JOURNAL

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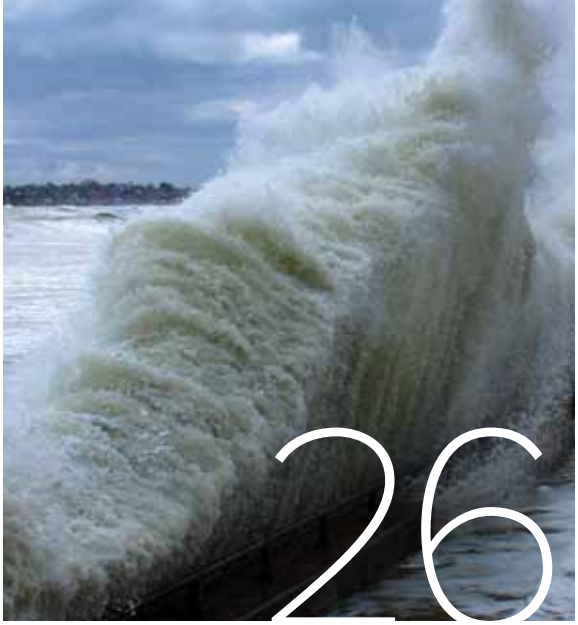

JOURNAL OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

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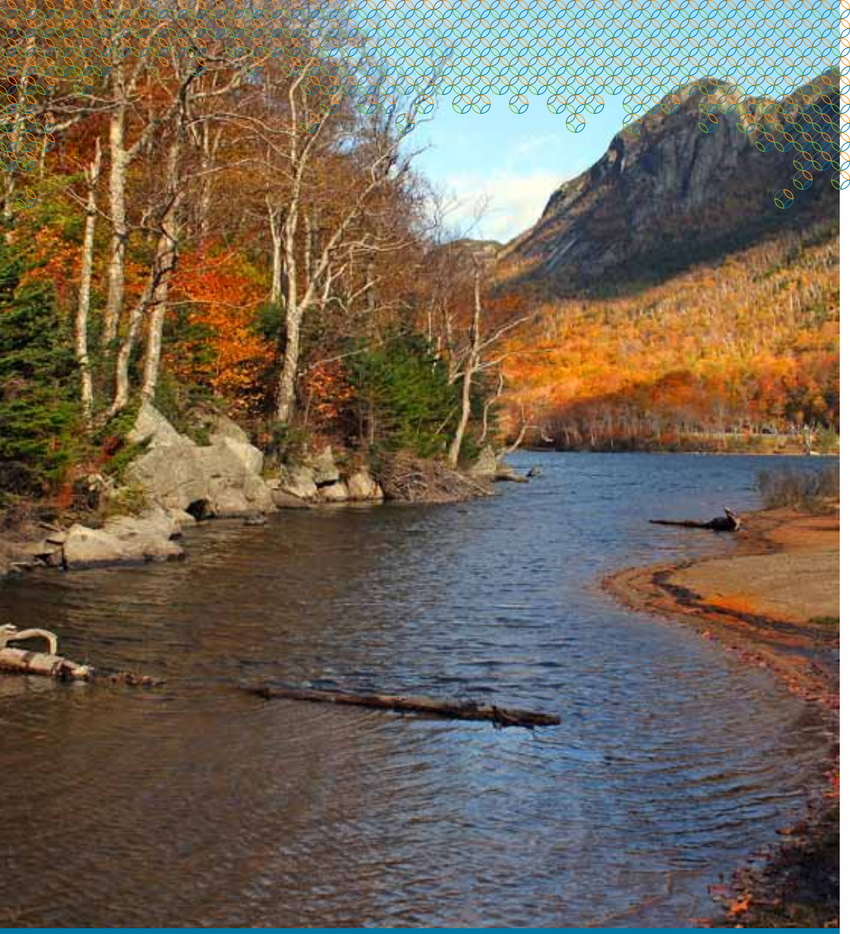
Contents

On the cover: The biosolids compost facility at the Fairfield, Connecticut Water Pollution Control Facility, one of the oldest continuously operating biosolids compost facilities in North America

Page 65: Measurement unit conversions and abbreviations



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OUR ASSOCIATION WAS ORGANIZED EIGHTY-NINE YEARS AGO in Hartford, Connecticut, on April 23, 1929, with the objectives of advancing the knowledge of design, construction, operation and management of waste treatment works and other water pollution control activities, and encouraging a friendly exchange of information and experience. From 40 charter members, the membership has steadily grown to more than 2,000 today. Membership is divided into the following classes:

Professional Member—shall be any individual involved or interested in water quality including any manager or other officer of a private waste treatment works; any person engaged in the design, construction, financing, operation or supervision of pollution control facilities, or in the sale or manufacture of waste treatment equipment.

Executive Member—shall be an upper level manager interested in water quality and who is interested in receiving an expanded suite of WEF products and services.

Corporate Member—shall be a sewerage board, department or commission; sanitary district; or other body, corporation or organization engaged in the design, consultation, operation or management of water quality systems.

Regulatory Member—this membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, Connecticut Department of Energy and Environmental Protection, Maine Department of Environmental Protection, Massachusetts Department of Environmental Protection, New Hampshire Department of Environmental Services, Vermont Department of Environmental Conservation, and Rhode Island Department of Environmental Management.

Academic Member—shall be an instructor or professor interested in subjects related to water quality.

Young Professional Member—shall be any individual with five or fewer years of experience in the water quality industry and who is less than 35 years of age.

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Student Member—shall be a student enrolled for a minimum of six credit hours in an accredited college or university.

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- Complete and mail the membership application form on pages 67–68
- Download a membership application from **newea.org** by clicking—*How Do I Join?*
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2018 RATES ($)

Professional	185
Executive	353
Corporate	411
Regulatory	50
Academic	181
Young Professional	69
PWO	109
Dual	40
Student	10

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Legitimate paid and/or requested distribution	Outside county paid/requested mail subscriptions	0	0
	In-county paid/ requested mail subscriptions	2,200	2,200
	Sales through dealers & carriers	8	8
	Requested copies distributed by other mail classes	0	0
Total paid and/or requested circulation		2,208	2,208
Total nonrequested distribution		0	0
Total distribution		2,208	2,008
Copies not distributed		292	492
Total		2,500	2,500
Percent paid and/or requested circulation		100	100

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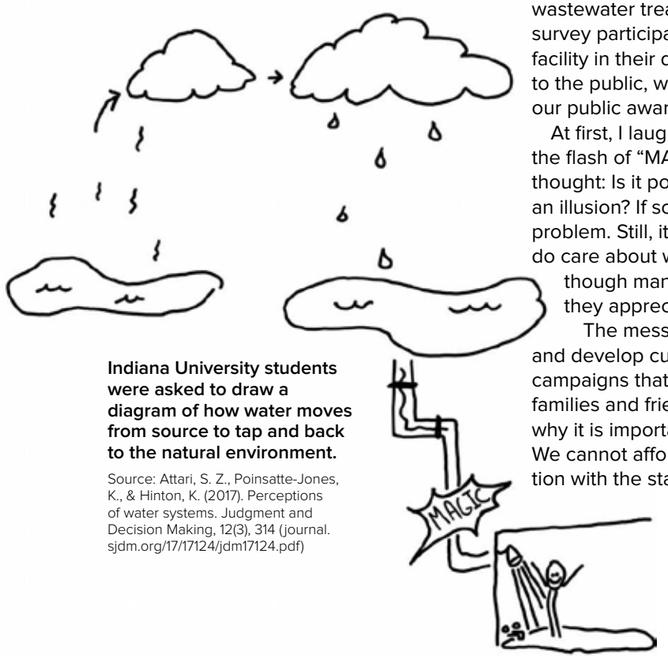
President's Message

You may have missed the news section of WEF's *Water, Environment & Technology (WET)* in September 2017. We wanted to share this with you, so the *Journal* Committee obtained permission to reprint a graphic that caught my eye. It was from an article about a survey by Indiana University (IU) Professor Shahzeen Attari and her research team. The team asked a survey group of 457 IU students to "draw a diagram of how water moves from source to tap and back to the natural environment."

Some drawings were elaborate and detailed. I imagine that the surprisingly few that were reasonably accurate had been drawn by students with a family member in—or with some other connection to—the clean water profession. While we would hope for university-level students to better understand the water cycle than was demonstrated by most of Professor Attari's polling, that unfortunately was not the case in this survey.

As if we needed more proof to reinforce what many of us have observed, the *WET* article concluded that the average customer "knows very little about the veiled inner workings of water and wastewater treatment." Sixty-four percent of Professor Attari's survey participants failed to include a water resource recovery facility in their drawing. If these survey results can be extrapolated to the public, we have another strong reminder that we surely have our public awareness work cut out for us.

At first, I laughed at the drawing (shown to the left) that included the flash of "MAGIC" in the water cycle. But then I had a second thought: Is it possible that people really do think that what we do is an illusion? If so, that could be a huge part of our public perception problem. Still, it is not all bad news, as it seems that people really do care about water quality and rebuilding our infrastructure—even though many people do not fathom how we do our "tricks," they appreciate the results of the "magic."



Indiana University students were asked to draw a diagram of how water moves from source to tap and back to the natural environment.

Source: Attari, S. Z., Poinsatte-Jones, K., & Hinton, K. (2017). Perceptions of water systems. Judgment and Decision Making, 12(3), 314 (journal.sjdm.org/17/17124/jdm17124.pdf)

The message is that we need to build on that concern and develop customer knowledge through public awareness campaigns that can be as simple as each one of us talking to our families and friends (our most "local" public) about what we do, why it is important, and what we can do better with public support. We cannot afford to rest on our meager laurels of public satisfaction with the status quo and let people take water for granted. If each NEWEA member can carry the message of the important work we do forward to inform and win over even one person in the public arena, we can make a huge collective difference.

I would like to share with you how the light bulb went on for me. It started with one of my daughter Billie's college essays, which she did not want me to read (and which she would be mortified to know that I am sharing in this article). In her essay, she related a vivid grammar school memory of a parents' career day, a day about which she had been apparently nervous because I had volunteered to speak:

"In the front of the classroom stood my mother, tall and proud, as she revealed her renowned position as the head of the city's wastewater treatment plant, but we all knew what that title really meant. My classmates hid their giggles and smiles behind their hands as they listened to my mother speak about the wonders of the sewer system."

To my surprise, based on her essay, she had only muted respect for my career—my own daughter! I never suspected. I had always insisted that I had a very important, very cool job. And then there was the Flood of 2010 in Rhode Island. After going through that experience with me, she conceded:

"Despite the fact that the flood showed the huge economic importance of my mother's career, other people did not see this significance."

Epiphany! She finally got it! I no longer embarrassed her (at least not with my career choice).

In fact, the 2010 flood brought home to many people their appreciation of the value of clean water, at least until things got back to normal. For the freshness of that appreciation to fade with time is human nature no doubt, but that is why we need to keep these issues on the front burner and take advantage of "teaching moments" such as the 2010 flood and the Flint, Michigan debacle. I like to re-read my daughter's essay from time to time to remind myself why I do what I do. It is not magic but in the perception of many, it might as well be. It is time for us as a community to open the magical black box and display for all the world just how our magic works.

By far, the biggest professional community event in this past quarter of my term as NEWEA president was the June Spring Meeting in Newport, Rhode Island. As president, it was my turn to play a major role in making it a success. It was a great honor to introduce Senator Sheldon Whitehouse as our keynote speaker. After some enlightening comments, he showed an eye-opening video about the impacts of climate change on Rhode Island (youtube.com/watch?v=3Cys8HG6uG8). NEWEA members in attendance asked a number of thoughtful questions, which the senator answered cogently and with much humor. One person asked, "How do you suggest that one can talk to friends and neighbors around the dinner table about climate change?" In his answer, the senator urged us above all to "make it local."

