existing rates. The latter issuer may experience customer push-back and/or must prolong spending to decrease rate shock.

Table 1. Fitch’s Water & Sewer Rating Criteria.

Revenue Defensibility

- Charges and Rate Affordability
- Community Characteristics
- Customer Growth and Concentration

Operating Profile

- Costs of Operations
- Capacity
- Compliance with Environmental Regulations
- Capital Demands and Debt Burden

Financial Profile

- Coverage and Financial Performance
- Cash and Balance Sheet Considerations

Asymmetric Risks

- Contingent and Derivative Obligations
- Covenants
- Crew

The second criterion is an issuer’s operating profile. Fitch evaluates an issuer’s cost drivers, which are typically dominated by debt service and capital spending. Fitch then assesses trends of revenue and expense stability or volatility, and levels of capital investment relative to annual depreciation costs. LCR-associated capital spending could be extensive and purely additive to existing capital programs, resulting in potential heightened operating risk. Individual utility debt burdens could escalate and/or affordability concerns could accentuate if existing capital projects cannot be delayed. Alternatively, existing capital improvement plans may be postponed if utilities with revenue constraints are required to prioritize LCR projects ahead of other planned projects.

Fitch’s key financial indicators include debt service coverage (DSC), liquidity and free cash flow (FCF). DSC measures an issuer’s ability to meet its fixed annual debt service costs with recurring revenues. Any additional margin above a break-even DSC level indicates the ability to generate surplus revenues (or FCF) available for other spending, including funding capital projects or accumulating rainy day cash balances. Liquidity is a measure of an issuer’s available free cash and relative financial flexibility. The strength of each of these indicators determines an issuer’s ability to address increased LCR capital spending requirements, should they be required.

Fitch’s fourth and final major criterion area concerns asymmetric risks. These are risks that are considered neutral to the rating, unless the risks are assessed as negative. Factors include a strong and experienced managerial team, minor to no political involvement in the rate-setting process, and legal covenants that benefit bondholders.

Affording Compliance

As discussed earlier, Revenue Defensibility is a key part of Fitch’s rating criteria. How utilities can afford to comply with rule changes, particularly LSL replacement, is an important part of their credit profile. Anticipating future needs and revenue availability will determine how prepared utilities are to act once regulations are in place. The NDWAC stressed that the USEPA must “work with agencies at all levels of government to support financial assistance programs for LSL removal.” (*NDWAC 2015, p. 40*). One recommendation was a federal tax deduction to support replacement of the customer portion of LSLs. Some utilities with aggressive LSL programs have taken advantage of state revolving fund (SRF) loans, such as in Galesburg, Illinois and Eau Claire, Wisconsin. However, there has been discussion as to how much of future SRF loan funds will be available to pay for replacement. Other issuers will provide medium-term loans to customers, outside of normal operations, to be paid off over time along with normal water charges. For system-wide capital spending, issuers may find it necessary to explore new rate structures that better align customer charges to rising fixed costs. Maintaining customer affordability will be a challenge.

Case Study: Madison, Wisconsin Implements LSL Replacement

To date, few utilities across the country have successfully completed full system LSL replacement given how extensive and hard to fully quantify they are. However, the city of Madison, Wisconsin was one of the first major utilities in the nation to address the lead content in its drinking water, well ahead of today’s national focus on the issue. The city began its LSL replacement program in the late 1990s, after learning that its lead levels exceeded the USEPA’s drinking water standards. After unsuccessfully implementing anti-corrosivity treatments, Madison sought approval from its state



A simple scratch test can tell you if your line is lead. *Madison Water Utility*

regulators and lawmakers to commence a full LSL replacement program (*City of Madison – Madison Water Utility 2016*). Given the difficulty justifying the costs for a relatively misunderstood public health concern, the program was narrowly approved and an ordinance was passed following a lengthy approval process.

Even after securing the legal authority to implement the program, the city still faced logistical challenges and substantial customer push-back. The city recognized the need to conduct widespread educational community meetings, gather inventory of customer-owned service lines and personally oversee and verify the replacement of identified LSLs. To solve financing obstacles, the utility created a reimbursement program that covered about half the customer-owned pipe replacement costs. During the first six years of the program, the utility spent from \$1 million to \$1.5 million annually, representing between 10 percent to 20 percent of the utility's annual capital spending. In the following six years however, costs declined to a more manageable amount of less than \$100,000 annually (*City of Madison – Madison Water Utility 2017*). The program was largely completed after about 12 years. Although not fully abated, lead levels have remained minimal since.

Conclusion: Start Planning Now

It is useful to gain insight from Madison's initiative when considering how the LCR revisions may impact an issuer. The city's program was successful and effective for a number of reasons, driven primarily by the utility's expertise, leadership and recruitment of multiple influential stakeholders. One of the most difficult aspects of the program was the justification for replacing, with partial funding by customers, privately-owned service lines. However, the utility was successful in its public outreach and cost-sharing arrangement to make LSL replacement possible.

There are several other LSL replacement program examples nationwide, such as Denver, Colorado and Washington, D.C., in which utilities are inventorying LSLs and conducting public outreach. The likely outcome for the LCR to require full or partial LSL replacement programs will undoubtedly be a substantial lift for most utilities and private homeowners. However, the ability

for management teams to anticipate these changes by planning requisite rate increases or rate structure changes, re-prioritize or re-sequence capital spending, and garner customer support will be essential to maintain stable credit quality.

The authors hold positions with Fitch Ratings, Inc., of New York City: Allison Clark is an Associate Director and may be reached at allison.clark@fitchratings.com; Rachel Grossman is an Analyst and may be reached at rachel.grossman@fitchratings.com; and Eva Rippeteau is a Director and may be reached at eva.rippeteau@fitchratings.com.

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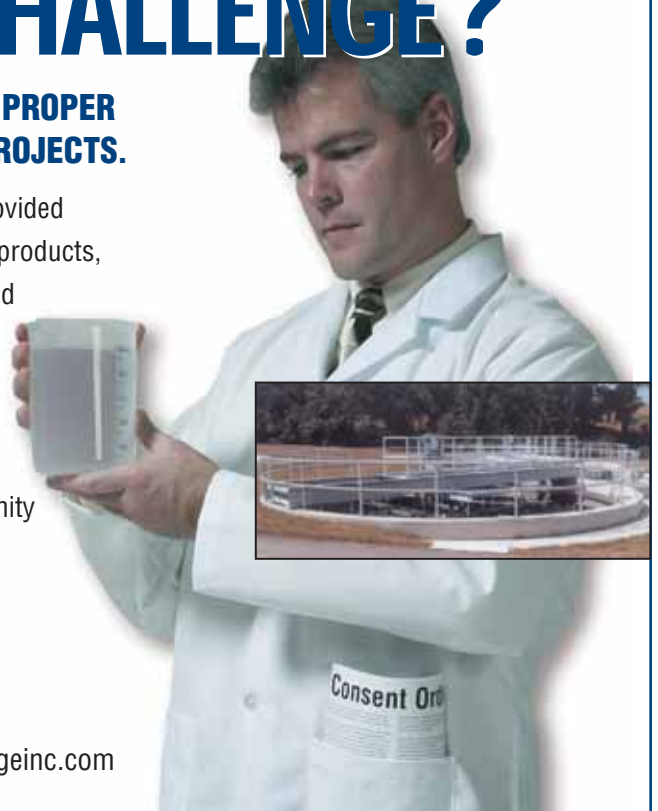
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Information for Utilities on Lead Service Replacement

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Madison Water Utility has gotten inquiries from utilities all over the country about our Lead Service Replacement Program. In 2000, Madison was the first major city in the country to adopt a full lead service replacement initiative. Below, you will find information about how the program was funded, average replacement costs, homeowner reimbursements, and more. If you have any further questions about lead service replacements, please contact water@madisonwater.org.

In 2000, Madison's Common Council passed an ordinance (*Madison General Ordinance 13.18*) that requires property owners to replace their side of a water service if it is lead. The penalty for non-compliance is a fine of \$50 to \$1,000 per day. We did have a handful of property owners who refused to comply with the city's lead service replacement ordinance. Those cases were turned over to the city attorney's office. We also discover one to two properties a year during main work, street replacements, etc., that have lead services. Customers who discover a lead service can still receive reimbursement for half the cost of replacement up to \$1,500 (the reimbursement was raised in 2017 from \$1,000). They can also apply for financing through the city to help pay for the remainder of the cost.

For each property where a private-side lead lateral will be replaced, a licensed plumber is required to fill out an Application for Lead Replacement Contract before work begins. When work is completed, the property owner fills out an Application for Reimbursement Form.

Prior to our Lead Service Replacement Program, we did not generally keep records of the material used on the property owners' side of the lateral. But we did often have records noting the material used on our side, so we had a good idea which properties were likely to be impacted by the ordinance. Madison stopped using lead for water pipes in the late 1920s. We sent surveys to thousands of property owners, which they were required to fill out, sign and return to us stating what material was used for their water service. We held community meetings across the city where we showed people how to locate their service and do a scratch test to check for lead.

In addition, the utility has exhaustively documented the composition of water service lines through staff inspections (meter shop and construction inspectors), and observations by contractors and inspectors during water main replacement projects. Efforts to identify additional lead water service lines continue today albeit with less urgency since, based on the available information, it is assumed that the remaining service lines are not lead.

Here is more information about our program that may be helpful:

- Our program replaced more than 8,000 lead service pipes, but only about 5,600 of those included the property owner's side; many people had already had their portion of the service replaced in the decades since 1930.



Staff of the Madison Water Utility replacing lead pipe as part of their Lead Service Replacement Program.

- The cost of the program was about \$15.5 million over 12 years, not including what property owners paid.
- Wisconsin's Public Service Commission did not allow us to use rate-payer dollars to fund customer reimbursements, but we were able to use revenue generated by renting space on top of our water towers to cell phone companies for their antennas.

- While our crews handled the utility-side replacements, private plumbers handled the private side. We often worked closely with plumbing companies, leaving trenches open after replacing our side to lower the cost for homeowners. Plumbers would then follow us down the street replacing the private side immediately after our work was done.

- During the program, our average reimbursement for half the cost of the private-side lateral was \$670. So, the entire cost to replace the private-side portion was \$1,340 on average.

- The average cost to replace our side during the program was \$1,997.

- Between 2000 and 2006, our annual capital budget was about \$7 million to \$9 million. During those years, we spent about \$1 million to \$1.5 million on utility-side lead service replacements annually. After 2006, the amount we spent on lead service replacements dropped off to less than \$100,000 a year.

- Properties that had tested high for lead, as well as places like schools and apartment buildings, were prioritized during the program, so their services were replaced right away.

- 80 Percent of replacements were completed between 2000 and 2006. The rest were completed during already planned street and main replacement projects between 2007 and 2012.

- Before our Lead Service Replacement Program was enacted, our 90th percentile lead result was 16 micrograms per liter ($\mu\text{g}/\text{L}$). However, it was not uncommon to find results of 40, 50, even greater than 100 $\mu\text{g}/\text{L}$ at some homes.

- We continue to monitor for lead at the customer tap. Each time – twice in 2011 and once in 2014 – the 90th percentile level has been around 3 $\mu\text{g}/\text{L}$. Lead testing will occur again in 2017 and then every three years after that.

This article first appeared on the website for Madison Water Utility, the City of Madison, Wisconsin. The article is reprinted with permission from the Madison Water Utility. (<https://www.cityofmadison.com/water/water-quality/lead-service-replacement-program/information-for-utilities-on-lead-service>).





CASE STUDY:

A Two MGD Water Resource Recovery Facility in NY

The facility is designed with a peak flow of 12.5 MGD. During a recent upgrade, a multirake bar screen was purchased for the headworks. It was estimated that the multirake captures about 30% to 40% of the screenings material.

After commissioning, it was quickly discovered that rags and screenings were getting through the multirake, causing issues with the SBR decanter, clogging pumps and the disk filters.

SOLUTION & RESULTS:

The Hydro-Dyne Great White Center Flow Fine Screen

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The Evolution of Erie County Asset Management Tools

by David Millar and Steve Russell

Introduction

The Erie County Department of Environment and Planning, Division of Sewerage Management (ECDSM) owns and operates hundreds of millions of dollars of assets in seven sewer districts, including six water resource recovery facilities, five overflow retention facilities, approximately 100 pumping stations, 1,000 miles of sanitary sewers, 400 grinder pumping units, and approximately 24,000 manholes. These facilities must be reliable and sustainable as they provide an essential service to roughly 250,000 ratepayers and the community as a whole. The ECDSM utilizes Advanced Asset Management principles to deliver this objective and support its mission to provide cost-effective, customer-oriented wastewater service that protects public health and enhances our natural environment.

As it applies to the ECDSM, asset management is the practice of managing the infrastructure of the Erie County Sewer Districts to meet our mission and deliver desired levels of service. Asset management provides for the systematic planning, acquisition, deployment, utilization, control and decommissioning of capital infrastructure assets. The ECDSM recognizes the more we understand about our assets – including condition, remaining useful life, risk and consequence of failure, renewal options and related costs – the higher the confidence we can have in making effective management decisions.