Speaking of making it local, having the spring meeting in my home state was awesome. But something even more awesome was the Ocean State Alliance team from Rhode Island winning the Operations Challenge competition! Also appreciated was the Program Committee's session covering important local issues and solutions. Perhaps most awesome of all was the Young Professionals Committee's community service project on Saturday, where they built a stormwater retention rain garden at a coastal community center, an effective, tangible example of local public exposure and involvement.

During the Sunday Executive Committee (EC) meeting in Newport, the EC voted to approve a new public relations/communication position to be filled as soon as possible. We may even have someone on board by the time you read this. Things will start happening with this new hire, our re-energized Website Committee, and our increased involvement with the New England Water Innovation Network. Please watch for the changes we expect (we are hoping to help blow the cover right off that magic black box), and give us your honest feedback on the direction we are moving.

With this momentum, NEWEA (and that includes all of you who are or who may become members) is ready to rise to the next level, emphasizing public relations and encouraging everyone to carry our message of involvement and progress into the center of the public forum. We're hoping this is a tipping point, a watershed moment you might say. The EC is going all in! I am all in!

At the risk of some further embarrassment to my family, I will persist in talking to people I meet about what I do for a living. I have struck up conversations at bars, in doctor's office waiting rooms, at the airport, and on the beach. I have stepped forward to speak in classrooms. (it is easy, check out the resources at newea.org/resources/publiceducation.) I find that people *are* interested and *do* care and *will* change their behaviors once they understand that what happens downstream is a result of much planning and hard work—and if this extra effort is what it takes to spread the word about our magical success, then repeat after me—Abracadabra!

I hope you all stand tall and proud for your role in the water cycle, and that you share it with your local public—family, friends, and interested strangers alike. Please raise your hand and your voice, and let us turn those survey numbers around. Water's Worth It—let's go all in!

COMMUNITY SERVICE PROJECT
HELP: Eastern Rhode Island Conservation District
THANKS: YPs
WOW: The entire community coming out to build an 800 ft² (74 m²) rain garden to collect 50 percent of the stormwater runoff from the Common Fence Point Community Center in Portsmouth, Rhode Island

From the Editor

Joe Boccadoro, PE, Associate Vice President, AECOM

As many of our readers know, the *Journal* focused on disciplines or sectors of the water industry this year. In the spring and summer editions, we featured operators and engineers, respectively. This upcoming winter, we are excited to highlight young professionals. In this fall issue we are pleased to put the spotlight on the public works/municipal sector.

Journal themes & submission deadlines
Winter 2018—**Young Professionals** (September 28, 2018)
Spring 2019—**Stormwater** (December 28, 2018)
Summer 2019—**Wastewater Treatment** (March 29, 2019)
Fall 2019—**Collection Systems** (June 28, 2019)
Winter 2019—**Safety** (September 27, 2019)

When recognizing achievements and day-to-day importance, public works could be the most overlooked sector of municipal government. This sector keeps our roads, buildings, and open spaces in top condition, and from our water industry perspective, nearly always keeps essential sewer, drainage, and water systems in operation. When is the last time you can recall nothing coming from the tap when you turned on the water or the sewer in the street not doing its job? So, we tip our cap to public works professionals. Thank you for what you do and have been doing for quite some time. Read on for a little history of when the first public works agencies might have been formed, perhaps more than 100 hundred years ago.

As mentioned above, this sector of our industry is often overlooked and that shows somewhat in the research. If one would like to know when the first municipal public works departments were formed in New England and their focus, internet searches uncover spotty information, at least from my experience. A lot of data turns up nationwide—formation of the Army Corps of Engineers in 1775, organizations that built massive canal and aqueduct projects in the 1800s, and federal Public Works and Works Progress Administration agencies from the 1930s. But research uncovers little about local departments of public work and when they were formed. This is not to say there is nothing on the internet—hundreds of municipalities and agencies describe what they do on their websites and some include a history of their organizations; however, little information seems available on the collective history. Common sense tells us that 1) public need called for installation of infrastructure, 2) systems were built, and 3) departments were formed to run them. My starting point was searching for historical water projects in New England, focusing mostly on Boston, and trying to piece together the period when organizations could have been formed to operate and maintain them.

This is speculative (and maybe a little biased!), but I believe the first public organizations operated water and sewer systems, and then grew to encompass other traditional aspects of these departments such as roads, solid waste, etc. Desire for clean water sources in the 1700s and 1800s led to privatized source and distribution networks throughout New England.[1] As population increased it undoubtedly became too daunting for private interests to provide water to a large user base. In 1848, serving the city of Boston, Lake Cochituate and the Cochituate aqueduct became one of the first publically funded water supply and distribution networks.[1] In response to the ever-growing population in the decades that followed, additional water supply projects were completed; however, these still could not keep up with the demand, so the city formed the Metropolitan Water District in 1895. So, it seems one of the first public departments must have been formed in the mid-1850s to operate and maintain the water supply systems developed in that era, followed by the aforementioned water district in 1895.

During this time of expanded water supply and distribution, not much was known about disease and good sanitation practice. Health problems proliferated. Disposal of wastewater was local (privy, outhouse), until private pipes originally carrying water away from basements and low-lying areas in Boston, a practice that had been in place since the 1700s,[2] were used in the 1830s to dispose of untreated wastewater to a nearby stream or surface waters. An anecdote to the times was the city encouraging the addition of rain water from roof leaders to flush the system[2] of sanitary waste, a nod to the belief that "the solution to pollution is dilution." This flushing did not solve widespread health problems stemming from such wastewater disposal practices and prompted Boston to commission a study that led to the Boston main drainage system,[2] completed in 1884 under the supervision of a special committee.[2] The system consisted of 25 mi (40 km) of sewers, a pumping station, a tunnel, and an outfall to Moon Island. The committee formed in the late 1800s to oversee construction of the BMDS could be viewed as a forerunner to the public works agencies of today.

One can conclude from this brief historical perspective that public works agencies have been around since the mid- to late 1800s to further the work initiated by private concerns when health issues and public demand called for large-scale water and sewer infrastructure projects. Though Boston was the focus of the research, the formation of such entities during this time could apply to many other New England regions. Such entities were needed to operate and maintain water and sewer systems and to expand them to other geographical areas of need. Over time, separate water and sewer departments were combined into one public works function, along with other traditional areas such as roads, solid waste, buildings, parks, open spaces, etc. It seems to have all started with the water industry, a point of pride for everyone in our association. With such a rich background, we can only hope that municipalities appreciate the contributions of public works professionals in the same way they recognize public safety and education as vital parts of government.

As noted above, we will feature young professionals in the 2018 winter edition of the *Journal*. In 2019, we will return to a traditional theme-based approach.

1. Marcis Kempe, "New England Water Supplies—A Brief History," *Journal of the New England Waterworks Association* (Sept. 2006)
2. bwsc.org/aboutbwsc/systems/sewer/sewer history

LETTER TO THE EDITOR
Correction to the Spring 2018 *Journal*—Operations Challenge history timeline
In 1995 the New Hampshire (New England) Synergetics received 3rd place at the National competition in Florida.
– Sharon Surra
(formerly Ostrander) former Synergetic

Industry News

EPA Plans to Award up to $9.3 Million in Beach Water Quality Monitoring Grants

– EPA Press Office

As peak beach season proceeded in the United States, EPA began fulfilling its plans to award up to $9.3 million in 39 states, territories, and tribes to develop and implement beach monitoring and notification programs.

Under the Beaches Environmental Assessment and Coastal Health (BEACH) Act, EPA awards grants to eligible state, territorial, and tribal applicants to help them and their local government partners monitor water quality at coastal and Great Lakes beaches. When bacteria levels are too high for safe swimming, these agencies notify the public by posting beach warnings or closing the beach. Since 2002, state and local governments, territories, and tribes have used more than $157 million in EPA BEACH Act grants to monitor beaches for fecal indicator bacteria, maintain and operate public notification systems, identify local pollution sources, and report results of monitoring and notification activities to EPA. Grant funding under the BEACH Act is part of a broader EPA effort to find and eliminate sources of water pollution that contribute to beach closures.

EPA's 2018 BEACH Act grant funding, contingent upon meeting the eligibility requirements, will be allocated to the following states, territories, and tribes:

- Connecticut $211,500
- Maine $240,500
- Massachusetts $240,500
- New Hampshire $192,000
- Rhode Island $201,500

For specific information on grants under the BEACH Act, grant guidance, and contact information for state and local beach programs, see epa.gov/beach-tech/beach-grants.

Connecticut Company to Help Protect Thames River Under Settlement with EPA

– John Senn, EPA Press Office

EPA New England settled with Electric Boat Corporation to resolve alleged violations of the Clean Water Act (CWA) at the company's Groton, Connecticut submarine assembly facility. Under the settlement, Electric Boat must perform specific facility improvements to promote its compliance with EPA stormwater management requirements. The company will also pay a civil penalty of $60,000 as part of the settlement.

"This settlement significantly reduces stormwater pollution from Electric Boat's facility in Groton, which means a cleaner Thames River," said EPA New England Regional Administrator Alexandra Dunn. "Stormwater is a major source of water pollution in New England, and EPA is committed to working with companies such as Electric Boat to improve compliance."

Under the settlement, Electric Boat will install heavy metal filters on a number of storm drains, outfit outdoor waste accumulation containers with covers, and improve stormwater management training for shipyard trades. These measures will reduce pollution that can be picked up by stormwater and improve Electric Boat's compliance with its CWA stormwater discharge permit.

After EPA informed Electric Boat of the alleged violations, the company responded promptly to EPA's concerns and worked to resolve the claims.

During an April 2017 inspection, EPA found that Electric Boat had allegedly violated provisions of its CWA permit for stormwater discharges by failing to adequately implement best management practices to minimize the impacts of stormwater discharges on the Thames River. In addition, EPA inspectors observed that an Electric Boat employee had dumped used fiberglass resin into a storm drain.

Stormwater is the leading cause of impairment of the region's rivers, lakes, and streams. Stormwater runoff is generated from rain and snowmelt events that flow over land or impervious surfaces, such as paved streets, parking lots, and building rooftops, and does not soak into the ground. The runoff picks up pollutants like trash, chemicals, oils, metals, dirt, and sediment that can harm our rivers, streams, lakes, and coastal waters.

For more information on EPA's work to address stormwater pollution, go to epa.gov/npdes/npdes-stormwater-program.

Annual Report Card Shows Water Quality Improvements in Mystic River Watershed

– Emily Bender, EPA Press Office

EPA, in collaboration with the Mystic River Watershed Association (MyRWA), announced its annual Water Quality Report Card on the Mystic River watershed for 2017. For the fourth year in a row, water quality monitoring data show that bacterial contamination in the main stem of the Mystic River, including the Upper and Lower Mystic Lakes, is regularly very low and meets water quality standards nearly all of the time, especially in dry weather.

"We are happy to see some improvement in certain segments of the river, indicating the work we are doing is making progress," said Ms. Dunn, EPA regional administrator. "There is still work to be done to improve water quality in the tributary streams, and we look forward to working closely with our partners on those efforts."

"We are pleased to celebrate an *A*- water quality grade for the Mystic River. The Mystic meets standards for boating safety more than 98 percent of the time in dry weather, which doesn't mean that all of the work is done," said MyRWA Executive Director Patrick Herron. "EPA's system for appraising water quality stream-by-stream gives us confidence that we can document positive changes over time in areas that aren't doing as well. We look forward to celebrating the municipal investments and continued stream and lake improvements over the next several years."

The report card shows improvement in some segments of the watershed in 2017, indicating that work to reduce bacterial contamination may be starting to show positive changes. Since 2015, EPA has used an enhanced, locally specific analysis of water quality in the watershed that gives grades for 14 river segments, including ponds and tributary streams.

While no single "overall" grade is generated for the Mystic River watershed, the data show that the main stem of the river is often safe for swimming and boating; however, bacterial levels in many of the tributary streams feeding the Mystic are high, and these areas often do not meet water quality standards. In 2017, some of these problem streams showed signs of improvement, including Belle Isle Inlet in Revere/East Boston, Meetinghouse Brook in Medford, and Mill Brook in Arlington.

More work remains. On July 1, 2018, the EPA and MassDEP updated Municipal Separate Storm Sewer (MS4) permit for Massachusetts became effective, and all Mystic River watershed communities will have to improve their stormwater management, helping further reduce pollution.

Grading methodology

The report card grades issued annually for the Mystic River by EPA are based on the level of bacterial contamination in samples collected by MyRWA volunteers over the past year at 15 monitoring sites throughout the watershed, as well as data collected at numerous locations by MWRA. The grades are calculated using a three-year rolling average, allowing for a more complete and accurate assessment of recent water quality that addresses weather variability from year to year.

Mystic River Watershed Water Quality Grades and Compliance Rates—Calendar Year 2017

Grade	Water Segment	Avg. score*
A+	Upper Mystic Lake	98.6%
A	Chelsea Creek	94.6%
A-	Mystic River (salt water)	88.3%
A-	Mystic River (fresh water)	87.6%
A-	Belle Isle Inlet	89.3%
B	Meetinghouse Brook	78.4%
C	Malden River	63.7%
C-	Aberjona River	59.4%
C-	Mill Brook	55.1%
D+	Little River	54.2%
D+	Alewife Brook	53.8%
D-	Island End River	42.5%
F	Winn's Brook	38.4%
F	Mill Creek	31.3%

*Average meeting Massachusetts water quality standards for boating and swimming

For the past several years, EPA, in partnership with MassDEP, has actively enforced finding bacteria "hot-spots" in the Mystic River and tracking down the sources of that pollution. Through innovative approaches to field testing methods, EPA has found and fixed illegal connections and prevented more than 42,000 gpd (160,000 L/d) of sewage from entering the Mystic River watershed.

More work is scheduled for these tributaries. Many communities are investigating their discharges and repairing sanitary and storm sewer systems, preventing tens of thousands of gallons more of sewage from discharging to the river during rain events.

In addition to bacterial contamination, the Mystic River watershed also suffers from excess nutrients, primarily phosphorus, entering the river from stormwater. EPA, MassDEP, MyRWA, and several other agencies are completing a two-year study that will help determine how much phosphorus must be reduced to meet water quality standards and the most cost-effective means of achieving those reductions.

In support of that effort, EPA has deployed a water monitoring buoy in front of the Blessing of the Bay Boathouse in Somerville that can measure, in real-time, numerous water quality parameters, including temperature, dissolved oxygen, pH, turbidity, conductance, and chlorophyll, and that helps the agency track cyanobacteria (blue–green algae) blooms. Data from this buoy—and from the water quality sampling program on the Mystic River that led to the grades in this report card—can be found at epa.gov/mysticriver.

Charles River Water Quality Improvements Earn an *A*- for the Second Time in Five Years

– Emily Bender , EPA Press Office

EPA has given the Charles River a grade of *A*- for bacterial water quality in the river during 2017. This is only the second time the river has earned a grade as high as this, and both have occurred within the past five years.

"The Charles River turnaround is a perfect example of what strong partnerships with states, municipalities, and non-profit organizations can achieve," said Ms. Dunn, EPA New England regional administrator. "EPA continues to work hard at improving water quality in the Charles River by tackling pollution sources by detecting illicit discharges and our work on combined sewer overflows. EPA is also protecting this great resource with stormwater permits that address the problem of nutrient pollution."

The EPA grade for water quality in the lower Charles River is based on bacterial sampling conducted by the Charles River Watershed Association (CRWA) throughout 2017. CRWA collects monthly water quality samples at 10 monitoring sites from the Watertown Dam to Boston Harbor. In 2017, the Charles River was meeting the state's bacterial water quality standards for boating 95 percent of the time and for swimming 72 percent of the time. This is the 23rd year EPA has issued a Charles River report card.

The Charles River grade is determined by comparing the amount of time the river meets water quality standards to the following criteria:

A – Almost always met standards for boating and swimming
B – Met standards for almost all boating and some swimming
C – Met standards for some boating and some swimming
D – Met standards for some boating but no swimming
F – Did not meet standards for boating or swimming

The lower Charles River has improved dramatically from the launch of EPA's Charles River Initiative in 1995, when the river received a *D* for meeting boating standards only 39 percent of the time and swimming standards just 19 percent of the time. The water quality improvements are due to significant reductions in combined sewer overflow (CSO) discharges to the river over the past 24 years, as well as enforcement of water quality standards and removal of illicit discharges. Illicit discharges often consist of cracked and leaking sewer pipes or improper sewer connections to the storm drain system.

The higher grade for 2017 was measured despite most sample events occurring during or soon after wet weather, when many pollutants are washed into area streams and storm drains, as well as directly into the river.

Use of the Charles River continued to expand in 2017, with 140 swimmers competing in the Charles River Swim, a competitive 1 mi (1.6 km) race held in June, in addition to continued advocacy for a permanent swimming area near the entrance to the Charles River at North Point Park. Last July, nearly 300 swimmers took part in City Swim off the Esplanade docks.

In addition to illicit discharges, stormwater containing phosphorus and the algae it produces are some of the major pollution problems remaining. A major load of phosphorus comes from fertilizer and runoff from impervious surfaces such as roads and rooftops. Citizens have been the driving force behind the Charles River Initiative, and they can continue to help improve water quality in the river while monitoring progress themselves. For more information see:

- EPA's efforts to improve water quality in the Charles River (epa.gov/charlesriver)
- Real-time water quality monitoring of the Charles River (epa.gov/charlesriver/live-water-quality-data-lower-charles-river)

Water Workforce Development Report*

– Katherine Saltzman, WEF publications assistant

Researchers at the Brookings Institute (Washington, D.C.), a bipartisan policy think tank, published a report focusing on establishing robust water workforce development programs to accommodate today's water infrastructure needs.

From wef hq
Leading-edge updates from the Water Environment Federation

The report, *Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity* addresses the unique employment opportunities available to the American worker in water sector jobs and the simultaneous high and urgent demand for these employees across the United States.

The report highlights the diverse opportunities and employment options in the water sector. In 2016, the water sector included 212 different occupations ranging from operators and construction workers to administrative and managerial roles. Employees in water occupations, on average, earn higher wages compared to all workers nationally; water employees may earn up to 50 percent more compared to workers at lower ends of the income scale. In the 10th and 25th income percentile, water workers earn hourly wages of $14.01 and $17.67, respectively, "compared to the hourly wages of $9.27 and $11.60 earned by all workers at these percentiles across the country," according to the Brookings report.

As income inequality in the U.S. continues to rise—especially between populations with university degrees and those without, researchers note—the water sector can offer good-paying jobs. Water sector jobs require rigorous hands-on-training and application of science, technology, engineering, and mathematics (STEM) skills and project management; this flexibility offers sustainable incomes for individuals with otherwise limited formal education.

Finding the right fit

Despite the long-term economic and educational opportunities available in the water sector, there are obstacles with finding and retaining talent. In 2016, research showed that employees in water occupations are significantly older than the national median (42.2 years), including water treatment operators (46.4 years old), the report says. Utilities and municipalities across the country are concerned about high retirement rates and limited pools of trained candidates to enter the water sector.

Water utility leaders, municipalities, and associations are finding innovative ways to engage and attract young people to opportunities available in the water sector.

Pipeline to the water sector

Researchers found the water sector lacks the public visibility needed to attract individuals to the water workforce. Despite lower education barriers and stable, good-paying jobs, there are not enough people pursuing water jobs or gaining the necessary skills or training to obtain careers in the water sector.

According to researchers, though internships or apprenticeships are being used to recruit younger and more diverse employees, these programs may be limited by budget shortages and/or the need to retrain students in basic math, science, and English skills, which are not necessarily taught in high school. Important to note is that inadequate newcomers to the water sector also may be part of a "general shift away from the skilled trades and vocational education among students, which is compounded by the many existing water workers nearing or eligible for retirement," according to the Brookings report.

Based on communication with utility managers and other stakeholders, researchers recommended a more collaborative effort among utilities, municipalities, government agencies, and policymakers to invest in and prioritize water workforce development programs to enhance the visibility and attractiveness of the sector. Plans to increase water workforce outreach programs include hiring and training diverse mentors. These mentors can connect with younger individuals, revitalize the recruiting process, and serve as a long-term guidance counselors for students in water-related internship or fellowships programs.

Other ideas include acquiring funding from federal and state policymakers to establish "bridge programs" and educational initiatives to provide opportunities for younger workers or adult students to explore water careers and gain experience.

Retention and long-term employees

There are financial and programmatic obstacles to developing workforce programs when water utilities also must finance infrastructure repair and investment. Utilities also face budget cutbacks and need to remain conscious of ratepayers' bills. In these cases, utilities may prioritize infrastructure improvements rather than workforce development programs. Though infrastructure investment is critical to maintaining water quality, limited funding for workforce development can lead to shortcomings in career advancement and earnings for water sector employees.

Some smaller utilities, for example, may have one or two employees with no supervisory role. In this situation, workers who have held the same role at a utility for several decades, may seek other opportunities at a larger utility or consulting group. Meanwhile, trends indicate that younger workers prefer opportunities to diversify and have mobility in their careers. This leaves a significant gap in skilled workers available to run the critical daily operations at the utility.

"To have a team manage the water infrastructure, in water emergencies but also day-to-day operations is really vital," said Keisha Powell, commissioner of the Department of Watershed Management for the city of Atlanta, at a panel discussion following the release of the Brookings report. "We have reached 130 water main breaks in the month of January and are facing a 55 percent eligibility retirement rate. Further, it is difficult to recruit young talent."

Researchers and stakeholders concluded that by increasing training for supervisory roles, developing income tiers for more experienced employees, and creating more established career paths, utilities could better retain skilled employees and create workforce advancement opportunities in the water sector.

Programs related to workforce development and training

Several utilities, national agencies, municipalities, and non-profit organizations are taking on the task to provide tools and programing to enhance recruitment and training.

National Green Infrastructure Certification Program (NGICP). This spring, WEF, in collaboration with DC Water, launched the NGICP. This program is a national certification standard for green infrastructure construction, inspection, and maintenance employees. To earn the certification, students with a high school degree must complete 35 hours of course material and pass an exam. NGICP supports the development of proficient green workforces, and establishes a career path for skilled green infrastructure workers.

PowerCorpsPHL. This 2013 initiative by the city of Philadelphia Americorps engages at-risk young adults and returning, formerly incarcerated citizens to enroll full-time in the program and work to support Philadelphia's environmental stewardship, youth violence prevention, and workforce development priorities. PowerCorpsPHL student crews work with the Philadelphia Parks and Recreation Department as well as the Philadelphia Water Department to improve stormwater management and revitalize public lands and parks. Students spend five months working and one month dedicated to career training. Students also can apply to a fellowship program that matches them with an external partner to gain additional environmental career experiences.

Bay Work. In 2008, amid concerns in the San Francisco Bay area regarding lack of water workforce development programs at local utilities, several water and wastewater utilities collaborated to develop Bay Work. This program's mission is to "develop and implement programs and strategies that support development of high-performance workforces." Bay Work's resources are open to all bay-area water and wastewater utilities. The program also provides opportunities for utilities to share research, ideas, and programs and concerns related to workforce issues. Bay Work also provides extensive job and internship listings and training schedules for those interested in the water sector.

These initiatives are some examples of the workforce development training necessary to bring public visibility to the water sector and green infrastructure jobs while also offering critical preparation and training for diverse and skilled individuals to enter and find long-term careers in the water workforce.

Five Star Urban Waters Grants Awarded for Projects in Maine, Massachusetts, and Connecticut

– David Deegan, EPA Press Office

The National Fish and Wildlife Foundation (NFWF) and EPA announced grant funding to help three New England-based organizations implement water quality or environmental improvement projects: **1. Passamaquoddy Tribe—Pleasant Point**, Pleasant Point, Maine; **2. the Lowell Parks & Conservation Trust, Inc.**, Lowell, Massachusetts; and **3. Earthplace—The Nature Discovery Center, Inc.**, Westport, Connecticut. The three New England grants are among 59 Five Star and Urban Waters Restoration Program grants awarded nationally, totaling $2.2 million to restore wildlife habitat and urban waters in 30 states and Washington, D.C. Grantees have committed an additional $5.2 million in local project support, generating a total conservation impact of more than $7.4 million.