While the concept of asset management is relatively new in the wastewater industry, the management of wastewater assets is not. The ECDSM has managed wastewater assets in Erie County for over a half a century. Many of those assets were constructed several decades before that. The ECDSM, not unlike other wastewater service providers, has always realized its responsibility to deliver long-term asset planning and investment effectively and efficiently. Over the last 50 years, strategies were developed to address asset condition and functionality to satisfy level of service demands and expectations. Early on, asset management was not a structured activity; however, these unstructured activities evolved and eventually grew into formalized practices used for the delivery of present-day Advanced Asset Management.

The ECDSM employs the fundamental elements of asset management for service delivery. Numerous tools are used by the County to support those elements including, but not limited to: a Computerized Maintenance Management System (CMMS); a Geographic Information System (GIS); a Capital Improvement Plan (CIP); Supervisory Control and Data Acquisition (SCADA); and electronic document management. A brief history of the development of three of those tools illustrates how asset management has evolved over time.

Computerized Maintenance Management Systems (CMMS)

CMMS started out in the ECDSM in the mid-1980s in response to an audit conducted by the Office of the Erie County Comptroller. At the time, the audit was performed to investigate inventory management practices used in the Erie County Sewer Districts. The result of that audit was commencement of the ECDSM's effort to maintain a "perpetual inventory".

Database management system products, primarily on a PC platform such as dBase and others, were considered to meet the new initiative. During an online search, one of the county's Assistant

Wastewater Treatment Plant Operators discovered a software package by Datastream Systems, Inc. In 1989, the County purchased a single user version of Datastream MP2 CMMS. Implementation began at the Southtown's Advanced Wastewater Treatment Facility (AWTF) in Erie County Sewer District Number 3 (ECSD No. 3) to track perpetual inventory. Following approximately one year of successful use, the decision was made to expand implementation of the product on a larger scale. In 1990, Datastream MP2 was also implemented in ECSD No. 6 for inventory control, as well as for procurement and order processing. The ECDSM spent the next three years adding basic information into the system to make it functional for tracking purposes.

As staff became more proficient with the software, one of county's Treatment Plant Operators began adding equipment information into the system. In doing so, the ECDSM now had the ability to track repairs, taking another step towards our present-day CMMS. Tracking repairs with this method started out at a high level but developed into a useful tool as more preventative and corrective maintenance activities were memorialized over the course of several years. In 1993, the ECDSM purchased and implemented a network version of Datastream MP2. Usage of the software increased at ECSD No. 3 and ECSD No. 6 and was expanded to the ECDSM's Northern Region location, which includes ECSD Nos. 1, 4 and 5.

Through a gradual evolution, the value of asset management through a CMMS platform like MP2 was being recognized by county staff. However, the MP2 software did have limitations; it was not strong in tracking linear assets. As a result, asset management principles were not as well-developed for the collection system as for the ECDSM's pumping stations and water resource recovery facilities. The ECDSM used the program as the primary business solution for equipment, vehicles and inventory in the collection system, but more capabilities were needed to truly expand into advanced asset management. Recognizing that in-house staff did not have the time or the expertise to take the ECDSM's CMMS to the next level, a Request for Proposals (RFP) was issued to solicit the services of a consultant.

In the early 2000s, IBM partnered with Erie County to implement the SAP platform. SAP software is a very powerful platform that provides a suite of services for business, government organizations and other users. Upon initial implementation, SAP modules for controlling, financial accounting, human resources, grants and purchasing were rolled out into the county's business practices. When the time came for the ECDSM to implement the next generation of its CMMS, a strategic decision was made to advance the SAP Plant Maintenance (SAP PM) module which would allow integration of the ECDSM's asset management protocols with other SAP functionality. After initiation of a blueprint process for SAP PM implementation, a consultant was retained to configure the module to fit the ECDSM's business practices. The ECDSM went live with SAP PM in March of 2012.

Today the ECDSM utilizes SAP PM to inspect, repair, and perform preventative maintenance on the division's assets. Scheduled maintenance plans have been created to reduce the occurrence of equipment breakdown, lower maintenance costs and to comply with

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regulatory standards. SAP PM also documents all corrective maintenance activities, including maintenance tasks that take longer than 15 minutes in a work order. Because the SAP platform handles not only CMMS functionality but also purchasing, human resources, and other business areas, complete lifecycle costing of the assets maintained can be performed. With the data that is collected, the ECDSM can perform budget analyses, prioritize the workforce to be more efficient, improve workflow process, and better control inventory.

Geographic Information Systems (GIS)

Before fall 2001, there was no digital GIS in use for ECDSM. Staff used paper maps of contracts and subdivisions, scanned TIFF images and six Computer Aided Design (CAD) basemaps representing sewerline and manhole data for each of the ECDSM's districts at that time.

In September of 2001, the ECDSM hired a person dedicated to building the Division's GIS. Assets available included the ESRI GIS software product, ArcView 3.2, and shapefiles provided by the Erie County Office of GIS (ECOGIS) and the Erie County Water Authority (ECWA) for street centerlines, parcels, hydrology, airports, poles, pavement, and buildings. This was enough information to begin development of a GIS basemap. To start the GIS

initiative, the ECDSM performed a pilot project using ArcView 3.2 in a small portion of ECSD No. 3.

The ECDSM's GIS was initially built by converting existing CAD basemaps to GIS. After much data manipulation, a basic GIS basemap was generated and the process of verifying sanitary assets was started. Summer 2002 brought the first set of interns to help build the GIS program. Summer 2003 the Global Positioning System (GPS) program was initiated. Each ECDSM sanitary asset was verified by GPS, and the exact location was shown on the GIS basemap. In 2004, the ECDSM started updating GIS databases, with interns used to populate manhole and sewerline databases with information such as pipe size, pipe type, rim, and influent and effluent elevations from the ECDSM's paper maps. The GIS database schema was developed using the ESRI Wastewater Utility Data Model.

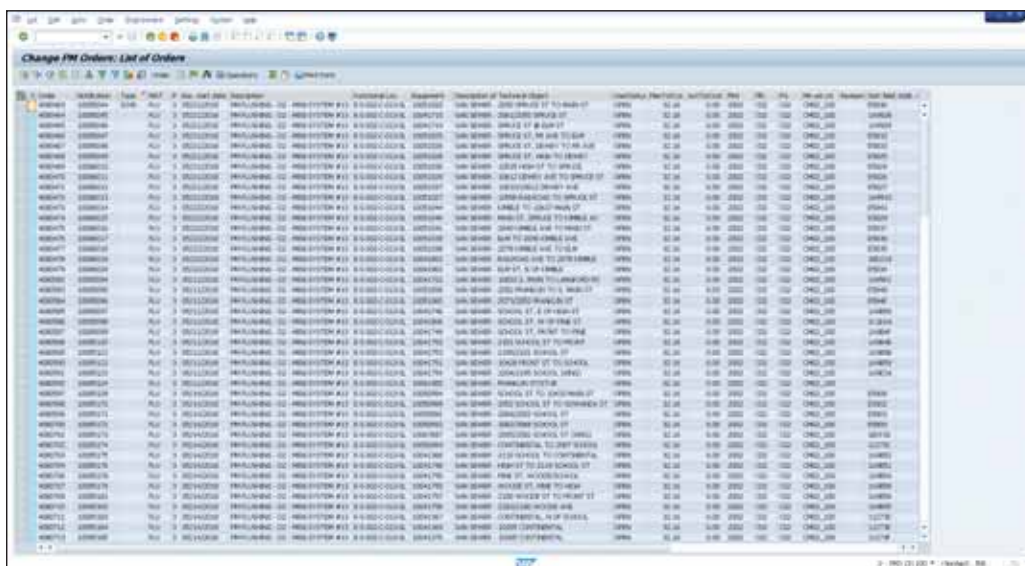
In 2004, the ECDSM started using the ESRI software application ArcIMS to allow non-GIS and sewer district personnel to access the GIS data from a web browser. ArcIMS was operated and maintained by the county's GIS department. Also in 2004, the Division began implementing the ESRI Mobile GIS solution. Mobile GIS allows for editing of the enterprise GIS data in the field. The ECDSM developed customized manhole inspection eForms on handheld devices using the ESRI ArcPad software. Mobile GIS was successfully used by the ECDSM during the evaluation of sewer systems in newly

acquired areas that merged into the County from other municipalities, as well as the ECSD No. 6 storm outfall inspections.

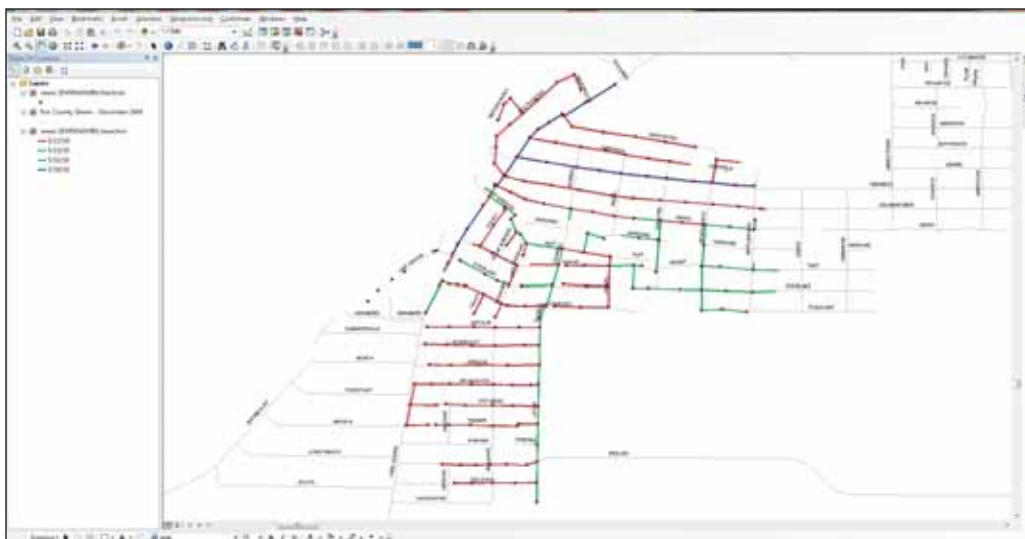
The years 2005 through 2010 were spent increasing the accuracy of sanitary and storm attributes and GIS spatial assets. The GIS data was moved from local File Geodatabases (FGDB) to the OGIS ESRI ArcSDE database storage program. ArcSDE provided nightly backups, and the ability for multi-user editing.

ECDSM used a consultant only once for its GIS program, in 2009. A local consulting firm was hired to go through all ECDSM's paper maps and add the attribute information to the GIS. All other work in developing an Enterprise GIS for the ECDSM has been performed in-house with the full-time GIS staff or interns.

Asset data was collected in the field using both GPS and Mobile GIS methods, and the ECDSM started fact-checking the record drawings. This methodology allowed the creation of accurate mini-system boundaries. Once an ECDSM mini-system was verified, assets were given updated manhole numbers and sewerline identification handles. Field crews viewed GIS information first with Trimble Recon data collectors, and then Panasonic Toughbooks with the ESRI ArcPad software.