The Lowell Parks & Conservation Trust will engage youth and adults through educational programs and a volunteer stewardship and monitoring program to improve habitat and restore anadromous fish to the Sudbury–Assabet–Concord River watershed. The project will include five resource management partners, seven additional partners, 75 volunteers, and 12 schools, engaging more than 2,000 diverse community members to provide 250 fish monitoring observations and restore 3 ac (1.2 ha) and 1,000 lf (305 lm) of riverbank abutting the Concord River Greenway and Centennial Island Fish Ladder.

Earthplace—The Nature Discovery Center, Inc. will conduct water quality monitoring in Rippowam River, Norwalk River, and Bruce Brook to identify sources of sewage pollution. These watersheds are on the Connecticut Impaired Waters List due to elevated bacteria concentrations, low dissolved oxygen levels, or other issues. These impairments indicate pollutants in these urban watersheds must be reduced. Monitoring will take place 10 times between May and September 2018 on each river. Data collected at each site will include dissolved oxygen, conductivity, water temperature, fecal coliform, and E. coli. Track-down work will be conducted to identify sources of pollution such as leaking sewer laterals, broken sanitary lines, or leaching septic systems. This project will create a dataset of water quality conditions where limited information currently exists, reduce bacteria and nutrient inputs to Long Island Sound tributaries, and, as a result, reduce beach and shellfish bed closures.

"Water quality in Connecticut is threatened by both point and non-point sources of sewage pollution, which harms both people and the environment. With support from the NFWF's Five Star and Urban Waters Restoration Program, we will work with our partners to locate and mitigate sources of sewage in three local waterways that discharge into Long Island Sound adjacent to local bathing beaches and shellfish beds. The human health and environmental benefits of this work will be substantial, and we are so grateful for this support," said Dr. Sarah Crosby, Director of Harbor Watch.

The Passamaquoddy Tribe and partners propose to repair two fish ladders in the Pennamaquan River in Pembroke, Maine, that are inhibiting fish passage into the Pennamaquan River watershed. These ladders are in such poor condition that only 25 percent of the alewife and blueback herring returning to the river can reach their spawning grounds. Both species, collectively known as river herring, have been National Oceanic and Atmospheric Administration (NOAA) designated as "Species of Concern." Current river herring production in the Pennamaquan River is one quarter of sustainable capacity. Returning the ladders to a serviceable condition will triple the river herring population. River herring transport nutrients between the freshwater and marine environments and are an important prey species. A population increase of this size will boost the bio-productivity of the watershed and the Gulf of Maine. The restored population will also produce multiple economic and cultural benefits to the Tribe, the town of Pembroke, and the local community.

"The Sipayik Environmental Department is pleased to be a part of the NFWF award to continue working on a connected ecosystem that enhances biodiversity of aquatic native species. It is the goal of the department to once again see sea-run alewives and other sea-run fish species run in the millions with improved fish passages. The fish passages are in need of improvements and are vital points of access for sea-run fish that need to reproduce in the fresh water system that the dams contain. The project will allow the department to get close to its goal of seeing a more vibrant and productive Gulf of Maine," said Marvin Cling Sr., environmental planner/director of the Sipayik Environmental Department of the Passamaquoddy Tribe—Pleasant Point Reservation.

These grants are awarded through the NFWF's Five Star and Urban Waters Restoration Program, which support projects that develop community stewardship of natural resources and address water quality issues in priority watersheds across the country. Support for the 2018 Five Star and Urban Waters Restoration Program is provided by the Wildlife Habitat Council, and major funding by EPA, U.S. Forest Service, U.S. Fish and Wildlife Service, FedEx, Shell Oil Company, Southern Company, and BNSF Railway.

"The Five Star and Urban Waters Restoration Program generates measurable results for wildlife and communities across the nation," said Jeff Trandahl, executive director and CEO of NFWF. "The 59 grants announced today will help communities improve water quality and support wildlife through a variety of conservation efforts, from the removal of invasive species and planting of native vegetation to the reduction of stormwater runoff and creation of wetlands."

More information

- The 2018 grant winners were selected from a highly competitive pool of more than 250 applications. A list of 2018 projects is available at nfwf.org/fivestar/Documents/2018grantslate.pdf.
- Since 1999, the Five Star and Urban Waters Restoration Program has supported more than 945 projects, with more than $11.9 million in federal funds, $10.6 million in private and corporate contributions, and $74.7 million in matching local funds.
- EPA information on the Five Star and Urban Waters Restoration Grant program: epa.gov/urbanwaterspartners/five-star-and-urban-waters-restoration-grant-program-2018

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FEATURE

The last one standing—Fairfield, Connecticut's compost facility

WILLIAM NORTON, Town of Fairfield, Connecticut
JOSEPH MICHELANGELO, PE, Town of Fairfield, Connecticut
JOHN BODIE, Town of Fairfield, Connecticut

ABSTRACT | The town of Fairfield, Connecticut, has a composting facility for its biosolids reduction and disposal. The town uses wood-chipped material, collected within the town, to mix with its dewatered, anaerobically digested sludge. This saves the town a significant amount of money compared to hauling either liquid or dewatered biosolids to another facility either within or outside Connecticut for final disposal. The final composted material then serves as a small revenue generator, as it is sold as a soil amendment for ball fields, landscaping material, and crops not directly consumed by humans.

KEYWORDS | Composting facility, compost, agitated bay composting, biosolids composting, biosolids

The town of Fairfield is 50 mi (80 km) north of New York City on the shore of Long Island Sound in Fairfield County, Connecticut. It is located between the cities of Bridgeport and Stamford, and has a population of 59,000. The Fairfield Water Pollution Control Authority owns and operates an extensive wastewater collection system, eight pump stations, and an advanced water pollution control facility (WPCF) that handles wastewater from Fairfield's sanitary sewer service area. The WPCF has a design annual average flow rate of 9 mgd (34 ML/d) and a peak flow rate of 24 mgd (91 ML/d), processing an annual average flow of 8.64 mgd (32.7 ML/d) with peaks of 33 mgd (125 ML/d), or the maximum flow capable of being recorded at the effluent flow meter.

The Fairfield WPCF is an advanced secondary treatment facility that has stringent discharge limitations for total nitrogen. The treatment process consists of mechanical screening, grit removal, influent pumping, primary sedimentation, aeration tanks, nitrification/denitrification, final sedimentation, and ultraviolet (UV) disinfection. Biosolids are anaerobically digested, dewatered, and composted on site. Photo 1 shows an aerial view of the treatment facility.

The WPCF was originally constructed in 1950 to provide secondary treatment for collected sewage flows from the town, with treated effluent discharged to Long Island Sound. The plant was expanded in 1968 and 1972 to meet the needs of a growing town and expansion of the sewer collection system. Additions in 1980 improved biosolids dewatering and in 1988, a composting facility for beneficial reuse of plant biosolids was added. Modifications to the plant's aeration system and Zone A aeration tankage followed in 1996 to allow the plant to achieve partial nitrogen removal. The most recent WPCF upgrade was completed in 2002; this upgrade involved most of the wastewater and biosolids processing facilities, including addition of aeration tankage (Zone B), new final settling tanks, UV disinfection, effluent pumping, and odor control biofilters.

1. Fairfield Water Pollution Control Facility with compost facility in foreground

BIOSOLIDS

Biosolids are the byproduct of our primary settling and waste activated sludge (WAS) process. The biosolids from five primary clarifiers are pumped on a time basis directly to our primary anaerobic digester. The WAS is thickened on a gravity belt thickener, pumped to our gravity thickener tank, and then pumped to the primary digester on a time sequence. The WAS daily thickening is based on process control numbers generated by laboratory staff and forwarded to the operation staff to execute. The mixture of primary and WAS biosolids stays within the primary anaerobic digester for approximately 17 days; it then decants over the mixing chamber to the secondary digester where it continues its stabilization process for an additional 17 days. The elevation of the secondary digester's floating cover indicates the amount of anaerobically digested biosolids we need to remove to keep the system operating properly (photo 2). The necessary volume of anaerobically digested biosolids is pumped from the secondary anaerobic digester at 2 to 3 percent solids to the belt filter press where it is dewatered to 17 to 18 percent solids (photo 3). Once dewatered, the biosolids are discharged to an agricultural mixing dump truck. When the weight of the biosolids reaches 7,500 lbs (3,400 kg) within the truck, the drop-hatch doors from the belt press are

2. Anaerobic digesters

3. Belt filter press

4. Wood chips added to biosolids in agricultural mixing truck

5. Front-end loader filling compost facility bay with biosolids/wood-chip feedstock

The town's biosolids compost facility, located on the WPCF site, is the last such facility in Connecticut and one of the oldest continuously operating biosolids compost facilities in North America

closed and the dump truck is removed. The truck is then pulled out of its bay and pulled around to the entrance of the compost building. It is then loaded, by a front-end loader, with 7,000 lbs (3,200 kg) of wood chips (photo 4) and mixed by the agricultural truck's internal mixing equipment for several minutes. The resulting compost feedstock mixture is then dumped on the floor of the compost building for the start of the composting process.

COMPOST FACILITY

The town's biosolids compost facility, located on the WPCF site, is the last such facility in Connecticut and one of the oldest continuously operating biosolids compost facilities in North America. WPCFs in Hartford, Greenwich, Farmington, and Bristol, Connecticut, all practiced biosolids composting before but discontinued these facilities, largely due to operational issues.

Fairfield's initial compost building and process were built and put into operation in 1989 using an agitated bay with a forced aeration-type composting process. The initial building was steel, but due to the corrosive atmosphere within it, the structure rotted and was replaced by a stainless-steel building in 2006. The building is 300 ft (91.4 m) long by 60 ft (18.3 m) wide by 30 ft (9.1 m) high. Within the building are six bays, formed by concrete walls. The internal measurements (i.e., between the concrete walls of the bays) are 6.5 ft (2 m) wide by 6 ft (1.8 m) high and 220 ft (67 m) long. Each bay is filled with approximately 14 yd^3 (10.7 m^3) of the biosolids/wood chips feedstock material by a front-end loader (photo 5). The feedstock material is given a numerical number, representing a "charge number," so it can be followed through the bay during the compost process by the automated process control system (SCADA). The charge is followed through the bay from the initial loading until it exits the bay around 28 days later. During this period the compost agitator machine turns the compost material in each bay four to five times a week. With each agitation the compost material is transported approximately 12 ft (3.7 m) along the length of the bay. Air is blown up through the compost within the bays at five locations along the length of each of the six bays. The SCADA computer monitors the bays for appropriate time and temperature protocol to make sure that the compost meets EPA requirements for pathogen reduction (three days at ≥ 132˚F [55˚C]) and vector attraction reduction (14 days at ≥ 113˚F [45˚C]).

At the end of the 28 days the compost reaches the end of the bay where the agitator deposits it into a pit at the back of the compost building, in an open offloading area where the compost builds up. This area measures 60 ft (18.3 m) wide by 20 ft (6.1 m) deep. Each week this area is cleared of the composted material by a front-end loader and dump truck (photo 6). Twenty-five truckloads, each carrying 4,700 lbs (2,130 kg) of compost are removed and hauled across the street to a town-owned, contract-operated site. The site operator contracts with the town to process all its green or yard waste. The compost is then stored in a pile for 30 days, after which it is tested for fecal coliform. If it passes the fecal coliform test it is ready to be used as soil augmentation for ball fields, flower and landscaping beds, and non-edible crops (photos 7–8). If the compost pile does not pass, it must sit for an additional 30 days and be retested.