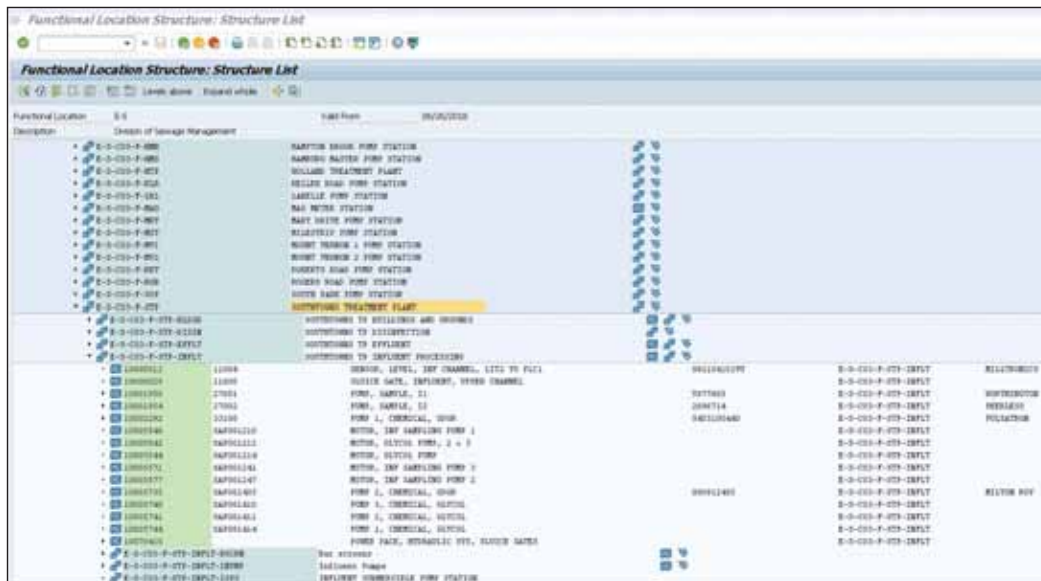
Order ID	Description of Task	Priority	Status	Created On	Created By
1000000001	1000000001	1	1	10/01/2001	1000000001
1000000002	1000000002	1	1	10/01/2001	1000000001
1000000003	1000000003	1	1	10/01/2001	1000000001
1000000004	1000000004	1	1	10/01/2001	1000000001
1000000005	1000000005	1	1	10/01/2001	1000000001
1000000006	1000000006	1	1	10/01/2001	1000000001
1000000007	1000000007	1	1	10/01/2001	1000000001
1000000008	1000000008	1	1	10/01/2001	1000000001
1000000009	1000000009	1	1	10/01/2001	1000000001
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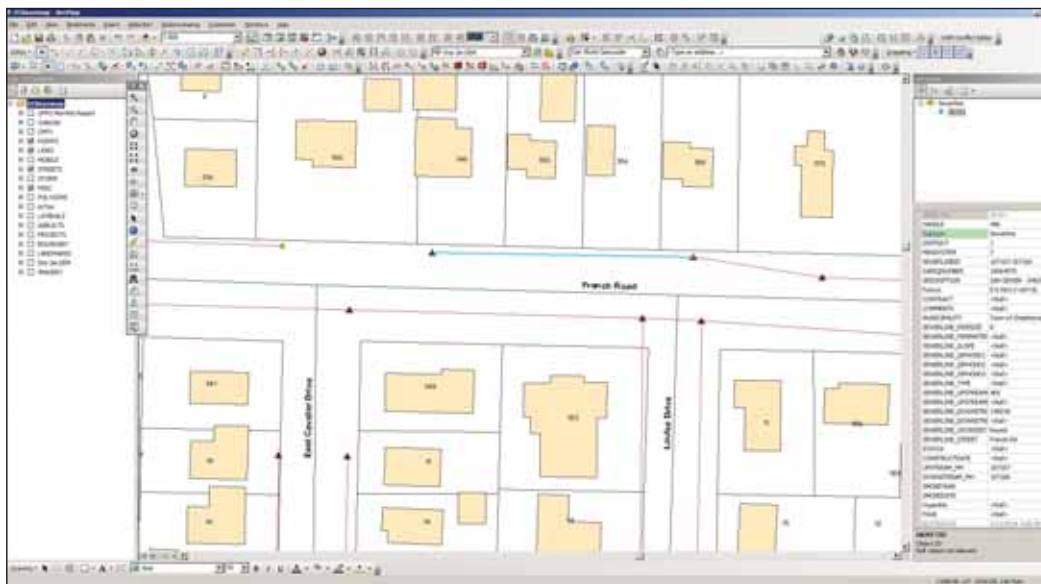
The SAP PM module can display information both tabular (top) and graphic (bottom).

ECDSM

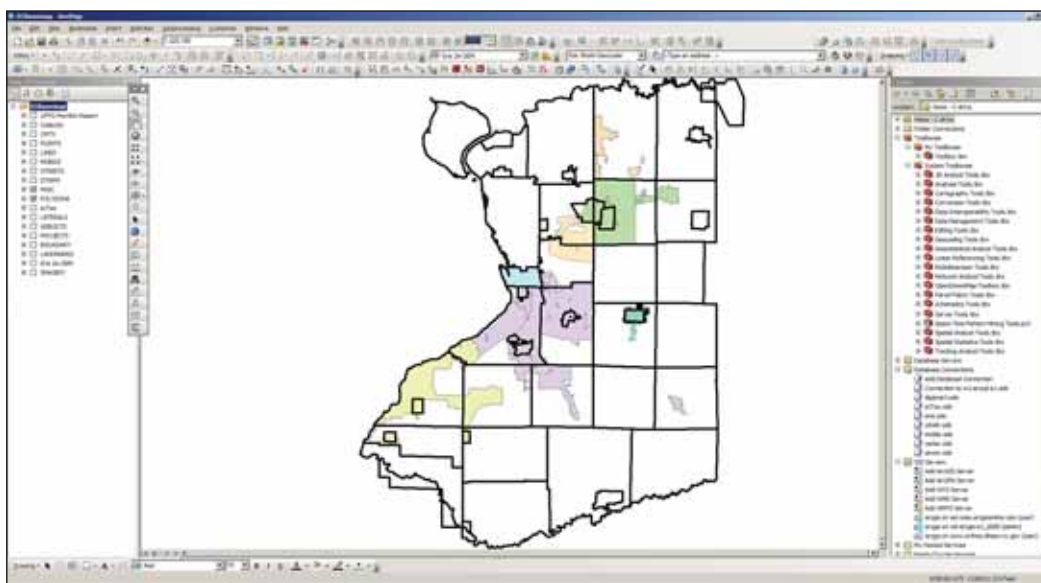
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Details about structures are accessible in the SAP PM module as expanding lists. ECDSM



Assets plotted in GIS are viewable at street-level detail. ECDSM



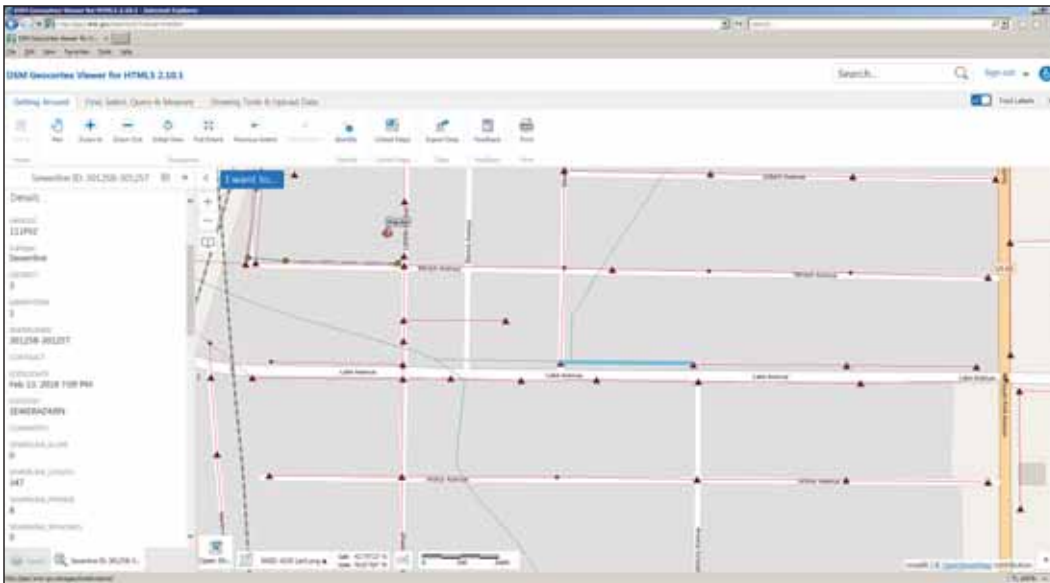
Users of the GIS can also view information at a county-wide level. ECDSM

In 2009, the ECDSM purchased a Real-Time Kinematic (RTK) survey unit which allowed one-centimeter spatial accuracy of asset locations. This was good for accurately adding spatial assets such as valves, lateral cleanouts, and items found in dense vegetation.

The years 2010 through 2016 were defined by the proliferation of Web GIS for the ECDSM. ArcIMS was replaced by ArcGIS Server, allowing a much more user-friendly web interface with a lot less programming. ArcGIS Server allowed the design of Flex or Silverlight websites, which allowed users to search for ECDSM assets and attribute information, and print paper maps from their web browser. OGIS purchased Geocortex in 2013, which allowed for the design of user-friendly custom-built GIS websites that did not require a lot of complex coding. When Geocortex moved to an HTML5 platform, it allowed ECDSM staff to access GIS information on phones, tablets and desktop computers.

The ECDSM's Underground Facilities Protection Organization (UFPO) program has been working with the ECDSM's GIS information since the move from paper-faxed UFPO tickets from Dig Safely New York (DSNY) to the use of Dig Smart 2.2, a stand-alone UFPO application. The ECDSM moved to the Enterprise version of Dig Smart in 2014. This update transformed how the ECDSM handles UFPOs. The ECDSM has gone from eleven employees processing UFPO's daily to four. Management of the UFPO tickets has shifted from secretarial/dedicated UFPO personnel to the UFPO crews in the field through the use of the software infraMAP, which integrates with Dig Smart on a Surface Pro computer with an internet data plan. InfraMAP allows field crews to receive and process UFPO tickets on a Surface Pro, while eliminating thousands of paper UFPO tickets per year. In 2015, the ECDSM won the GIS Applications Award by the New York State GIS Association for the UFPO program.

The ECDSM's GIS program con-



The Geocortex viewer provides users with an interface to customize the GIS application. ECDSM

continues to evolve. In 2017, the ECDSM's GIS group developed an online flushing program that utilizes ESRI's ArcGIS Online, Web AppBuilder and the iOS/Android app, Collector, which eliminates paper forms and provides accurate, error free data that can be imported easily into the SAP. This data is collected with 7-inch Panasonic Android ToughPads with a data plan. There are numerous groups using the ECDSM's GIS data for various purposes including the County's field staff, staff maintaining records using OnBase software, Engineering and Survey personnel, the ECDSM's Fats, Oils and Grease (FOG) program, SAP Plant Maintenance users, and more. Future work includes further GIS asset quality assurance and quality control (QA/QC), updating the accuracy of assets in the field through GPS and RTK methods, and continued collaboration with the OGIS and SAP groups to provide synced GIS data.

Capital Improvement Plan (CIP)

Over the course of its history, ECDSM has executed capital projects from initiation, through funding, development, design and construction, to handover and commissioning. Investment in infrastructure throughout the ECDSM over just the past 50 years runs into hundreds of millions of dollars. For several decades most of the final capital investment decision-making occurred in the Deputy Commissioner's office. Capital projects rising to the point of consideration were systematically tracked on lists and spreadsheets populated with information provided from various sources. Decision-makers had to balance available funding opportunities to satisfy level-of-service requirements. Capital projects were prioritized to comply with applicable regulatory permit requirements, protect public health and safety, and meet ratepayer expectations.

While this system served the ECDSM well for many decades and the ECDSM proactively maintained its infrastructure and ensured regulatory compliance, the decision was made in 2005 to pursue a more formal approach to capital planning to improve the effectiveness of this very important task. The ECDSM issued a Request for Proposals to solicit the services of an engineering firm for the development of a division-wide CIP. Over the course of two years, ECDSM worked jointly with the selected consultant to develop a comprehensive five-year plan, which was finalized in 2007.

The focus of the CIP supported rational asset decisions and

brought a strong case for required capital investments to the Erie County Legislature, the Sewer District Boards, the public and other stakeholders. The plan was flexible in that it was developed as a "living" document to be evaluated and updated on an annual basis accommodating changing drivers such as business needs, financial considerations, regulatory requirements, and technology trends.

The new CIP, and corresponding process, included the basic principles of asset management and was very thorough; however, it proved to be too complex for practical use by the ECDSM into the future using its in-house resources.

As a result, the ECDSM amended some of the capital planning protocols detailed in the plan to better suit the division's needs and capabilities. In-house staff now handle the required facility evaluations, review SAP PM data, and develop standard asset management metrics for rating assets on a risk-based methodology. All ECDSM pumping stations went through the new process and were entered into updated CIP documents. The priorities set forth in these documents will inform near and long-term capital decisions. The same process for the ECDSM's six water resource recovery facilities is presently in progress with consultant studies assisting with regulatory-driven upgrades. The CIP process, now modified, continues to use sound asset management principles but is now more manageable for the ECDSM to maintain and identify projects based on the division's priorities and drivers.

Conclusion

The future of asset management at ECDSM is bright. While all aspects of asset management planning cannot be accomplished overnight, tools such as CMMS, GIS and CIP, which have existed in simpler forms in the past, can be developed and used to deliver modern Advanced Asset Management.

The ECDSM has managed wastewater assets in Erie County for over a half a century and has always realized its responsibility to deliver long-term asset planning and investment. And just as tools used to deliver the fundamental elements of asset management have evolved during that time, the ECDSM will continue to enhance its asset management approach to protect public health, protect water quality, and ensure that the standards of service to which our customers have become accustomed are maintained.

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What Funding Gap? Financing Options Are Surprisingly Plentiful, but Utilities Must Be Proactive

by Ryan M. Connors

Facing considerable operational and strategic challenges, many water and wastewater systems are working proactively with professional service firms and equipment vendors to develop solutions that ensure continued access to safe potable water and sustainable wastewater management. Water and wastewater professionals are passionate about this aspect of their mission, and it is no surprise that utilities are ahead of the curve on meeting the technical challenges unique to their system. Unfortunately, most systems lack similar passion in dealing with the mundane – and at times daunting – issue of how to finance these solutions.

While the financial aspects of managing a system can be intimidating, particularly for smaller utilities, the popular perception that sufficient funds are not available to address water and wastewater infrastructure issues is simply false. There are abundant financing alternatives available for utilities willing to roll up their sleeves and explore the funding landscape. Although for many this work lacks the sense of mission that comes with tackling clean water challenges directly, it is an equally important component of delivering sustainable water and wastewater services at a reasonable cost to customers and the community at large.

When faced with funding needs, the immediate reflex is to look outside the system for an external capital source. But the first step toward creating a sustainable funding model is to ensure that rate structures are set such that the paramount *internal* capital source – customers – are capable of providing a funding backbone that will simultaneously minimize the need for external capital while also attracting capital from external sources. While outright grants do exist, they are typically small and unlikely to constitute a significant, recurring source of funding. The bulk of external financing

options come in the form of debt. Lenders focused on the water and wastewater industry seek out utilities that are on the path toward a “full-cost pricing” model whereby customers are paying as much of the total cost of service as possible. This not only makes a utility more attractive to lenders, but it also enables such systems to achieve better terms on debt in the form of lower interest rates, which is critical to minimizing further impact on ratepayers.

As is the case for all classes of infrastructure, sustainable funding models are driven by direct financial support from those using the infrastructure. Water and wastewater systems are no different. This is why community relations and corporate marketing are critical even for monopolies like utilities, particularly when faced with significant capital investment needs that will likely necessitate future rate increases. Customers not only need to appreciate the underlying value of the service, but also understand what they are paying for. This includes the pipes, pumps, filtrations systems, and other infrastructure required to deliver water and wastewater services, not simply the water itself. Misperceptions on this critical issue lie at the heart of the often-contentious debates over the increasing cost of water and wastewater services. It is up to utilities themselves to educate customers on the value of these critical services and the costs involved.

Financing should always be secured well *before* a project gets underway, during the pre-development phase. This is both much easier and cheaper if a utility can demonstrate to potential external capital providers that the system has a self-sustaining tariff structure in place. Not only does this increase capital providers’ confidence in the utility’s ability to service the capital going forward, it also ensures that capital providers themselves will not become embroiled in controversial after-the-fact rate hikes, which can complicate project financing and lead to reputational risk. While external funding is vital to many large infrastructure projects, accessing the capital markets successfully requires utilities to be proactive in managing toward sustainable full-cost pricing models. Waiting until major capital projects are imminent before moving toward full-cost pricing can create “rate shock” that impedes access to much-needed external capital and creates bad blood between the utility and its customers.

With a sustainable rate structure in place, water and wastewater utilities can assess the funding landscape confidently and put themselves in the driver’s seat during the financing process. They will be able to secure the best possible deal rather than being forced to accept higher cost capital on sub-optimal terms. This applies to all the various sources of capital, including both the government and private sectors, each of which offers a range of potential funding alternatives.

Government Funding

There is a plethora of government funding programs available for water and wastewater infrastructure projects, ranging across all levels of government. Although there is a perception that the current administration’s de-regulation policy at the federal level is hostile to environmental issues and threatens funding of water and wastewater infrastructure programs, this is not the case. The reality is that considerable funding opportunities are still



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available for utilities willing to undertake a disciplined and diligent assessment of the options.

In fact, programs such as the Water Infrastructure Finance and Innovation Act are likely to see an increase in funding levels as the federal funding landscape for water and sewer systems is expected to improve going forward. The most well-known federal funding vehicles for water and wastewater systems are the Drinking Water and Clean Water State Revolving Funds (SRFs), which are federally subsidized, low-cost loan programs for eligible potable water and wastewater projects. SRFs are an attractive source of capital, but given their prominence and popularity, there is considerable competition for available funds. Securing capital access under these programs can be a challenge. Lesser-known programs offer compelling alternatives to SRF funding, particularly for smaller utilities in rural areas. These programs include:

- Rural Business Development Grants.
- Environmental Finance Center Network.
- Water Infrastructure Finance and Innovation Act.

Economic Development Authority – Rural Business Development Grants (RBDG)

Administered by the United States Department of Agriculture (USDA), the RBDG program is a competitive grant system targeted at rural public entities. These are defined as entities located outside of metropolitan areas hosting cities of 50,000 or more in population. Generally, grants range in size from \$10,000 to \$500,000, although there is no statutory maximum. The underlying purpose of the program is to foster conditions for business development and economic growth in rural communities, which is a stated focus for the current administration. Utilities interested in accessing capital via the RBDG program should contact the USDA field office in their state. For a list of state office contacts, including the New York field office in Syracuse, go to: <https://www.rd.usda.gov/contact-us/state-offices>.

Environmental Finance Center Network (NYSEFCN)

The NYSEFCN is a national, university-based organization focused on helping local governments to navigate the funding process and create tailored, innovative financing solutions. The NYSEFCN's member organizations are spread across the country and offer localized expertise for water and wastewater systems in their region. Syracuse University is one of the ten NYSEFCN institutions and has a specific focus on water and wastewater issues. The university offers a targeted mini-grant program as well as a range of seminars and other events designed to educate local leaders on the different government and private sector financing alternatives available for various project types. In addition, the Syracuse University NYSEFCN helps utilities in crafting community outreach efforts ahead of major projects and/or rate increases. For more information, go to: <http://NYSEFCN.syr.edu/syracuse-NYSEFCN-projects/NYSEFCN-smart-management-for-small-water-systems/>.

Water Infrastructure Finance and Innovation Act (WIFIA)

Created in 2014 under the U.S. Environmental Protection Agency and modeled on the successful Transportation Infrastructure Finance and Innovation Act (TIFIA) program for the transportation sector, WIFIA offers federally subsidized low-cost loans for qualifying water and wastewater infrastructure projects. The program is focused on larger projects, with a minimum project size of \$5 million. Eligible applicants can receive debt financing for up to

49 percent of total project cost under the program. Underscoring the importance of establishing a sustainable rate structure ahead of time, WIFIA loans are available only to creditworthy systems having a dedicated source of revenue. While the WIFIA program is still relatively limited, it enjoys strong bipartisan support and is likely to expand in the years ahead. For more, visit: <https://www.epa.gov/wifia/learn-about-wifia-program#overview>.

Private Sector Funding

Accessing funding from the private sector often has a negative connotation in the water and wastewater industry, with many associating it with “privatization” and asset sales, but these options are just one extreme end of a spectrum of private sector financing options, most of which allow local governments to retain full control of their local water and wastewater resources and infrastructure. In fact, the well-trodden path of accessing private debt capital markets is among the cheapest, most seamless of all funding options for those utilities large enough to qualify. For smaller utilities, there is an emerging trend toward regionalization, which has many benefits including the ability to pool resources and access private capital markets as a larger, unified regional entity whose greater scale broadens the range of funding options. One of the great myths of the water and wastewater industry is that there is a lack of funding available. In reality, there is a mountain of private sector capital looking for ways to invest in the water industry, although the challenge is finding the right partner and structure for each specific utility and/or project.

Public-Private-Partnerships (PPPs)

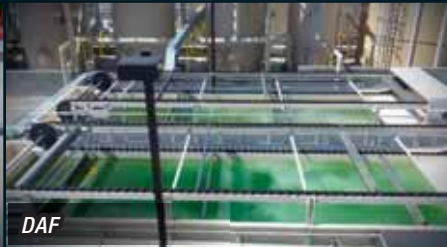
PPP is a catch-all term for infrastructure projects that entail functional and/or financing collaboration between government entities and the private sector. While PPPs have been promoted for years as a potential panacea for the funding challenges facing the water and wastewater industry, to date their use has been relatively limited. PPPs have been skewed toward massive projects that can afford the significant professional fees required for lawyers and bankers to craft a unique deal structure tailored to a specific project. Recently, however, there has been a push to streamline the PPP process by fostering “templates” that standardize elements of the process for certain deal types, bringing down costs considerably. PPPs have become a focus of ongoing talks surrounding a comprehensive federal infrastructure bill and could become a much more prominent aspect of the funding landscape going forward. Utilities interested in exploring PPPs as a potential funding solution should discuss options with professional service vendors such as investment banks and legal firms.

Privatization and Asset Sales

Long viewed with apprehension by locally-owned water and wastewater systems, privatization is gaining steam as a mainstream solution in many parts of the country. Whether they intend to seriously explore it or not, utility leaders have a responsibility to learn what these controversial solutions entail. Although New York has not yet taken this step, neighboring states have passed so-called “Fair Market Value” legislation that allows investor-owned utilities such as American Water – which operates in parts of Long Island – to acquire water and wastewater systems for considerably higher valuations than in the past. The significant sums are proving hard to resist for cities under fiscal duress. In a close-to-home example,

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the city of Scranton, Pennsylvania (population 77,000) recently sold its sewer system to American Water for \$195 million. While asset sales remain a niche solution, such sticker prices are raising eyebrows and will likely lead more utilities to explore privatization.

Alternative Revenue Sources

While customer rates must and will always be the backbone of system funding, many utilities are finding that alternative revenue sources can provide welcome incremental cash flow. Most utilities are well aware of now-conventional options such as leasing water tower space for telecommunications equipment, monetizing residual sludge for fertilizer applications, and entering into “peak demand response” contracts with electric utilities. But the evolution of the environmental economy is creating new cash flow options for creative and resourceful utilities. The market for carbon credits, for example, continues to expand. Many utilities with significant real property holdings have been able to generate significant income by selling their carbon credits to the private sector. One regional utility has become Disney Corporation’s largest source of carbon credits. Another valuable source is corporate impact investments, as publicly-traded corporations increasingly seek to enhance their sustainability profile by funding grants for important community projects.

Be Proactive

Traditionally, financing is not a popular topic for water and wastewater utility leaders. Many lack specialized financial training and understandably would much rather focus on solving the technical and operational water and wastewater challenges facing

Still, utilities that approach ratepayers the right way often find reasonable, well-telegraphed rate increases are more seamless than they expect.

their system and community. Leaders fear that discussions about financing will lead to the prospect of rate hikes. To make matters worse, the widespread perception that there is insufficient funding available for the nation’s infrastructure challenges makes wading into the issue of financing even less appealing. Still, utilities that approach ratepayers the right way often find reasonable, well-telegraphed rate increases are more seamless than they expect. There is a considerable amount of funding available for utilities willing to make a disciplined assessment of the landscape.

There is also lots of help available to make sense of what can seem an intimidating maze of different public and private sector funding alternatives; this assistance is often not as expensive as expected. In reality, *procrastination* is the aspect of water and wastewater system financing that should be most feared. Systems that put off much-needed infrastructure projects and corresponding rate increases are the ones that ultimately find themselves in the most difficult situations.

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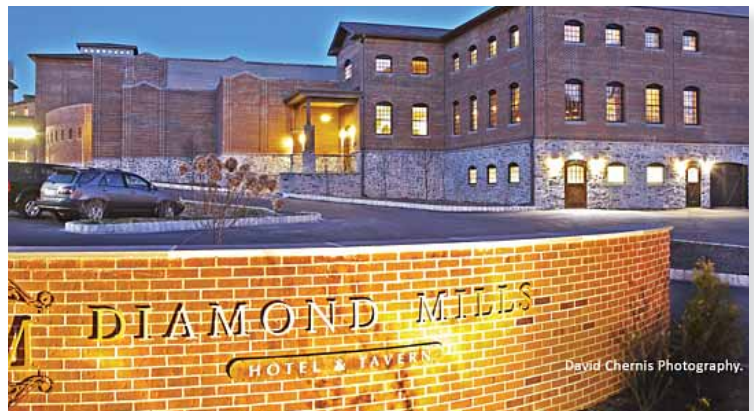


“Clean Water Through Protection and Partnership” 2018 NYC Watershed Science and Technical Conference

September 12, 2018 • Diamond Mills Hotel, Saugerties, NY

This conference is the premier New York State venue for presentations on the latest development in the science and practice of preserving and improving water quality. Last year’s conference attracted over 150 participants who engaged in a wide variety of technical presentations, panel discussions, and special-topic sessions on various aspects of watershed protection.

Featuring Keynote Speaker, Dr. Philippa Pearson, head of water services science at Dŵr Cymru Welsh Water. Dr. Pearson will talk about using NYC DEP’s program in the Catskills as an evidence-based model on which Wales is hoping to pattern its changes and enhancements. Her presentation will also cover some of the challenges they have in Wales, specifically nutrients from farms, taste and odor compounds, and a recent crypto outbreak, and the strategies that they’ve begun to



For more information, visit nywea.org

Mitigating Uncertainty and Risk with Public-Private Partnerships

by Jack Huttner and Ted Pytlar

Background

Reforming the Energy Vision (REV), an effort to rebuild, strengthen and modernize New York's energy system, was initiated by the New York State Department of Public Service in 2014. One REV goal obligates utilities to procure at least 50 percent of their power from renewable sources by the year 2030. The REV effort includes creating transparent market signals to stimulate energy efficiency and renewable energy investment by free-market (non-utility) players.

NYSERDA's Workshop Series

In 2017, the New York State Energy Research and Development Authority (NYSERDA) funded a workshop series, facilitated by Jack Huttner and Ted Pytlar, to help municipal managers understand and manage the uncertainties and risks associated with anaerobic digester gas (ADG)-to-energy projects; and to understand how public-private partnerships could be used to their advantage to help mitigate these uncertainties and risks. The project team interviewed managers of municipal water resource recovery facilities (WRRF) and solid waste management agencies throughout New York and, based on their input, fashioned four expert-led webinars to address common concerns. The four webinars were:

- Contracting Mechanisms
- Organic Waste Market
- Energy Markets for ADG
- Developing Public-Private Projects

The four webinars were led by speakers with extensive direct experience in the development and management of ADG-to-energy projects. All the speakers emphasized the importance of characterizing the potential organic waste streams – volumes, make-up, cost, and long-term supply – in order to truly understand the economics of the project.

The workshop series ended with a face-to-face meeting.