As part of the contract, the site owner supplies the WPCF with all the necessary wood chips or amendment for the composting of the biosolids as well as roughly 4,400 yd^3 (3,360 m^3) of wood chips for biofilters. The biofilters handle all the noxious odors from the compost building and several other buildings within the facility. The town has just signed a new contract with the site owner in which the town

6. Compost loaded onto truck at end of 28-day agitation/aeration period

will receive $50,000 to allow the contractor to process all its green or yard waste and to screen and store all of the compost.

COMPOST MANAGEMENT

The town also contracts with another company to market and distribute its compost. This company also helps the town submit a plan to the Connecticut Department of Energy and Environmental Protection for distributing the compost, and it maintains a permit to distribute the compost in New York. Fairfield's Compost Management Plan was approved in 2002 and revised in 2008 and 2015. The plan includes:

- Product testing
- Record-keeping and reporting
- Compost application rates (based on nitrogen)
- Use restrictions
- Storage requirements
- Product labeling and customer terms

Most of the conditions of the Compost Management Plan follow the Standards for the Use or Disposal of Sewage Sludge (40 CFR Part 503), except for the following additional requirements:

- Compost shall not be used for food chain crops, tobacco, crops grown for animal feed, or on grazing land for animals whose products are consumed by humans
- Compost must be tested for beryllium
- Testing for salmonella is not accepted as an alternative to fecal coliform
- Specific limits exist on use and storage of compost including setbacks from wells and water bodies

7. Compost used for lawn restoration—Stamford, Connecticut

8. Yale University landscaping bed after compost application

The town generates on average 5,250 yd^3 (4,010 m^3) of compost annually. Of this amount, 85 percent is distributed in Connecticut, with the remainder going to New York. The diversified customer base includes 20 to 30 customers each year. The median customer takes less than 200 yd^3 (150 m^3), with only two or three customers taking more than 500 yd^3 (380 m^3) each year. Compost is used as a soil amendment for general landscaping, including tree planting and the construction of lawns and sports fields, for top-dressing established lawns and sports fields, and as an ingredient in potting media. The town receives a payment of \$5/yd^3 (\$6.54/m^3) for its supplied compost.

With the two contracts, the town makes roughly \$70,000 on its compost. To haul its biosolids instead to one of the sewage sludge incinerators in Connecticut would cost the town more than \$300,000 at current rates. The existing composting practice provides beneficial reuse of the biosolids, reduces the WPCF's carbon footprint for biosolids management, and lessens the carbon footprint associated with production of soil amendments and fertilizers that the biosolids replace.

REFERENCE

Wright-Pierce (April 2017) Wastewater Facility Plan for the Town of Fairfield, Connecticut

ACKNOWLEDGMENTS

Geoff Kuter, Agresource, Inc.
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ABOUT THE AUTHORS

- William Norton, superintendent of Fairfield's Water Pollution Control Facility, is a Class IV wastewater operator licensed by the state of Connecticut. Mr. Norton spent 29 years with the city of West Haven in various positions, culminating with the position of administrator of water pollution control facilities, and three years with the town of Greenwich as its process control engineer. He has a Bachelor of Arts degree from the Rochester Institute of Technology and a Master of Science degree from the University of New Haven, both in environmental science.
- Joseph Michelangelo, PE, has been employed by Connecticut municipalities for 32 years and has served as the public works director for the town of Fairfield since September 2012, approximately six weeks before Hurricane Sandy struck the Connecticut coast. Mr. Michelangelo holds bachelor's degrees in civil engineering & electrical engineering from the University of New Haven, and a master's degree in environmental management from Yale University.
- John Bodie is the assistant superintendent of the town of Fairfield's Water Pollution Control Facility and has been employed by the town at the facility for over 30 years. He has been part of the operation of the composting facility since its inception in 1989.

The new emergency preparedness for water and wastewater utilities

KATE NOVICK, PE, CSP, Gradient Planning LLC, Middletown, Connecticut

ABSTRACT | While utilities endeavor to maintain service during increasing floods and other extreme weather events, they find it impossible at times as they battle budget cuts, aging infrastructure, and infrastructure that was not designed to respond effectively to current and changing conditions such as climate change. As a result, industry standards in emergency preparedness have rapidly evolved over the past 15 years to enable utilities to transform their old way of thinking about emergency response plans. It is no longer just a spoke in the wheel. Now it is part of all operations, and it informs everything we do at a utility. The emergency response plan is being replaced by an emergency preparedness and response *program* that innovatively uses risk management, planning at all levels, and staff development in an iterative cycle to protect the utility from events that threaten to disrupt service.

KEYWORDS | Emergency preparedness, emergency response plan, business continuity, water and wastewater security, resilience

Many but not all water and wastewater utilities have an emergency response plan to comply with industry standards and regulatory requirements. However, these plans could have implications to the utility far beyond compliance. Recognizing the increasing difficulty of maintaining service with a growing list of risks from technological breaks to extreme weather to cyber events, an increasing number of water and wastewater utilities are leveraging their old emergency response plans into something more. Emergency preparedness and response programs are innovatively using risk management, planning, and staff development in an iterative cycle to protect the utility from events that threaten to disrupt service.

This is not just a new emergency response plan template or add-on; it is a paradigm shift in our utility culture and the surrounding culture at large. This shift results in utilities making every decision with emergency preparedness in mind. It also results in the community and government organizations prioritizing water and wastewater service as the life-sustaining and critical program that it is.

The 2018 State of the Water Industry Report by the American Water Works Association (AWWA) shows that emergency preparedness is on the top 10 list of concerns of water utility professionals, yet only 54 percent of utilities have an emergency response plan.

In my career in many different sectors including government, healthcare, industrial manufacturing, food and beverage, and utilities nowhere have I met professionals who work more tirelessly to maintain essential services in their communities, and who are more dedicated than in the water and wastewater sector. And typically, the surrounding stakeholders are unaware of the heroic acts and tireless work that go into this service. Yet these efforts will get us only so far.

Maintaining service during increasing episodes of floods and other extreme weather may be impossible at times as utilities battle budget cuts, aging infrastructure, and infrastructure that was not designed to effectively respond to current potential emergencies. These compounding challenges reduce a utility's ability to recover from a disruption.

As a result, utilities can no longer afford to have emergency plans that are not both compliant with standards and requirements, and effective in a major emergency.

STATUS QUO IS NO LONGER ENOUGH

The old emergency response plan was drafted as follows. First, a person accesses the latest templates. Then, section by section, the person fills in and updates the plan. In doing so, he or she speaks with an expert, a manager, an administrative assistant, and others, and continues until the plan is updated and complete. This individual then shares the draft with others who review it and offer feedback. Eventually, after the plan is vetted and finalized, leadership approves the plan. The plan is then printed, enclosed in a binder, and placed in an easy-to-access location or several locations. A utility also keeps it on the network drive where staff can easily find it.

Then the utility personnel check "yes" to the box when asked, "Do you have an up-to-date emergency response plan at your utility?" Over time, beyond the ubiquitous emergency contacts list, which is always helpful, the outcomes of emergencies indicate that this process alone fails to produce a plan that can perform when needed.

Even with the best intentions, the plan may satisfy requirements but serve no further purpose. This happens when utility personnel:

- Lack the time or ability to think about the plan and talk with others about the utility's real needs
- Lack the experience of what can catastrophically go wrong that may affect the utility
- Do not know how to correctly prepare for emergencies

To prevent a plan from serving no further purpose, the planning process should begin by asking the question, "How and why do we plan to respond to the emergencies of our time?" A utility must step outside its comfort zone to find correct answers. How do utilities do this?

NEW EMERGENCY PREPAREDNESS

Utility professionals do not want to be burdened by plans that do not work. Careful vetting of service providers offering emergency planning services is increasingly more necessary to ensure integrity and effectiveness of emergency response plans.

Also, more and more utilities are testing their plans using tabletop exercises and drills and performing risk assessments to focus their emergency response plans. Utilities are mitigating potential hazards and threats that could reasonably be expected to affect the utility. This is not just tweaking an emergency response plan. Early adopters of this new emergency preparedness mindset are initiating discussions into all aspects of a utility from staff succession planning, to capital improvements, to political activities with stakeholders, to utility operations and maintenance practices, to communications.

Early adopters are also meeting with response partners and having frank discussions about potential event scenarios. The result is unprecedented collaboration that is bringing utilities and their partners to new levels of preparedness. This new mindset is allowing utilities to maintain "bent knees" that enable bouncing back more quickly and with fewer losses when disruptions occur. This new mindset is also described as "resilience."

Some utilities have critical assets along the coastline subject to the slow-moving hazard of rising sea level and the fast-moving hazard of coastal flooding during extreme high tides and coastal storms

re-sil-ience
noun
1. the capacity to recover quickly from difficulties; toughness.
2. the ability of a substance or object to spring back into shape; elasticity.

These emergency preparedness programs focus on the utility's mission and maintaining life safety, protection of property, continuity of operations, and public reputation. These programs increase staff capabilities to self-organize and adapt by making incremental changes over time to the architecture of its systems as follows:

- Non-physical systems such as community relationships and partnerships, utility culture, and standard operating procedures
- Physical systems such as the distribution or collection system, treatment plants, and digital and communications systems

Gaming the System

Business literature discusses the concept "disrupt or be disrupted." Even though the concept is based on taking market share from competitors, it is fundamentally based on the question of how to survive in a world of disruption. This concept is apt for how water and wastewater utilities are using innovation and emergency preparedness strategies to improve their odds of bouncing back after a major upset.

Adopting this concept may lead a utility to establish backup plans for its most critical functions and backup plans for the backup plans. This is called "two deep." The utility may then investigate whether all their backup plans could share a single point of failure. For example, if all the backup plans risk failing during an extreme flood, and an extreme flood could reasonably be expected to affect the utility, then developing another backup plan that

Some utilities use portable emergency power generators with pre-built electrical connections to provide backup power to remote facilities

does not fail during an extreme flood would be beneficial.

A related strategy is to resolve the problems that occur during normal operations, such as staffing or operational issues. Nuisance problems during normal operations can become significant during emergency operations. For example, a raw water intake facility that freezes during very cold temperatures and is not perceived as a high priority to fix could lead to no water in the system during a water contamination event or a major fire. Or, an ongoing lack of supervision at a facility that is known but seemingly managed results in a worker being injured or killed during an emergency response. Addressing these issues before they become significant ones will increase a utility's emergency preparedness.

About the Paradigm Shift

The fully realized emergency response plan, or program, as described above, arises out of working tirelessly to maintain essential services to communities. It also arises out of recognizing the vulnerabilities of our utilities and all the failures—the failures of the systems we manage and the failures we hear about from our peers. For example, in one Connecticut community in April 2018, tens of thousands of residents as well as local businesses, schools, nursing homes, and a hospital were without water for 48 hours due to a valve failure. The city lost several million gallons of water. According to news reports, the replacement valve had to be special-ordered from Buffalo, New York. When an emergency like this strikes a utility, it serves as a wakeup call that it can happen at any peer utility.

I have found in my 20 years of developing emergency preparedness programs at hundreds of facilities that, although it is uncomfortable, by preparing a plan in full recognition of all emergencies that could reasonably be expected to happen, we allow a utility to significantly transform its preparedness into greater strength and resilience. It is the difference between having a plan and then blowing like a leaf in the wind during a major emergency, and having a plan based on skill and insight that enables the utility to reduce losses, reduce duration of the emergency response time, and mitigate and prevent things that can go wrong as much as possible.

The fully realized plan is no longer imprisoned in a three-ring binder. Now it is leaping out and into the hands of staff who establish preventative precautions ahead of time through their insight, and then take skillful actions during an emergency. This is called a "culture of preparedness."

LEARNING FROM CASE STUDIES

One rich place to access case studies is the Chemical Safety Board (CSB), which investigates emergency incidents involving chemicals and documents its work in public reports. Many other emergency events such as cyber events, critical infrastructure failures, and supply chain failures are not publicly reported so prolifically, thoroughly, and scientifically as the chemical incidents documented by the CSB. Below, I summarize two of its investigations, one in the water industry and one in the chemical industry, where planning and response were limited due to decisions based on mistaken views. These two case studies are by no means outliers or unique. In fact, they illustrate why standard practices in all industries including those in water and wastewater need to shift and improve, and indeed have been doing so since 9/11 and Hurricane Katrina.