First Webinar – Contracting Mechanisms

In the first of the four webinars, Steven Torres, a partner at West Group Law and expert in municipal finance, presented information on two contracting mechanisms that could be used to develop ADG-to-energy projects: Energy Performance Contracting, which is familiar to many; and General Municipal Law §120-W, which covers contracts and agreements for solid waste. These mechanisms are proven alternatives to New York's standard municipal procurement ("low bid") laws. Each approach has different features, but both are workable alternatives to low-bid rules and could provide the legal framework for including private development partners. Steve also explained that a WRRF might use the General Municipal Law §120-W contract framework if the project includes management of biosolids.

Second Webinar – Organic Waste Market

Jeff LeBlanc, President of WeCare/Denali, presented the infor-



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mation discussed during the second webinar on sourcing organics and managing digestate. WeCare/Denali is an experienced organic residual management company with more than 20 years of operating in the organic waste industry. They operate anaerobic digester systems that handle an array of organic waste streams throughout the United States and Canada, as well as numerous compost facilities. Jeff provided the group with insights into the dynamics driving the organic waste market. He discussed tipping fee pricing, feedstock supply agreements and risk management strategies. He also emphasized an often-overlooked project success factor: cost-efficient disposition of digestate. Several participants agreed that sourcing of organic waste and cost-effective disposition of digestate are challenging. But, they also mentioned that these issues represent the best opportunity to leverage private partner expertise.

Third Webinar – Energy Markets for ADG

The third webinar was given by Jeremy Holland, a partner at HDR Inc., and the consulting firm's lead on biogas projects in North America. The focus of Jeremy's webinar was energy markets for ADG. In many New York WRRFs, anaerobic digester systems are used to manage biosolids. Some of these systems are designed for combined heat and power (CHP) to provide on-site heat and power. Most often, excess biogas is flared. Supplementation of biosolids with off-site organic waste streams provides an opportunity to modernize and expand anaerobic digester capacity and greatly increase ADG production.

Jeremy detailed the primary markets for ADG, which include heat, power, transportation, and pipeline injection. He also discussed potential future markets, such as the manufacture of bioplastics. The economics of the primary markets are driven by the emergence of tradeable environmental attributes or renewable energy credits (RECs). The most lucrative attribute, from a revenue standpoint, is the road transportation fuel market via the federal Renewable Fuel Standard (RFS) and California's Low Carbon Fuel Standard (LCFS). Producers of ADG can claim the value of both the RFS and LCFS RECs. While these RECs can be claimed directly if used by the municipality as compressed natural gas (CNG) fuel, in most cases they are marketed by third parties. Less lucrative are the carbon offset credits available for the sale of ADG into the California natural gas market. Jeremy noted that, for pipeline injection, a minimum of 200 cubic feet per minute of ADG production is required to cover the costs of compliance and gas clean-up prior to injection. Finally, power is currently the least lucrative market for ADG.

Fourth Webinar – Developing Public-Private Projects

The fourth webinar, presented by Brandon Moffett, Vice President of StormFisher Environmental, focused on the financial and operational aspects of developing public-private ADG-to-energy projects. Brandon has developed several such projects across North America and has gained significant experience on what it takes for projects to succeed, and what causes projects to fail.

Brandon began by emphasizing the fact that clearly defined project goals are critical to success. Good public partners have one thing in common: they can clearly articulate the problems they are looking to solve with the project. He also highlighted the importance of clearly understanding the strengths and weaknesses of your municipal team. Once this is accomplished, your team will have the information needed to identify where gaps could be filled by private partners, including design, financing, construction,

operations, and maintenance. He also emphasized the importance of having support of municipal decision makers and understanding their tolerance for risk. And finally, Brandon recommended that however the project is structured, the Request for Proposals (RFP) should include proposed contract terms, which provide bidders with a clear understanding of municipal intent and faith that their potential public partner is knowledgeable, prepared and has the potential to be an excellent partner.

The Rockland County Case Study

In an effort to make the workshop series as practical and meaningful as possible, the project team used a case study to model the real-world implications of the decision-making process. The Rockland County Solid Waste Management Authority (RCSWMA) offered to serve as the case-study municipality.

The RCSWMA shared with workshop facilitators an estimate of the quantity of potential food wastes in their waste-shed. They also provided information on energy consumption and existing site infrastructure. Using this information, D&B Engineers & Architects prepared a complete financial model for the most representative and appropriate sites where potential anaerobic digestion systems could be located in the county. The financial model was then shared with workshop participants and discussed at length at the face-to-face meeting.

Upcoming Legislative and Market Changes

Municipal managers interested in developing ADG-to-energy projects should also be aware of legislative and other changes on the horizon. There is a diverse and significant coalition pushing the New York Legislature for passage of a *Food Recovery and Recycling Act*. The Act would require large producers of organic wastes throughout the state to recover food for donation and recover inedible scraps. This should increase the volume of organic wastes diverted from landfills to ADG or composting. Should this occur, the volume of organic wastes available to anaerobic digester projects could significantly increase. Second, in what might signal a new trend for natural gas utilities, Consolidated Edison recently issued an RFP to secure "non-pipeline" alternatives to natural gas; and renewable natural gas from an anaerobic digester system is one of the alternatives mentioned.

Conclusions

Public-private partnerships have been used for over a decade to develop and maintain successful ADG-to-energy projects. A thoughtfully and logically considered public-private partnership, significant information-gathering and careful planning are required to develop a sound project foundation that can lead to project success.

Jack Huttner is President and Chief Executive Officer with Huttner Strategies, LLC and may be reached at jhuttner@huttnerstrategies.com. Ted Pytlar is recently retired from his role as Vice President with D&B Engineers & Architects, P.C., and may be reached at tpylar@db-eng.com.



How Can a Municipality Afford a Water Infrastructure Project?

by *New York State Environmental Facilities Corporation*

Over the last few years there has been a particular focus on the condition of our water infrastructure at the national level. New York State has been no exception, but as municipalities across the state of New York look to improve their water quality and safeguard public health, they are left grappling with the complexities and high cost of undertaking an infrastructure project. New York State Environmental Facilities Corporation (NYSEFC) can provide the needed financial and technical assistance to help communities of any size complete even the most challenging water infrastructure projects.

Low-cost Financing Through NYSEFC

Low-cost financing for water quality infrastructure projects is available from NYSEFC through a number of programs that it administers. NYSEFC manages the most successful State Revolving Funds (SRFs) in the nation. These programs have provided over \$34 billion in low-cost financing and grants for approximately 3,000 water and sewer infrastructure projects in all corners of the state. While many of NYSEFC's recipients have funded several projects through NYSEFC, each year new communities come to NYSEFC to access affordable funding for projects to help safeguard essential water resources.

State Revolving Fund Programs

NYSEFC offers financial assistance for a variety of project types at various stages of design and construction. Our core funding programs provide financing through two SRFs. The Clean Water State Revolving Fund allows NYSEFC to provide interest-free or low-interest rate financing and grants to support a variety of eligible water quality improvement projects, including point source, nonpoint source and national estuary projects. NYSEFC similarly finances drinking water infrastructure projects through the state's Drinking Water State Revolving Fund, in collaboration with its partner the New York State Department of Health.

Short-term and Long-term Financing Available

The financing through the SRFs is available for various durations and may be combined with financing from other entities to create a full plan of finance. Short-term financing, intended to provide recipients with funding to design and initiate construction on SRF eligible projects, is usually for a term of up to five years. Long-term

financing is generally amortized for a term of up to 30 years. Many communities finance costs short-term with NYSEFC, then convert to long-term financing once construction is finished.

Grant Programs

Ensuring that water infrastructure projects are as affordable as possible has also been a priority of New York's Governor Andrew Cuomo and the state Legislature. NYSEFC administers a number of grant programs including the New York State Water Infrastructure Improvement Act (WIIA) grant program and the Intermunicipal Grant (IMG) program. These programs provide at least \$1.15 billion in competitive grants to assist municipalities in funding both drinking water and clean water projects that protect or improve water quality and/or protect public health. Under the WIIA grant program, depending on the total estimated cost of a clean water project, a municipality could receive up to 25 percent of total estimated costs or \$25 million, whichever is less. Drinking water projects could receive up to 60 percent or \$3 million, whichever is less. Municipalities awarded an IMG grant receive the lesser of 40 percent of total project costs or \$10 million.

NYSEFC also offers grants for engineering and planning costs through the Engineering Planning Grant program. Projects that incorporate green infrastructure may be eligible for financial assistance through two programs: the Integrated Solutions Construction award program and the Green Innovation Grant Program.

Need More Information?

NYSEFC is currently accepting applications for the WIIA grant program and the IMG program. Applications must be submitted, with all required supporting documentation, no later than 5:00 pm, September 7th, 2018.

For more information on these programs and how NYSEFC may be able to assist with your water quality project, please visit NYSEFC's website at www.efc.ny.gov.

New York State Environmental Facilities Corporation is a public benefit corporation which provides financial and technical assistance primarily to municipalities by providing low-cost financing for their water quality infrastructure projects. More information about NYSEFC's services may be found on the website <https://www.efc.ny.gov/>.



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The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA)

by USEPA, edited by Kerry A. Thurston

The information presented here is distilled from the USEPA's website *Learn About the WIFIA Program* (USEPA 2018a). A *program handbook* is also available on-line (USEPA 2018b).

In 2014, the Water Infrastructure Finance and Innovation Act (WIFIA) set up a federal credit program administered by the U.S. Environmental Protection Agency (USEPA) for eligible water and wastewater infrastructure projects. Loans with low, fixed interest rates and flexible financial terms are made available for eligible borrowers through this program.

Eligibility

There are three eligibility levels that must be met for a WIFIA program loan:

- Borrower eligibility.
- Project eligibility.
- Cost eligibility.

Borrower Eligibility

Eligible borrowers seeking loans through the WIFIA program are:

- Local, state, tribal, and federal government entities.
- Partnerships and joint ventures.
- Corporations and trusts.
- Clean Water and Drinking Water State Revolving Fund (SRF) programs.

Entities from the U.S. territories and the District of Columbia, as well as non-profit entities, are also eligible. Municipal governments with a common security pledge can file one application together.

Project Eligibility

The WIFIA loans may be used for these eligible projects::

- Projects eligible for the Clean Water SRF, notwithstanding the public ownership clause.
- Projects eligible for the Drinking Water SRF.
- Enhanced energy-efficiency projects at drinking water and wastewater facilities.
- Brackish or seawater desalination, aquifer recharge, alternative water supply, and water recycling projects.
- Drought prevention, reduction, or mitigation projects.
- Acquisition of property, if it is integral to the project or will mitigate the environmental impact of a project.
- A combination of projects secured by a common security pledge or submitted under one application by an SRF program.

Eligible project size is based on the size of the community it will serve. For large communities, the minimum project size is \$20 million; for small communities, with a population of 25,000 or less, the minimum is \$5 million.

Cost Eligibility

Not all project costs are eligible. Eligible project costs are:

- Development phase activities, including: planning; preliminary engineering, design; environmental review; revenue forecasting; and other pre-construction activities.
- Construction, reconstruction, rehabilitation and replacement activities.
- Acquisition of real property or an interest in real property, environmental mitigation, construction contingencies, and acquisition of equipment.
- Capitalized interest necessary to meet market requirements, reasonably required reserve funds, capital issuance expenses and

other carrying costs during construction.

Benefits and Limits

The WIFIA loans may cover up to 49 percent of the eligible project costs; the project applicant must obtain the remaining 51 percent through other means. WIFIA loans can be combined with private equity, revenue bonds, corporate debt, grants, and SRF loans. Total federal assistance, however, may not exceed 80 percent of a project's eligible costs.

Eligible projects must be creditworthy and have a dedicated source of revenue such as taxes, rate revenue, transfers pledged from state or local governments, dedicated taxes, a municipal general obligation pledge, revenues that are pledged for retiring debt on the project, and general recourse corporate undertakings.

The WIFIA program bases its loan interest rate on the U.S. Treasury rate on the date of loan closing. The rate is calculated using the weighted average life (WAL) of the loan rather than the loan maturity date, which can result in a lower interest rate. All borrowers benefit from the AAA Treasury rate, regardless of whether they are rated AA or BBB. The WIFIA program does not charge a higher rate for flexible financial terms.

Loan repayment can be delayed up to five years from the substantial completion of the project; however, the maximum final maturity date of the loan is 35 years from substantial completion. Borrowers can customize their repayments to match their predicted revenues and expenses for the life of the loan. This flexibility provides borrowers with the time they may need to phase in rate increases to generate revenue to repay the loan.

The USEPA is limited in the total amount of credit assistance it can provide through the appropriation. For 2018, Congress provided at least \$55 million in budget authority for the WIFIA program to cover the subsidy required to provide a much larger amount of credit assistance. The USEPA estimates that this budget authority may provide about \$5.5 billion in credit assistance and may finance approximately \$11 billion in water infrastructure investment, while covering increased costs associated with implementing a larger program (USEPA 2018c).

Kerry A. Thurston is the Editor for Clear Waters magazine and may be reached at clearwaters@nywea.org.

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The Order of the Engineer: Our Own Hippocratic Oath

by P.J. Connell

“I am an Engineer. In my profession I take deep pride. To it I owe solemn obligations.”

These are the first words of an oath taken by all those who join the Order of the Engineer, a group formed in 1970 whose members vow to work tirelessly for the benefit of the public good. The American Order of the Engineer (the Order) is based on a similar Canadian concept, established in 1922, called the “Ritual of the Calling of an Engineer.”