Elk River Chemical Spill
West Virginia American Water

On January 9, 2014, approximately 300,000 people lost their potable water supply as the result of 11,000 gal (41,640 L) of crude 4-methylcyclohexanemethanol (MCHM) and stripped dipropylene glycol phenyl ether (PPH)—chemicals used in the mining industry to wash coal—spilling into the Elk River 1.5 mi (2.4 km) upstream from West Virginia American Water Company's raw water intake facility. According to CSB's report, it was the only raw water intake facility to serve the population. Water utility personnel assumed that the plant would effectively remove the reported chemical spill from the raw water. This assumption was incorrect. West Virginia American Water settled a class action lawsuit for $126 million. The owner of the chemical tanks assumed that the tanks were compatible with the chemical mixture when, in fact, the chemical corroded the tank material. The owner of the chemical, Eastman Chemical Company, settled the same class action lawsuit for $25 million. The owner of the tank, Freedom Industries, went bankrupt.

Hurricane Harvey, Arkema Crosby

Another example, although outside the water and wastewater industry, occurred when Hurricane Harvey hit the Texas coast in August 2017. According to another CSB report, Arkema Crosby, a facility that manufactures organic peroxides, chemicals so unstable that they require extreme refrigeration to handle safely, had a Hurricane Preparedness Plan.

The facility was identified to be in the 100- and 500-year flood zones. Based on the collective experience of Arkema Crosby employees, the staff assumed the amount of rain from Harvey would likely flood surrounding roads. They based this assumption solely on some previous flooding events but not all past flooding events and did not anticipate any safety systems being affected. To their shock, by the time the hurricane had passed through southeastern Texas, not only were safety systems at Arkema Crosby affected, all the layers of protection to stabilize more than 350,000 lbs (159,000 kg) of organic peroxides stored on site failed due to one cause—flooding. This happened despite the Herculean efforts by employees in ankle-deep, waste-deep, and then chest-deep water to move chemicals to higher ground.

A tank farm on the Elk River in Charleston, West Virginia, stored a mixture of crude MCHM and PPH that corroded the storage tank and resulted in 11,000 gal (41,640 L) spilling into the river about 1.5 mi (2.4 km) upstream from West Virginia American Water's raw water intake

The only thing first responders could do was to evacuate residents in a 1.5 mi (2.4 km) radius surrounding the facility and let all the organic peroxides burn up. Before this event, despite risk assessments and emergency planning, not once had any staff member considered a flood worse than those experienced in the past. Flooding was not included in the facility's chemical risk assessments and therefore not one of the many layers of protection could mitigate the event that ended in clouds of chemical fumes blowing over a major highway and into the surrounding community area for an entire week.

WATER AND WASTEWATER RESPONSE NETWORK'S AFTER ACTION REPORT ON HURRICANES HARVEY AND IRMA

Federally declared emergencies such as hurricanes typically receive significant public discussion in forums and are documented in national and industry reports. Unfortunately, no published case studies of water and wastewater utility experiences during Hurricanes Harvey and Irma exist; however, the *Water and Wastewater Response Network's (WARN's) After Action Report on Hurricanes Harvey and Irma* documented improvement actions discussed by water and wastewater utilities, state and federal partners, and the WARNs in Florida, Georgia, North Carolina, South Carolina, Tennessee, and Texas that were affected after Category 4 Hurricanes Harvey and Irma made landfall on August 25 and September 5, 2017, respectively.

Key improvements identified in the report that affect water and wastewater utilities are as follows:

- The U.S. Government should designate water and wastewater services as top priorities for power restoration.
- Water utilities should assess emergency power requirements and identify backup power options, including alternative fuel supply plans.
- State emergency management agencies should ensure that water and wastewater utilities are represented in local and state emergency operations centers during activations.
- Local emergency managers should facilitate information sharing with water utilities and power providers.

WAY FORWARD REQUIRES PERSEVERANCE

True stories such as these caution utilities to plan imaginatively (asking, What could reasonably happen?), question assumptions, use scientific data, look for warning signs and innate tendencies toward denial, and plan for what could happen.

If a utility does not already have a leader or manager questioning and examining potential threats to its mission, one should be assigned. Once assigned, that role can initiate protections against loss of life, loss of property, loss of revenue and economic stability, and damage to the utility's reputation. Activating this role is significant and necessary to adequately respond to current and anticipated needs.

When utilities work on emergency response plans, they should not just use the basic template process but also counteract default reactions that minimize what could go wrong. Utilities can do the following:

- Use scientific data such as annual rainfall and temperature data
- Use valid resources such as Federal Emergency Management Agency (FEMA) Flood Maps
- Investigate neighboring facilities and identify chemicals and quantities stored there
- Review regional and state hazard mitigation plans and Threat Hazard Identification and Risk Assessment (THIRA) reports
- Seek other data to clarify the risks that could affect a facility and its operations and staff, and other resources

Utilities should meet with local fire and police departments and local emergency managers and listen to their perspectives on the potential risks. It is perseverance with one goal: protecting the utility's mission.

HOW TO BUILD AN EMERGENCY PREPAREDNESS PROGRAM

A skilled emergency manager and mentor of mine used to say whenever we started something new, "Use the KISS approach," meaning "keep it simple stupid." While it may no longer be politically correct to say this in the workplace, it is good advice. It means to expend the least effort to create the biggest effect.

Emergency preparedness, as presented in guidance documents and possibly even this article, can sound complicated and burdensome. It can be difficult to communicate to staff, because it is more conceptual than tangible—until a utility compares the emergency preparedness process to responding to a major emergency without having such a program in place. In an emergency, a utility will not have time to work out issues or determine the best and most defensible response plans. Utilities should keep emergency preparedness programs simple and grow them incrementally over time. Eventually, staff will adapt.

A utility should begin emergency preparedness with the following three questions:

1. Why plan for emergencies?
2. Why plan for emergencies at our utility?
3. Why plan for emergencies at our utility now?

These questions lead to discussions about what could be lost if the utility is not prepared for a flood, tornado, critical component failure, cyber attack, hurricane, or other event. At stake are lives, property, revenue, continued service, economic viability, and the utility's and stakeholders' reputations.

These questions motivate a utility to have an emergency preparedness program and result in real and explicit commitment to emergency preparedness by utility leadership.

Explicit Commitment to Preparedness

When utility leadership has emergency preparedness as a goal while fully recognizing the negative consequences that could occur, then the capacity to respond to emergencies increases. For example, compare emergency response outcomes of a fire department that is organized, equipped, and ready to respond to one that is not. An unprepared department wastes money while failing to save lives and property, and morale suffers.

Many ways exist to develop an explicit commitment to emergency preparedness:

- Include a statement of commitment to emergency preparedness in utility documents
- Ensure staff and leadership participation during emergency preparedness training and exercises
- Recognize and support staff who demonstrate actions that identify and communicate hazards, mitigate risks, and improve emergency preparedness
- Include emergency preparedness in the budget
- Perform and participate in emergency exercises at utility, municipal, and state levels
- Support continuous improvement of emergency preparedness through incident investigations that support staff while identifying root causes, lessons learned, and action items to be discussed
- Convey "preparedness culture" at the utility when talking with staff and explain its value

Figure 1 illustrates a utility's emergency preparedness cycle. This proven methodology is the same across all sectors, from emergency services to banks to water and wastewater utilities.

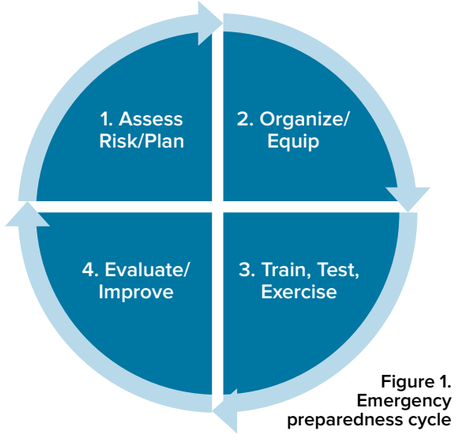

Figure 1. Emergency preparedness cycle

The utility manager should first identify hazards and threats, assess risks to the utility, and create plans for controlling risks and responding to emergencies. This is not easy; however, many state, national, and global guidance documents are available to help water and wastewater utilities with this task.

Risk Assessment

In New England, a utility would not plan for a volcanic eruption, at least not for the next million years according to scientists, but a utility in Hawaii would. Similarly, a utility with assets near the coastline would assess the risks of coastal flooding (e.g., hurricane with strong winds and coastal flooding) while a utility with all inland assets would not (e.g., hurricane with strong winds only).

The ANSI/AWWA J100 *Standard, Risk and Resilience Management of Water and Wastewater Systems* provides a list of hazards and threats that a utility can use to begin identifying relevant hazards and threats.

Equally important is that a utility identify and characterize (1) its critical assets at risk to potential threats and hazards, (2) the consequences of those threats and hazards that could materialize in an emergency, and (3) the vulnerabilities that could exacerbate and escalate the consequences.

Those assets that support the entire service area or most of it, such as a transmission main or a treatment plant, are more critical than a pump station that serves only two percent of residential customers. The consequences of losing each critical asset must be explored.

Similarly, vulnerability of critical assets should be explored. Two assets that support the same service area may carry different levels of vulnerability. For example, one may be in a flood plain or near a potential explosion source, while other assets may be well outside any geographical threat. Also this is true if one asset has advanced communication and security features and the other does not, or if one asset has components that require a long lead time to replace, and another asset has components that are quick to replace. The vulnerability of each critical asset must be assessed.

Also, a risk assessment should include the consequences and vulnerabilities to customers, such as health care facilities, schools, other critical infrastructure, dense populations, vulnerable populations, critical large users, and others.

Finally, the information from the risk assessment informs emergency preparedness and response activities.

Emergency Response Plan

An emergency response plan must address the following: (1) how incidents are managed at the utility, including roles, responsibilities, trigger points, and response procedures for incident management functions as well as for hazard-specific functions; and (2) how staff communicate during an emergency, including an up-to-date emergency contact list.

Also, a utility should ensure that response procedures use the Incident Command System (ICS) a standard system proven to best manage incidents.

The plan should also address how the emergency preparedness program is managed at the utility, and include items such as the following:

- How often the emergency response plan is updated and who is responsible for the plan
- Procedures to document and record activities of the emergency preparedness program
- Statement of explicit commitment to preparedness
- Multi-year training and exercise plan to keep staff engaged and ready to implement the plan
- Procedure for investigating incidents to capture lessons learned and use them for continuous improvement

Last, the plan should include resources to aid incident management. These resources may be kept in appendices and include drawings and figures, contractual agreements that may be activated during an emergency, guidance documents, tools, and templates.

A risk assessment should include the consequences and vulnerabilities to customers, such as health care facilities, schools, other critical infrastructure

Communications

During an emergency, communications are critical to a successful response. To ensure that communication is as seamless as possible, the emergency response program should establish, ahead of time, a communications plan. It can be part of the emergency response plan and should include the following:

- Identification of staff who are part of a "communications team," responsible for emergency communications, and are authorized to speak publicly for the utility
- Up-to-date emergency contacts list that includes all-hours contact information for critical customers, local and customer municipalities, state agencies including regulators, other stakeholders, critical vendors, and others as appropriate
- Actions to take to develop relationships with emergency preparedness partners, learning who they are, identifying others who a utility may be unaware of, and continuing those relationships through regular meetings and joint efforts such as participating in emergency exercises together
- Procedures to communicate with the public
- Procedures to communicate with the media to instruct the public about safety actions to take (e.g., boil water notice), basing these procedures on proven risk communication methods such as "message mapping" and best practices such as "be first, be right, be credible"
- Procedures to communicate with the media and the utility's response
- Procedures to communicate with staff to keep them safe, aware, and aligned with the utility's objectives in the emergency response

Training and Exercises

Key response staff at the utility should be trained in the ICS—the standard system all response partners should be using. This ensures a coordinated effort, with all responders speaking the same language.