The process of joining the Order is relatively simple. At many American universities, as student engineers approach graduation they are invited to participate in the initiation ceremony to join that school’s chapter (called a “link”). At the ceremony, all prospective members recite an oath called the “Obligation of an Engineer,” (Obligation) whose first words are stated at the beginning of this article. After taking the oath, members are presented with a stainless steel ring (called the “Engineer’s Ring”), to be worn on the little finger of their dominant hand.

That symbol – the ring on the little finger of your dominant hand – is the unofficial trademark of both the Canadian and American organizations. In the case of the Canadian group, the ring is composed of iron instead of stainless steel. The original purpose of wearing the ring on your dominant hand was so that the ring would drag across any surface on which the engineer would write, thereby serving as an unerring reminder of the Obligation. In addition, the ring acts as a visible symbol both to the engineer and to the public, identifying the wearer as an engineer and servant of society.

The Obligation, which roughly equates to the engineer’s version of the doctor’s Hippocratic Oath, focuses heavily on honesty, integrity and service to humanity. The Obligation is a more concise version of the Code of Ethics of most, if not all, major engineering societies. If you look up the text of the Obligation and put it side-by-side with that of the Code of Ethics of any major engineering organization, you will notice that the major themes on which the Obligation focuses – selfless devotion to public welfare, fair dealing, dignity, etc. – are present in the Codes of Ethics.

I joined the Order just before graduating from the environmental engineering program at the SUNY College of Environmental Science and Forestry in 2015. After we each presented our capstone projects, we as a class were given the option to join the Order. All of us took the pledge. Since that day, I’ve been wearing the ring on the little finger of my right hand. The ring serves as a reminder that, while my supervisors are the ones who give me deadlines,

I ultimately answer to the public. While the clients pay the bills, true engineering success is measured by the amount of good you do with your knowledge, skill and resources.

The Order is an extremely large organization, with links at universities across the entire country. There are also several links that are not affiliated with a college or university; for example, many local chapters of Tau Beta Pi, the National Society of Professional Engineers, and the American Society of Civil Engineers have links. Members of the Order serve as engineers in many different arenas. Some members work for government agencies, some (like me) work for private consulting firms, and others remain in academia, and some represent the manufacturers of products used in the industry, among other professions.

Ultimate purpose aside, the function of the ring does not change. Each time I notice the ring on my hand, I recall my initiation ceremony. Each time someone asks me about it, I am reminded of my Obligation. And each time I see a fellow Order member wearing the ring, I feel a powerful sense of unspoken camaraderie.



Order of the Engineer members (l-r) Doug Daley, Rosie Nogle and Patrick Stevens proudly display their rings at the 2018 Spring Meeting.
Patricia Cerro-Reehil

If nothing else, the ring makes it impossible to forget who you are.

The Order is not a membership organization. There are no dues, meetings, etc. It has no formal connection to any other engineering organizations. However, it serves a powerful purpose in uniting those who are devoted to their profession and believe in the sacredness of the word “engineer.”

If the Order sounds like something you would be interested in joining, but you have long since graduated from college, don’t worry – you still can join. While most members I know joined around their graduation from college, any engineer is eligible so long as they have graduated from an accredited program, hold a P.E. license, or have equivalent qualifications as declared by the National Board of Governors. For more information, visit <http://www.order-of-the-engineer.org/> or call (866) 364-7464.

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The Select Society of Sanitary Sludge Shovelers

by *William Grandner*

The original chapter of the Select Society of Sanitary Sludge Shovelers (5S Society) was founded in Arizona in October 1940. The idea was conceived by A.W. Miller and F. Carlyle Roberts Jr., to recognize wastewater treatment and collection system personnel who contribute in the outstanding measure to control water resource recovery. Membership in the 5S Society recognizes the valuable service that so many of our colleagues perform in our field.

The 5S Society was originated to encourage members to get involved in our collective efforts to preserve water quality. Membership in the organization extends across the United States and Canada, and is based on merit. Selected members are those individuals who contribute their efforts, time and energies in ways that are above and beyond the call of duty. They are always ready to “dig in,” hence the use of the shovel as the symbol for the badge of membership.



The Golden Shovel is awarded to regular members elevated to the 5S Society.

Howard Robinson

The New York Chapter was chartered in June 1984 with the installation of officers and a Board of Directors by the New England Water Pollution Control Association at the Joint Spring Meeting in Hyannis on Cape Cod in Massachusetts. The 5S Society, while independent of NYWEA, is sanctioned by the association.

Officers of the 5S Society

There are no officers except the “Operator-in-Chief,” who is elected by a majority vote of the 5S Society members present at NYWEA’s annual meeting. The Operator-in-Chief must be a current member of the New York Chapter of the 5S Society and of NYWEA. The role of the Operator-in-Chief is to administer the Elevation Ceremony for new members of the 5S Society; record and report selections; present official certificates of Elevation; bestow the Shovels; and inform members concerning the Society’s activities.

Membership in the 5S Society

New members of the 5S Society cannot join or enroll; they must be selected for Elevation based on their history of willingness to get involved and their unselfish contributions of time and talent to NYWEA and to the water resource recovery field. Nominations are made by the Chapters and by the NYWEA Board of Directors. The

selection of new members for Elevation is made by the members of the 5S Society.

The honorary badge, in the form of a shovel, is to be worn or displayed at NYWEA and WEF functions to show membership in the 5S Society. The badges – gold, silver and bronze – represent different qualifications for membership.

- Regular members, who must be operators, are awarded gold shovels. These members have worked on-site in the operations, maintenance, laboratory or process control of a water resource recovery facility or a collections system or have a state Wastewater Treatment Plant Operators certification.
- Honorary members, who are not operators, are awarded silver shovels. These members are individuals dedicated to the advancement of water resource recovery, other than as an on-site operator, such as a researcher, educator, designer, construction manager, contractor, manufacturers’ representative, vendor, public official or administrator.
- Young professional members, who are less than 35 years old and are involved in one or more of NYWEA’s Young Professionals committees, are awarded bronze shovels.

The Elevation of new members into the 5S Society is conducted once a year during the NYWEA spring conference.

Selection Procedure for Membership

The first step in the selection procedure occurs in October when the wastewater operator certification administrator circulates the nomination form to chapters. Nominations are due to the NYWEA Executive Office by January 1st.

The next step in the process occurs at NYWEA’s annual (winter) meeting. The NYWEA President provides a proper forum for the Operator-in-Chief and 5S Society members to affirm the nominees for Elevation. Nominees should normally be accepted by the 5S Society members in attendance, but nominees can be rejected with cause.

After the forum has elected nominees, the Operator-in-Chief will inform the NYWEA President and the presiding officers of the Nominees and the type of membership for each. The presiding officers then inform the nominees of their election. The award is made at the NYWEA spring meeting. If the nominee is not attending the spring meeting, the award is made at a regular Chapter meeting.

Elevation Procedure

At NYWEA’s spring meeting, the Elevation of nominees to membership in the 5S Society follows a specific format. First, the Operator-in-Chief welcomes those in attendance, including the nominees, and reads a history of the 5S Society. Then, the nominees are recognized and called forward by name, their chapter affiliation and the type of shovel they will be awarded. As the nominees stand, the Operator-in-Chief reads the 5S Society citation (*see sidebar, page 51*). Following the reading, the Operator-In-Chief asks for appreciation by applause for the Elevation of the nominees.

William Grandner is the Operator-in-Chief of the 5S Society and may be reached at grandner@verizon.net.

The Golden Manhole Society

by Robert A. Albright

The original chapter of the Golden Manhole Society (GMS) was founded in New York in February of 1999. The idea was conceived by the New York Water Environment Association (NYWEA) Wastewater Collection Systems Committee to recognize collection system personnel who contribute in outstanding measure to the operation and maintenance of sanitary, storm and combined sewer systems. While independent of NYWEA, the GMS is sanctioned by the association.

The GMS was founded to encourage members to get more involved. Members from across the United States and Canada are selected based on merit. They are always ready to “pitch in, grab a hook and uncover and solve the problem,” hence the symbol and badge of membership: the manhole cover. The honorary badge of membership should always be worn or displayed at NYWEA functions to show their GMS membership.

The only officer of the GMS, the Operator-in-Chief, is elected by votes of the GMS members present at NYWEA’s annual meeting and serves until a successor is elected or installed. The duties of the Operator-in-Chief include: administering the Elevation ceremony for new members to the GMA; recording and reporting selections; presenting official certificates of Elevation; bestowing the badge; and informing members concerning the GMS activities.

GMS Membership

New members of the GMS cannot join or enroll. They must be selected for Elevation based on their willingness to get involved and their unselfish contributions of time and talent to the NYWEA and the field. The selection of new members for Elevation is made by the present members of the GMS.

Members of the GMS are individuals who have worked on-site in the operations or maintenance of sanitary, storm or combined wastewater sewer systems, as well as individuals who are dedicated to the advancement of wastewater sewer collection systems, such as researchers, educators, designers, manufacturers’ representatives, vendors, public officials or administrators. Each member is awarded a gold badge in the form of a manhole cover. Membership in NYWEA is a mandatory requirement.

Each chapter of NYWEA can annually nominate two individuals to be Elevated into the GMS as a member. The nomination is suggested and decided by vote of the members attending an official meeting of the Chapter. Should there be no GMS members in attendance, or recommended members are not submitted to the Chapter, the Presiding Officer can nominate up to two collection systems personnel for membership with the advice and council from fellow Chapter members. In addition, the NYWEA Board of Directors can annually nominate an individual to be Elevated as a member by vote of the GMS.

The Elevation of new members occurs once per year at the NYWEA Wastewater Collection Systems spring meeting. The Elevation is performed by the Operator-in-Chief. In the absence of the Operator-in-Chief, the NYWEA Chairman of the Wastewater Collection Systems Committee or the President can preside. Under extreme circumstances, newly elected members can be installed by the presiding officer at a regular NYWEA Chapter meeting.

Selection Procedure

Members nominated by the Chapter or by the Executive

Committee must be brought to the attention of the Operator-in-Chief and the Wastewater Collection Systems Committee Chair prior to the annual meeting of each year.

At NYWEA’s annual winter meeting, the Wastewater Collection Systems Committee Chair provides a proper forum for the Operator-in-Chief and GMS members to affirm nominees for election. Nominees are typically accepted by the members but can be rejected if there is cause. If less than three members are present in the forum, the Operator-in-Chief can elect the nominees with the advice and counsel of those members who are in attendance.

After the forum has elected nominees, the Operator-in-Chief informs the NYWEA President, Wastewater Collection Systems Committee Chairman and Chapter Presiding Officers of the nominees selected for Elevation. The Chapter Presiding Officer will inform nominees of their election and that the award will be made at the NYWEA Spring Technical Conference & Exhibition.

If nominees do not attend the spring meeting, their badges, certificates and elevation procedures will be returned to the appropriate Chapters for elevation of the individuals by the Presiding Officers at a suitable Chapter function.



The official badge of the Golden Manhole Society is in the shape of a manhole cover.
Robert Albright

Elevation Procedure

The elevation procedure is detailed in the rules of the GMS. The Elevating Officer reads the history of the GMS, then calls forward the nominees to the chair by name and affiliation. Each in turn, is given his/her badge and certificate and asked to remain at the chair. Once the badges and certificates are handed out, the Elevating Officer reads the citation for meritorious service (*see sidebar, page 51*). The ceremony closes as the Elevating Officer asks for appreciation by applause of the meeting attendees.

Robert A. Albright Jr., P.E., BCEE is a Senior Associate with Hazen and Sawyer, and the Operator-in-Chief for the Golden Manhole Society. He may be reached at ralbright@hazenandsawyer.com.



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The North American Robin: Unifying Sewer People Everywhere

by Patrick L. Stevens

People in the sewer business have always struggled with their self-image, trying to strike a balance between the sense of humor presented to the public and the professional pride that only a few can appreciate. For a few years I have promoted the idea that the sewer industry adopt the American robin as its mascot. It would be similar to the water industry's use of the single water drop.



The official bird of collection systems, American robin (*Turdus migratorius*).
iStock by Getty Images, Steve Byland

The reasons for selecting the American robin as the mascot are that, just like sewer people:

- The robin lives and works in every state and province in North America and is found wherever people live or congregate.
- The robin spends its day with an eye to the ground looking after

things unseen by others.

- The robin makes a living doing things with holes in ground that most people find disgusting.
- Most importantly, the robin's scientific name is a fitting reflection of our business – *Turdus migratorius*.

The 'Odor of the Turd' is an organization that has evolved to recognize sewer people of note based, on their activity in the sewer business and their sense of humor. Inductees to the 'Odor of the Turd' are given their sacred pin, the secret handshake and the secret password. It is estimated that the Odor of the Turd has over 500 members.

Patrick L. Stevens, P.E., is a Vice President of Engineering with ADS Environmental Services. He may be reached at PStevens2@idexcorp.com.



Design of the Sacred Pin, featuring the official bird of collection systems.
Patrick L. Stevens

Select Society of Sanitary Sludge Shovelers Citation

Effective and efficient operation of our wastewater treatment plants is the keystone to clean water. The people we honor here today hold that keystone in place every day.