Also, key response staff at the utility should be trained in their roles and responsibilities in the emergency response plan. This may include hazard-specific procedures such as storm preparedness, shutdown of critical components, manual and temporary operations, cold weather operations, and many others that may be needed.

After a utility has performed its risk assessments, emergency response planning, and training, it is important to know whether these activities better prepared the utility. The two ways to test an emergency preparedness program's effectiveness are a real emergency and an emergency exercise that simulates a real emergency. Therefore, a utility should set aside time in meetings and in normal operations to discuss or conduct an emergency response to a possible scenario.

When discussing an emergency response, important questions to ask are "How would the utility continue operations if it lost SCADA, power for one week or more, a critical system component, or its top three people?

Example tests a utility could perform include the following:

- Turn off the SCADA system and perform manual operations
- Operate the utility without using a critical system component
- Perform a tabletop exercise with staff backups, not with primary staff
- Evacuate the building and measure how long it takes to do so safely and as expected
- Contact all key emergency response partners as a drill

After both real emergencies and emergency exercises, it is important to record what happened, lessons learned, and ways to improve risk assessments, mitigation of consequences, response capabilities, emergency and communications planning, staff training, and future exercises. This creates a roadmap to improve the utility's preparedness.

PLANNING RESOURCES AVAILABLE

The following resources can help water and wastewater utilities plan for emergencies:

- ANSI/AWWA J100 *Standard, Risk and Resilience Management of Water and Wastewater Systems*
- ANSI/AWWA G440-17 *Standard on Emergency Preparedness Practices*
- AWWA M19, *Emergency Planning for Water and Wastewater Utilities* published in 2018
- AWWA *Emergency Preparedness and Response for Water Utilities* DVD

One helpful resource to prevent and prepare for cyber emergencies is AWWA G430-14 *Standard on Security Practices for Operation and Management*. Also, FEMA's ready.gov is a good resource for everyone.

LAST WORDS

Emergency response planning is not just a box to check. It is a real opportunity to dig deep and identify actual risks to your utility. With this knowledge, improved actions are not only possible, they can enable us to reduce losses, reduce an emergency's duration, and mitigate and prevent things that can go wrong.

ABOUT THE AUTHOR

Kate Novick is managing director and founder of Gradient Planning LLC, a consultancy that helps manage risk and safeguard life safety, critical resources, reputation, and operations from natural disasters, technological crises, and human-caused threats. Ms. Novick has dedicated her career to helping clients protect their mission during emergencies through readiness, strength, and resilience. She co-led the creation of the 2011/2012 Water Research Foundation's *Business Continuity Toolbox for Water and Wastewater Systems*. She also served on the AWWA M19 Emergency Planning for Water Utilities Manual Committee and was an expert on the AWWA *Emergency Preparedness Response for Water Utilities* DVD released in July 2018.

Emergency response and rehabilitation of a sewer force main in Plymouth

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ABSTRACT | From late December 2015 to the end of January 2016, Plymouth, Massachusetts, experienced catastrophic ruptures in three locations along its 30 in. (76 cm), cement lined ductile iron force main. This force main was the sole conduit for the town's wastewater flow between the central pump station at Plymouth Harbor and the wastewater treatment facility nearly five miles inland. Shortly after the first break, the town set out to assess the extent of it and the condition of the entire force main, prepare and evaluate alternative rehabilitation options, and identify a sustainable and permanent solution. Assessment and analysis of the force main via closed-circuit television (CCTV) inspection, multi-sensor condition assessment, ultrasonic thickness measurement, and detailed hydraulic modeling helped to formulate and assess various design options. These options included a new or rehabilitated force main, based on ease of incorporation into the hydraulic system, that would minimize construction duration, community disruption, and cost. The replacement pipe was placed into service on January 10, 2017.

KEYWORDS | Force main, catastrophic rupture, condition assessment, pipeline rehabilitation, sliplining

BACKGROUND

Plymouth, Massachusetts, is a coastal community about 44 mi (71 km) southeast of Boston and the oldest and largest municipality by land area—134 mi^2 (347 km^2) in Massachusetts. The town's Department of Public Works manages the wastewater system, which comprises one wastewater treatment facility, eight pump stations, approximately 54 mi (87 km) of gravity sewers, and 16 mi (26 km) of force mains. The Plymouth Wastewater Treatment Facility (PWTF) is toward the northern side of the town. The central pump station—Water Street Pump Station (WSPS)—pumps all of the wastewater approximately 4.5 mi (7 km) southeast to the PWTF.

PROJECT INTRODUCTION

Between December 19, 2015, and January 31, 2016, the 30 in. (76 cm), cement lined ductile iron (CLDI) force main that conveyed the town's entire wastewater flow from the WSPS to the PWTF experienced catastrophic ruptures at three locations along the 25,000 ft (7,620 m) long alignment (Figure 1).

The first break, on December 19, 2015, occurred roughly one mile (1.6 km) from the PWTF within the easement parallel to State Highway Route 3. Since no redundant force main or a means to immediately redirect wastewater flow from the WSPS existed, a fleet of septic pump trucks was engaged to continuously transport sewage from the pump station to the PWTF. This allowed the town response team to assess the crisis and select an appropriate course of action. Meanwhile, twin, 1 mi (1.6 km) long 18 in. (46 cm) high-density polyethylene (HDPE) bypass pipes were constructed to redirect flow to the PWTF along the surface of the easement. The area also was excavated and dewatered. Five days after the break, operators began pumping wastewater through the bypass pipes.

On January 27, 2016, a second, more complex force main rupture occurred approximately 2 mi (3 km) from the PWTF. A twin 18 in. (46 cm) HDPE bypass pipe, a line stop, tapping sleeves, and valves were constructed, and the septage trucks returned. Four days later, the second bypass was online.

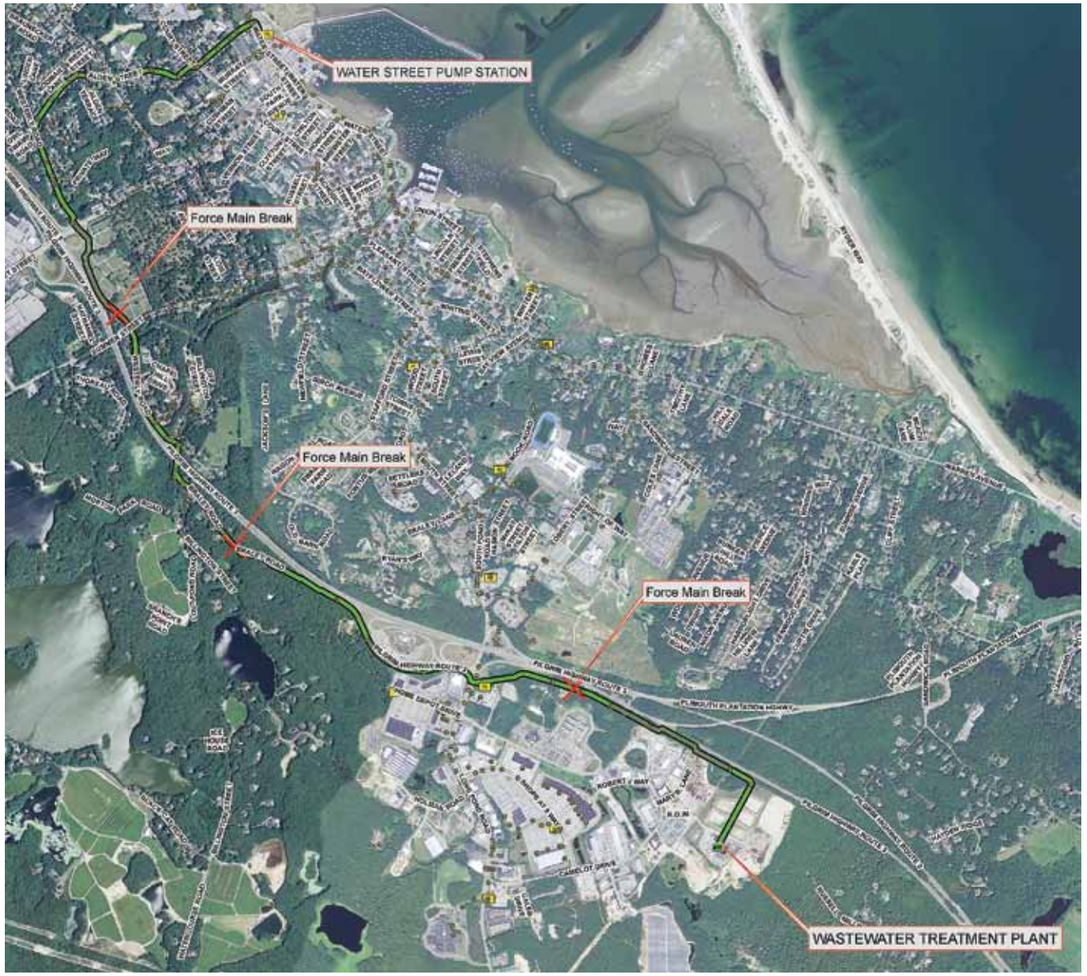

Figure 1. Sewer force main alignment including locations of force main ruptures

Less than 24 hours after the second bypass section was online and crews demobilized, a third rupture occurred 1.5 mi (2.4 km) from the WSPS on Westerly Road. The septage truck brigade again returned and a bypass of the remaining length of the 4.5 mi (7 km) force main was constructed to preclude additional ruptures of the failed force main. The 4.5 mi (7 km) twin bypass pipes were completed and put online on February 15, 2016.

The project's biggest challenge occurred at the WSPS. New temporary pumps and controls to match the bypass lines had to be sized and constructed outside the pump station, which was fully shut down to isolate, clean, and assess the original force main. Three 150 hp (112 kw) high-pressure pumps with variable frequency drive (VFD) units, manifolds, and knife valves, and a 200 hp (149 kw) standby diesel pump were assembled by the emergency crews and placed on line on March 7, 2016.

PROJECT APPROACH

While the bypass construction was proceeding, the failure was being assessed and alternative repair and replacement options identified that would be sustainable and permanent. To identify the desired long-term and sustainable solution, the town initially:

- Performed a hydraulic study, constructing a complete hydraulic model of the 30 in. (76 cm) force main, while also modeling rehabilitation alternatives for the WSPS to provide optimal hydraulic performance
- Quantified the condition of the pipeline, determining the structural condition of the entire 30 in. (76 cm) CLDI force main alignment through closed-circuit television (CCTV) inspection, visual inspection, multi-sensor testing, and ultrasonic testing of the pipe's cement lining thickness, and assessing the compromised pipeline segments

Table 1. Proposed conditions with various PVC/HDPE pipe configurations and pressures

Scenario	Material	Hazen Williams C Value	Nominal Diameter in. (cm)	I.D. in. (cm)	Flow per Pump gpm (L/m)	Total Q gpm (L/m)	TDH ft (m)	Velocity fps (m/s)	Flow Capacity % of Design
2 Pumps – Design Condition	Ductile Iron	120	30 (76)	31.06 (78.89)	2184 (8267)	4368 (16535)	180 (54.9)	1.85 (0.56)	100
2 Pumps – Slipline Bypass Section Only	SDR 17 HDPE (DIPS)	140	24 (61)	22.582 (57.35)	2148 (8131)	4296 (16262)	181 (55.2)	3.44 (1.05)	98.4
	SDR 17 HDPE (DIPS)	140	20 (51)	18.905 (48.00)	1925 (7287)	3850 (14574)	201 (61.3)	4.39 (1.34)	88.1
2 Pumps – Slipline Entire Pipeline	SDR 17 HDPE (DIPS)	140	24 (61)	22.582 (57.35)	2098 (7942)	4195 (15880)	187 (57.0)	3.36 (1.02)	96.0
	SDR 17 HDPE (DIPS)	140	20 (51)	18.905 (48.00)	1841 (6969)	3682 (13938)	207 (63.1)	4.20 (1.28)	84.3
	SDR 11 HDPE (DIPS)	140	24 (61)	20.83 (52.90)	2021 (7650)	4041 (15297)	193 (58.8)	3.80 (1.16)	92.5
	C-905 PVC (DR 25)	140	24 (61)	23.61 (59.97)	2120 (8025)	4240 (16050)	186 (56.7)	3.10 (0.94)	97.1
	C-905 PVC (DR 25)	140	20 (51)	19.77 (50.22)	1933 (7317)	3866 (14634)	200 (61.0)	4.04 (1.23)	88.5
	C-905 PVC (DR 18)	140	24 (61)	22.76 (57.81)	2102 (7957)	4203 (15910)	187 (57.0)	3.31 (1.01)	96.2
	C-905 PVC (DR 18)	140	20 (51)	19.06 (48.41)	1859 (7037)	3717 (14070)	205 (62.5)	4.17 (1.27)	85.1

- Prepared and assessed alternative pipe repair and upgrade options, including alternate force main alignment routes and methods of repair, replacement, and pipe reuse
- Identified optimal design alternatives, selecting and recommending the appropriate solution based on the assessment and analysis of the existing conditions and proposed alternatives

FORCE MAIN ASSESSMENT APPROACH

The force main assessment included several steps that allowed a long-term solution to be proposed. These steps are highlighted below.