Operators have help, for sure. Engineers design their plants using theories developed in our colleges and universities. Manufacturers construct their pumps and valves. Contractors build their plants. Employers supply operating funds. Government provides training and sets effluent limits.

The people we elevate into the Society today as members deserve our praise.

In the end, though, only operators "operate." Operators alone can be regular Society members. They know how to deal with filamentous bacteria without a Ph.D. They don't have to be mechanical engineers to read a pump curve. They can diagnose, fix a bad bearing with only a rare call to the manufacturer's service representative. They get the job done.

They work when and where the job has to be done. Plants, pump stations, laboratories, sewers, manholes, settling tanks and truck cabs are some of their many offices. They work in the dead of night or at high noon, in the heat of summer, and through the winter's bitter cold.

They are operators! We are here to honor the operators for a job well done. Through their individual efforts, and the work of all operators, our waters are cleaner than they have been in decades, and they will be even cleaner tomorrow.

On behalf of the Society and NYWEA, we thank you!

The Golden Manhole Society Citation

Effective and efficient operation of our sewer collection systems is key to the infrastructure service we provide to our municipal ratepayers. The people we honor now help to maintain this level of service every day. They have help, for sure, but they are an integral part of the team effort. The people we elevate to the GMS today as honorary members have been exemplary team members in this regard and deserve our recognition.

In the end, though, only the wastewater collection system personnel who know how to maintain pump stations, clean sewers, televise sewers and are responsible for the repair and rehabilitation of the collection system on a fixed budget are the ones who must get the job done.

They work where and when the job has to be done. Sewers, manholes and truck cabs are their "offices". They work in the dead of night or at high noon, in the heat of summer, and through winter's bitter cold.

They are sewer collection system personnel. We are here to honor these personnel for a job well done. Through the work of all the sewer system personnel, our sewers are in better shape than they have been in decades. Their individual efforts help prevent sewage backups into homes, businesses and sewer system overflows, thereby protecting our property and the environment.

On behalf of the GMS, and NYWEA, we thank you and welcome you to the GMS!





Operations Challenge Judge Robert Wither prepares the next test question.



John Fortin is Master of Ceremonies for the Operations Challenge Awards.



Sludge Hustler Robert Ferland cuts a pipe during the Operations Challenge event.



First Place in the 31st Operations Challenge is NYC DEP's Jamaica Sludge Hustlers. L-r: Joe Atkins (Alternate), Anthony Petrone, Ray Antenucci, Robert Ferland and Yu-Tung Chan.



Members of the NYC DEP Watershed Warriors work on the Laboratory Event during the 31st Operations Challenge, (l-r, foreground) Matt Burd and Bruce Decker.



Members of the Brown Tide compete in the Laboratory Event; left, James Behr, right, Rob Jentz.



Members of the NYC DEP Watershed Warriors, (l-r) Bruce Decker, Erik Coddington (Coach), Ken Taylor, Dan Byrne (Alternate), Eric Albano and Matt Burd.



Members of the Long Island Brown Tide, (l-r) Nick Barresi, Jake Miller, Brian Blouin (Coach/Alternate), Rob Jentz and James Behr.



Members of the Genesee Valley Chapter Water Recyclers, (l-r) Justin Slentz, Lucas Kasperowicz, Michelle Hess and Robert Holland.

Left: Priceless! On left, Chris Reyes and Anthony Cervone.





Members of the NJWEA Devils came to compete in the Regional Operations Challenge. (L-r) John Kahnke, Adam Sheick, Emily Zidanic, Kevin Barstow and Tim Fisher Sr. (Coach).



Members of the NYC DEP Bowery Bay Coyotes, (l-r) Chris Reyes, Anthony Quadrino, YueYue Guo, Eugene Buckley (Alternate) and Anthony Cervone. Howard Robinson (Coach) not pictured.

... and the 1st place winners are the NYC DEP Jamaica Sludge Hustlers!



(L-r) Anthony Petrone, Robert Ferland, NYC DEP Deputy Commissioner Bureau of Wastewater Treatment Pam Elardo, Ray Antenucci, Yu-Tung Chan and State Operations Challenge Coordinator John Fortin.

Bottom left, page 52:

In the true spirit of the Operations Challenge, the final moments of the day are spent together celebrating another year of friendly competition. A huge THANK YOU to all the teams, judges and coordinators whose tireless efforts make this possible. Congratulations to all the teams for a great showing, and especially to the Jamaica Sludge Hustlers, Long Island Brown Tide, the Bowery Bay Coyotes, and the Lower Hudson Watershed Warriors who will travel to WEFTEC in September to represent NYWEA in the Nationals!

Donna Bee, Operator Representative to the Board

Highlights from NYWEA's 31st Operations Challenge

Six teams competed in the Regional Operations Challenge Competition during the Spring Technical Conference & Exhibition on June 12th at The Sagamore on Lake George. We are pleased to announce that the NYWEA Board of Directors approved the expenses to send four teams to compete in New Orleans during WEFTEC. Congratulations to the winning teams: First Place, Jamaica Sludge Hustlers; Second Place, Long Island Brown Tide; Third Place, the Bowery Bay Coyotes; and Fourth Place, the Watershed Warriors.

2018 Upcoming MEC Training

September 20: Chlorine Disinfection Soup to Nuts: Chlorination and Dechlorination

SUNY Polytechnic Institute, Student Center, 100 Seymor Road, Utica, NY

October 18: Anaerobic Digestion and Biogas Safety Training

Bergen Point WWTP, 600 Bergen Avenue, Babylon, NY

October 24: Advanced Primary Treatment & Nutrient Removal

IBM East Fishkill, 2070 Route 52, Hopewell Junction, NY

November 7: Mathematics for Water and Wastewater Operators

New Rochelle WWTP, 1 Le Fevres Lane, New Rochelle, NY

November 8: Advanced Primary Treatment and Nutrient Removal

Chenango Town Hall, 11529 State Rte. 12, Binghamton, NY

November 13: Wastewater Professional's Guide to Online Process Instrumentation for Biological Nutrient Removal (BNR) Activated Sludge Monitoring

Van Lare Plant Training Room, 1574 Lake Shore Blvd., Rochester, NY

November 15: Mathematics for Water and Wastewater Operators

Vischer Ferry Firehouse, 360 Riverview Road, Rexford, NY

November 15: Wastewater Professional's Guide to Online Process Instrumentation for Biological Nutrient Removal (BNR) Activated Sludge Monitoring

Niagara County Fire Training Center, 5574 Niagara St. Ext., Lockport, NY

See more at <http://nywea.org/training/calendar.cfm>

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LIFT Program Expands with Water Technology Innovation Clusters

by Morgan Brown

The Water Environment Federation (WEF) is an avid supporter of innovation in the water sector. In fact, one of WEF's critical objectives is to "establish the conditions that promote accelerated development and implementation of innovative technologies and approaches."

As part of this initiative, WEF and The Water Research Foundation (WRF) jointly created the Leaders Innovation Forum for Technology (LIFT) program more than five years ago to help facilitate the adoption of water technologies and move innovation into practice.

For the newest addition to LIFT, WEF is coordinating a nationwide network of Water Technology Innovation Clusters, which were originally developed by the U.S. Environmental Protection Agency (EPA). The clusters program will be run as a LIFT focus group led by Bryan Stubbs, executive director of the Cleveland Water Alliance, and Aayushi Jain, market transformation associate for the Los Angeles Cleantech Incubator.

What Are Water Clusters?

Water Technology Innovation Clusters are regional groupings of businesses, government, research institutions, and other organizations focused on innovative technologies to provide clean and reliable water. WEF will facilitate cluster communications, advise cluster organizations, enable collaboration among clusters, and identify water programs that support cluster activities.

Clusters have a key role to play in addressing the nation's pressing water issues.

- **Spur innovation.** Clusters create a situation where companies and organizations can easily share ideas and solutions.
- **Accelerate the development of new technologies.** Connections within clusters lead to partnerships between businesses and researchers, facilitating the transfer of new technologies to the market.
- **Streamline the adoption of new technologies.** Clusters provide companies with easier access to test beds and partners for pilot studies and encourage communication among companies and regulators.

Building on Past Efforts

While the program is a new addition to LIFT, the clusters have been involved in WEF's Technical Exhibition and Conference (WEFTEC). For the last several years, the Water Technology Innovation Clusters, under the auspices of EPA, had a formal meeting at WEFTEC and have been showcased in several sessions within the WEFTEC Innovation Pavilion.

In 2017, cluster leaders from the New England Water Innovation Network (NEWIN), Current, The Water Council, and the Los Angeles Cleantech Incubator participated in a lively panel discussion titled "How can I benefit from a water innovation cluster?" Panelists talked about how clusters support pilot projects, foster collaboration among utilities and universities, and link entrepreneurs with advisors and customers.

Also at WEFTEC 2017, an Innovation Pavilion session, titled "The Water Council's BREW (Business – Research – Entrepreneurship – in Wisconsin) Accelerator," held a business-pitching session modeled after the successful show "Shark Tank." BREW participant companies pitched for three to five minutes, after which a panel grilled them about their business model, technology, intellectual property, marketing strategy, and more. Nothing was off limits in these lightning fast pitches.

In a third session, the Cleveland Water Alliance discussed the Erie Hack, which is Lake Erie's first water innovation competition. The Cleveland Water Alliance partnered with DigitalC, a civic tech collaboration organization to hold this competition. The Erie Hack brought together more than 100 partner organizations and 200 participants – coders, developers, engineers, data experts, and water professionals – from nearly every major city around the lake to work on its greatest challenges, especially harmful algal blooms.

As a follow-up to the Erie Hack, the Cleveland Water Alliance branched out into another water innovation competition, the Internet of H2O Challenge. This competition seeks to leverage next-generation networking and sensor technology to monitoring and managing nutrients in Lake Erie and beyond. The goal was to generate robust and resilient nutrient monitoring pilots with the potential to scale across the Great Lakes. The alliance partnered with DigitalC as well as US Ignite, which spurs the creation of next-generation applications and smart cities, and the National Science Foundation. Other participants include the Great Lakes Observing System, IBM, City of Sandusky, Bowling Green State University, Heidelberg University, AT&T, U.S. EPA, Great Lakes Commission, NOAA, Limnotech, and others to focus the Erie Hack's energy on developing a resilient monitoring system for nutrients.

Moving Innovation Forward

Water Technology Innovation Clusters are uniquely making a difference at a local and regional level. Even though each cluster is a separate entity located in various regions, this overall program brings together the cluster leaders so that they can work on a larger national scale.

For example, the cluster leaders previously have worked together to produce such reports as *Overcoming Barriers to Water Innovation in the U.S.* and *Building a Successful Technology Cluster*. These resources are beneficial not only to existing clusters, but also to those seeking to create a cluster in their region.

WEF is excited to take on this program set up by EPA and to continue to build valuable innovative programs for our members through LIFT and the WEFTEC Innovation Pavilion. For more information on the Water Technology Innovation Clusters program visit www.wef.org/techclusters.

Morgan Brown is Water Innovation Cluster manager at the Water Environment Federation (Alexandria, Va.). She can be reached at mbrown@wef.org.

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U.S. States, EPA Coordinating on Best Approaches to Nutrients Permitting

by Mark Patrick McGuire and Katie Foreman

In early December 2017, representatives from 24 state clean water programs involved in managing nutrient pollution as well as headquarters and regional staff from the U.S. Environmental Protection Agency (EPA) met for three days to learn, discuss, and confer on a broad range of nutrients permitting issues. Presentation topics included nutrient removal technologies, nutrients reduction strategies, variances, water quality trading, watershed-based and adaptive management approaches, integrated planning, and more. Participants also had the opportunity to work in small groups on three specific issues:

- nutrient removal technology implementation at water resource recovery facilities (WRRFs),
- overcoming impediments to permitting for nutrients, and
- integrating total maximum daily loads (TMDLs) with permits.

The workshop, held in Boise, Idaho, was the first in a series of seven meetings to be held between 2017 and 2021 by the Association of Clean Water Administrators (ACWA; Washington, D.C.), with support from the Water Environment Federation (WEF; Alexandria, Va.), as part of a cooperative agreement with EPA. The workshops are intended to assist with achieving several objectives and environmental outcomes by bringing together state, tribal, territorial, federal, and other stakeholders. The goals are to identify challenges and barriers to nutrient permitting program implementation, highlight opportunities for program improvement and enhancement, showcase innovations and achievements, and identify and attempt to solve the most intractable issues.

States Employ Various Approaches to Nutrient Permitting

A major takeaway from the Boise workshop was that states manage nutrient pollution through permitting in myriad ways. For example, Montana, Iowa, and North Carolina approach nutrients permitting via numeric nutrient criteria, performance-based actions, and water quality trading, respectively.

Montana. Montana adopted numeric nutrient criteria in 2014 to combat nutrient pollution. The development process for the criteria included three components:

- identifying geographic zones for specific criteria,
- understanding the cause-effect relationships between nutrients and beneficial uses, and
- characterizing water quality for reference sites.

Because nutrient concentrations vary naturally, Montana tested different geospatial frames and reference sites for nutrient concentration variation. To develop permit limits based on the criteria, Montana used EPA's 1991 *Technical Support Document for Water Quality-based Toxics Control*. Ongoing work in Montana will lead to other large-river nutrient standards and additional site-specific wadable stream standards.

Iowa. Iowa employs a nutrient reduction strategy to combat nutrient pollution. In Iowa, numeric nutrient criteria development presents significant challenges. Therefore, in lieu of adopting numeric nutrient criteria, Iowa hopes to achieve nutrient load reductions through performance-based actions. Working closely with the regulated community to adopt performance-based discharge limits, Iowa establishes limits based on the effect of the pollutant in the water and the feasibility and reasonableness of treating the pol-

lutant. Iowa focuses on major and minor municipal WRRFs and industries that treat more than 3.8 million L/d (1 mgd). Under this approach, there has been considerable progress in nutrient pollution reductions at point sources throughout the state.

North Carolina. North Carolina uses water quality trading to combat nutrient pollution. North Carolina implements nutrient trading programs in specific watersheds where impairments have been identified. In these watersheds, point sources have a collective nutrient allocation ("bubble") permit. Pursuant to this joint compliance approach, allocation is sold or leased among these facilities through an independently-operated compliance association. So long as the collective cap is met, individual nutrient limits are not enforced.

States and EPA Offer Solutions to Complex Issues

At the Boise workshop, participants focused on the three issues mentioned above (technology implementation, permitting impediments, and TMDL integration).

Technology implementation. Participants named some of the significant barriers to technology integration as affordability, resource constraints, operator expertise, and political will. They also identified some solutions, including targeted technical training and greater public education on the need for such technologies at WRRFs.

Permitting impediments. Regarding impediments to permitting, participants identified affordability, lack of data, and resource constraints as challenges. One solution identified to mitigate these problems included changing the 5-year National Pollutant Discharge Elimination System (NPDES) permit cycle to 10 years. Other solutions included increasing flexibilities for states, implementing stronger regulations for nonpoint sources, integrated planning to identify issues and priorities for regulators and the regulated community, increased support and technical training, and public education.

TMDL integration. In the final session on integrating nutrients TMDLs with permits, participant attendees acknowledged that communication gaps are a major barrier to adequate integration. They identified the existence of communication gaps between regulators and stakeholders and with permitting and TMDL staff. Many participants described better communication among the various interested parties as an important goal for resolving this challenge.

Future Meetings

ACWA and WEF plan to tackle these three issues and more in greater detail at the next six nutrients permitting workshops. These workshops provide states and EPA, as coregulators, the opportunity to identify and seek solutions for the diverse problems associated with nutrient pollution. In 2018, workshops are planned for summer and autumn; visit www.acwa-us.org for more details on these events.

Mark Patrick McGuire is an environmental program manager and Katie Foreman is an environmental program associate at the Association of Clean Water Administrators (Washington, D.C.).

WEFTEC® Opening General Session Speaker Highlights

How to Be a Hero in the Water Sector

The information provided in this article is designed to be educational. It is not intended to provide any type of professional advice including without limitation legal, accounting, or engineering. Your use of the information provided here is voluntary and should be based on your own evaluation and analysis of its accuracy, appropriateness for your use, and any potential risks of using the information. The Water Environment Federation (WEF), author and the publisher of this article assume no liability of any kind with respect to the accuracy or completeness of the contents and specifically disclaim any implied warranties of merchantability or fitness of use for a particular purpose. Any references included are provided for informational purposes only and do not constitute endorsement of any sources.

The water sector is full of everyday heroes. At WEFTEC® 2018 in New Orleans the Opening General session keynote speaker will share his vision for increasing the ranks. Kevin Brown, a motivational speaker and author of the book, *The HERO Effect*, will share his ideas, strategies, and principles to inspire water professionals to recognize and embrace being the everyday heroes who show up and give their best when it matters the most.

In this Q&A, Brown shared aspects of his message as well as his hopes for what WEFTEC attendees will take away.

Q *Your speech during the Opening General Session will focus on The HERO Effect. Can you summarize for us what exactly you mean by The HERO Effect and how it differs from the conventional understanding of being a “hero”?*

A *The HERO Effect is a shift in the conventional way of thinking about heroes. Traditional thinking suggests that heroes are ordinary people who do extraordinary things.*

What I have discovered on this journey is that heroes and high performers are anything but ordinary. Ordinary is a learned behavior.

Think about this; if heroes are ordinary people doing extraordinary things then by default we give ourselves permission to be ordinary most of the time with only the occasional burst of extraordinary. *The HERO Effect* is about what happens when extraordinary people choose not to be ordinary.

The HERO Effect is comprised of four principles.

- Heroes help people with no strings attached. They go “all-in” every time they take the field. They understand that in business and in life it’s always personal and never perfect. Heroes create strong connections and reach beyond the borders of transactional thinking to create transformational moments!
- Heroes create an exceptional experience; the hero’s calling card is pure excellence. It’s about using their talents, gifts, and abilities to their fullest potential and highest purpose. The hero uses the best of who they are to serve more people, more often, in bigger and better ways. The hero is committed to personal development and shows up better today than they were yesterday. Heroes build trust by serving others with an authentic passion

that turns everyday moments into superhuman experiences. The hero is driven to serve others and understands that the greatest rewards in life are determined by how well we take care of the people we live and work with.

- Heroes take responsibility; heroes own the moments that matter. They are actively present and engaged and do not believe in random acts of kindness. The hero is motivated instead by intentional acts of difference making. They live by a simple code: “bring your best stuff to the present moment and pour it into the lives of others.” They understand that before you can lead anyone else, you must first be able to lead yourself. The hero owns their attitude, their actions, and their results. They are committed to the best possible outcome in every situation regardless of circumstances or events beyond their control. The hero leads by example and knows that true success is found in the power of simple choices.
- Heroes live and work with optimism; heroes see the world differently. For them, it’s not about positive thinking, it’s about perspective. Looking through the lens of optimism gives the hero supernatural vision. They see what others cannot. They see opportunities instead of obstacles — possibilities instead of problems. When things go wrong — and they will — optimism is what helps the hero turn life’s messes into a masterpiece.

Participants will learn how to achieve greater results by eliminating “ordinary” thinking and mastering the habit of excellence: how to own the moments that matter (and they all matter) by taking responsibility for their attitude, their actions and their results, and how to create meaningful relationships and deliver an extraordinary experience for every “customer” at work and at home.

Q *Why do you think it’s important for those involved in the water sector understand the hero effect? How can they apply it in their respective fields?*

A Because if they don’t bring their best when it matters the most, bad things happen. The communities and people they serve get hurt. Every living thing on the face of this earth depends on their ability to execute at a high level. To create, innovate, and find solutions to problems that impact our most precious and powerful resource.

How can they apply it? That’s a great question and I cannot wait to answer that during my keynote address. We are going to have a great time and I assure you I am unlike any speaker they have ever heard. I will deliver a life message with powerful business implications.

Kevin Brown is a motivational speaker and author of the book, The HERO Effect. He will deliver the keynote address for the Opening General Session at WEFTEC® 2018 in New Orleans on Oct. 1.



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- D&B Engineers and Architects, P.C.

Coffee Breaks

- Barton & Loguidice
- CDM Smith
- D&B Engineers and Architects, P.C.
- Environmental Design & Research, Landscape Architecture, Engineering and Environmental Services, DPC (EDR)
- Environmental Training Center at SUNY Morrisville
- GHD
- Greeley and Hansen
- Koester Associates
- National Water Main Cleaning Company

Operations Challenge

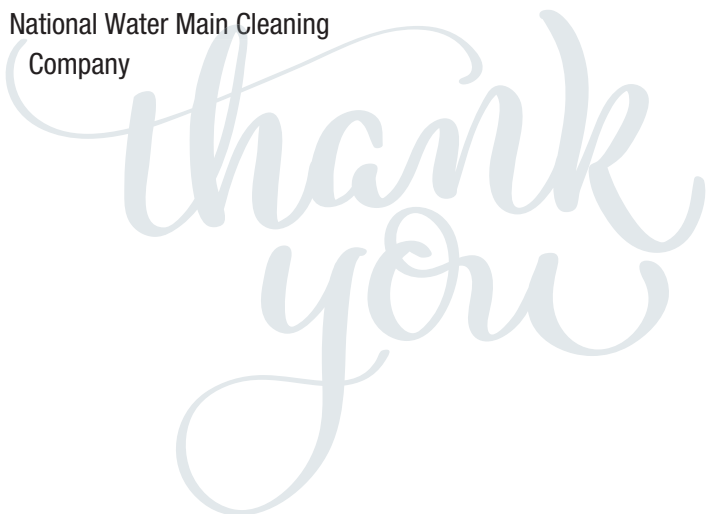
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Web Site Posting

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Signs

- GHD



Operator Quiz Test No. 120 – Operation Questions

The following questions are designed for trainees as they prepare to take the ABC wastewater operator test. It is also designed for existing operators to test their knowledge. Each issue of *Clear Waters* will have more questions from a different section of wastewater treatment. Good luck!

1. What is the name of the bacteria that converts nitrite to nitrate during the nitrification cycle?
 - a. Nitrobacter
 - b. Nitrosomonas
 - c. Nocardia
 - d. Thiobacillus
2. Determine the Total Suspended Solids given the following information:
Weight of crucible and filter – 22.2213 g
Weight of crucible, filter, and dry sample – 22.2310 g
Sample size – 5.0 mL
 - a. 9700 mg/L
 - b. 194.0 mg/L
 - c. 1940 mg/L
 - d. 4850 mg/L
3. What is the chemical formula for sulfuric acid?
 - a. H_2SO_4
 - b. HCl
 - c. HNO_3
 - d. NaOH
4. What would be considered a typical design detention time for a primary clarifier?
 - a. 4 hours
 - b. 30 minutes
 - c. 1.5 hours
 - d. 12 hours
5. The appearance of duckweed in a final clarifier is an indication of:
 - a. Nitrification
 - b. Denitrification
 - c. Low pH
 - d. Low dissolved oxygen
6. Anaerobic digesters should have a volatile acid to alkalinity ratio of:
 - a. 1:10
 - b. 1:2
 - c. 10:1
 - d. 2:1
7. Determine the detention time of a circular clarifier given the following information:
Diameter = 50 feet
Depth of clarifier = 10 feet
Flow = 2 MGD
 - a. 1.75 hours
 - b. 5.52 hours
 - c. 2.35 hours
 - d. 9.81 hours
8. Calculate the Chlorine Demand given the following information:
Feed rate = 150 lbs./day
Flow = 11.5 MGD
Chlorine residual = 0.5 mg/L
 - a. 1.06 mg/L
 - b. 1.56 mg/L
 - c. 2.06 mg/L
 - d. There is not enough information to determine the Chlorine Demand.
9. Calculate the Biochemical Oxygen Demand for the following:
Initial dissolved oxygen – 8.3 mg/L
Final dissolved oxygen – 5.4 mg/L
Initial sample temperature – 12°C
Sample size – 20 mL
 - a. BOD cannot be determined
 - b. 43.5 mg/L
 - c. 12.8 mg/L
 - d. 75.9 mg/L
10. A rotten egg smell in wastewater can most likely be attributed to:
 - a. Chlorine
 - b. Sulfur dioxide
 - c. Methane
 - d. Hydrogen sulfide

Answers on page 62.

For those who have questions concerning operator certification requirements and scheduling, please contact Tanya May Jennings at 315-422-7811 ext. 4, tmj@nywea.org, or visit www.nywea.org/OpCert.

Clear Waters

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Answers from page 61: 1A, 2C, 3A, 4C, 5A, 6A, 7A, 8A, 9B, 10D

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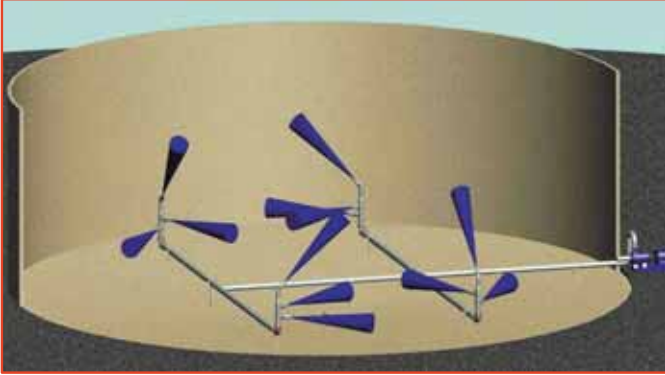


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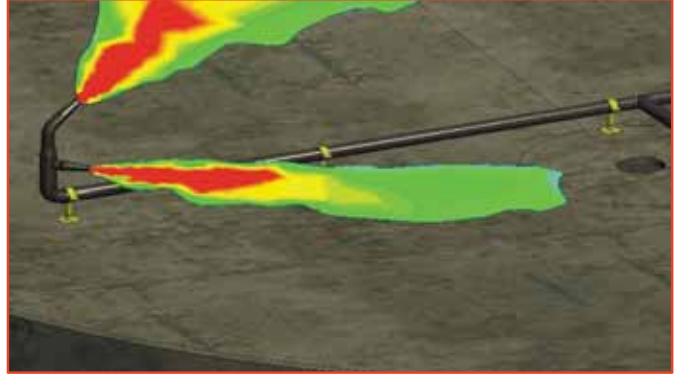
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