1. Access Pits

Once the twin HDPE 18 in. (46 cm) bypass pipes were in service from the WSPS to the PWTF, access pits were constructed along the 30 in. (76 cm) CLDI force main to enable subsequent pipe cleaning and assessment. Strategically located access pits minimized disruption to utilities and traffic. Since jetting and CCTV equipment typically cannot reach lengths exceeding 2,500 lf (762 lm), access pits were spaced accordingly. Access pits were also proposed along the force main that were directly accessible to heavy equipment but with appropriate setbacks from environmentally sensitive areas. Once exposed, the top half of the 30 in. (76 cm) CLDI pipe was cut and removed for a length of around 3 ft (0.9 m) to allow for pipe cleaning and CCTV inspection. Additional access pits were constructed as needed to expedite the force main's cleaning and assessment.

2. Hydraulic Study

To fully assess and analyze the hydraulic conditions of the 30 in. (76 cm) force main, a hydraulic model was developed using as-built plans and flow information from the town for the WSPS. An existing-conditions model was created to identify and highlight force main sections that would be susceptible to corrosion due to the regular occurrence of open channel flow conditions. Results from the existing-conditions model were later confirmed by CCTV inspection, multi-sensor condition assessment, and ultrasonic testing.

Proposed conditions models with various PVC/HDPE pipe sizes and pressure ratings were created using the 30 in. (76 cm) CLDI pipe as a baseline reference. As shown in Table 1, for each pipe size and material, three scenarios were run with one pump, two pumps, or three pumps, respectively, in operation at the WSPS. Each proposed rehabilitation alternative was modeled to ensure the proposed system could achieve the optimal force main velocities, retention times, and corrosion prevention.

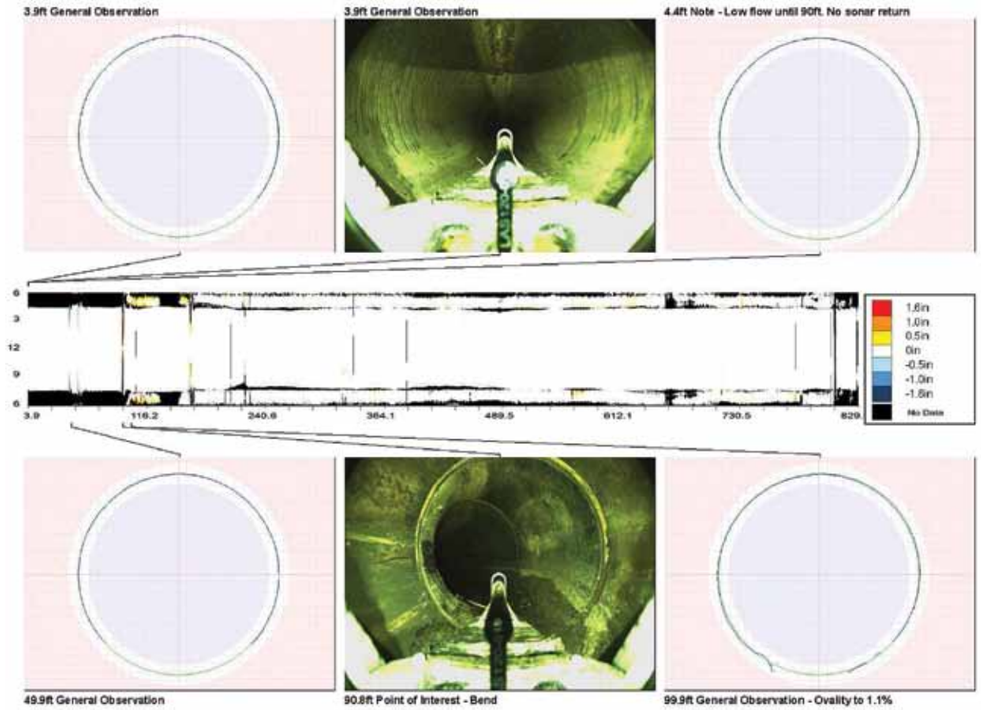

Figure 2. Sample multi-sensor scan report

3. CCTV Inspection

Following installation of force main access pits, cleaning of the 30 in. (76 cm) CLDI force main was performed using high-velocity jet equipment. Water used for the jetting and cleaning process was accessed via nearby hydrants equipped with backflow preventers and meters. For each pipe segment, a sufficient number of passes were made with the jet nozzle to remove all sludge, debris, and other obstructions from the pipe. All liquids and solids pumped from the force main during cleaning were transported to the PWTF for disposal.

High-velocity jet cleaning of the 30 in. (76 cm) CLDI force main allowed the pipe to be visually inspected using a CCTV camera. The full circumference of the pipe was visually inspected along its entire 4.5 mi (7 km) length to identify and locate pipe sections compromised due to blockages, breaks, leaks, infiltration, corrosion, or structural failures. The camera was moved through the force main at a rate no greater than 20 fpm (6 m/min), in accordance with National Association of Sewer Service Companies (NASSCO) standards, to identify the pipe's condition and catalog defects accurately. Log sheets and videos were prepared for each pipe segment for review.

4. Multi-Sensor Condition Assessment

Following the initial cleaning and CCTV of the 30 in. (76 cm) CLDI force main, a multi-sensor condition assessment was done of roughly 1 mi (1.6 km) of the force main from the first break site to the PWTF. A proprietary system provided a 2-D laser scan, sonar data, and traditional HD CCTV inspection of the pipe. The system also determined levels of corrosion and deformation using a new 30 in. (76 cm) CLDI pipe as a baseline reference. A sample multi-sensor scan report is shown in Figure 2.

5. Ultrasonic Thickness Measurement

In addition to the multi-sensor condition assessment, ultrasonic thickness of the 30 in. (76 cm) CLDI force main was measured at several locations to determine if a loss of wall thickness had occurred in the pipe. This assessment provided a non-destructive, non-invasive method to evaluate the pipe condition in addition to the multi-sensor force main assessment.

REHABILITATION ALTERNATIVES

Following the pipe condition assessment and hydraulic study of the 30 in. (76 cm) CLDI force main, the town looked at alternative pipe rehabilitation and upgrade options, including alternative force main alignment routes and methods of repair, replacement, and pipe reuse. The main design considerations for the alternative options were as follows:

- Making the proposed design alternatives compatible with the existing WSPS layout and wet well capacity

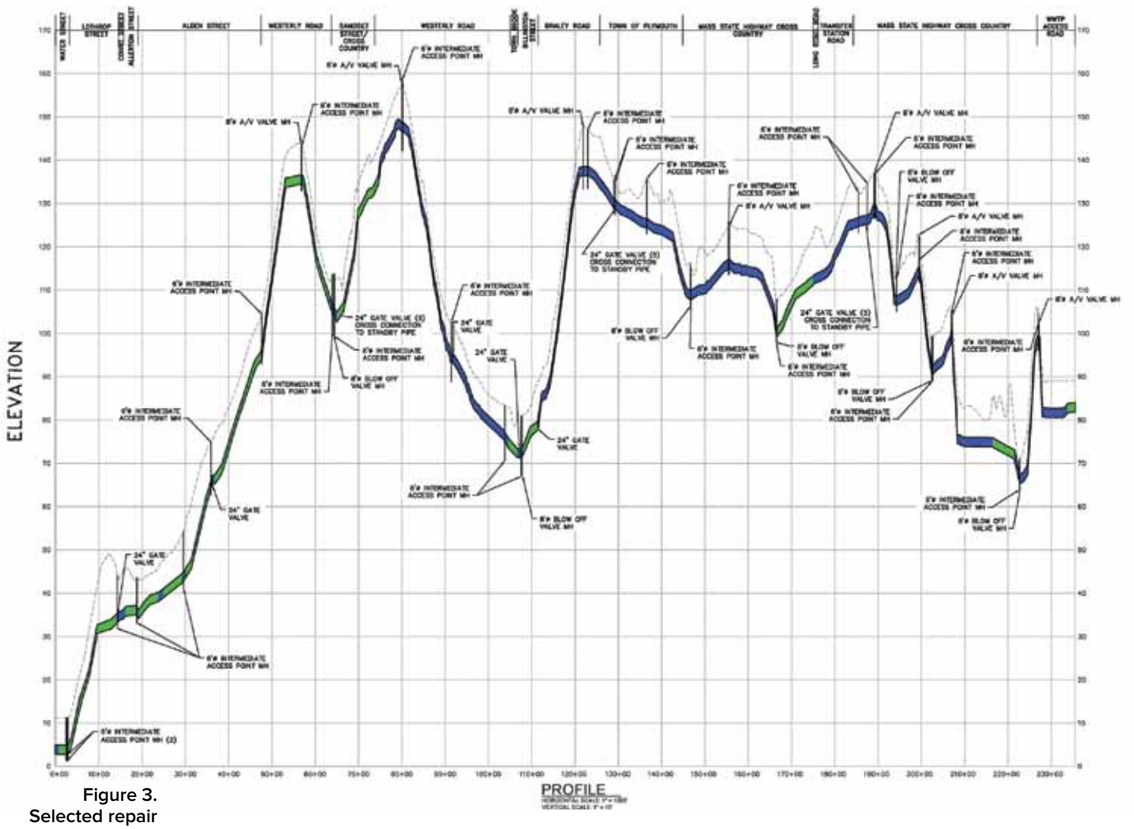

Figure 3. Selected repair alternative, including limits of sliplining and cut and cover

- Minimizing the likelihood of additional pipe failures by selecting optimal corrosion-resistant pipe materials and incorporating new design features into the system to allow for efficient maintenance and pipe redundancy
- Minimizing the construction period necessary to make the proposed solution operational and consequently minimize the time rental equipment was necessary and in use
- Minimizing the capital cost associated with the materials, appurtenances, construction, and equipment to make the proposed solution operational
- Determining the optimal force main route to minimize disruption and disturbance near and adjacent to the force main, particularly residences, tourist and sensitive resource areas, and main roadways
- Evaluating average and peak flow hydraulic scenarios when preparing the design alternatives to determine the optimal force main velocities and retention times that could be achieved with the proposed solution
- Evaluating alignment routing to minimize interference with traffic patterns, particularly within the downtown area and main road crossings
- Incorporating town-requested design features that enhance operation and maintenance

Factoring in these considerations, five options along with cost estimates were developed and presented to the Plymouth board of selectmen and residents, prior to Town Meeting:

1. Make spot repairs including replacement of 4,400 ft (1,340 m) of the 30 in. (76 cm) pipe with new pipe
2. Slipline 12,000 lf (3658 lm) of the 30 in. (76 cm) CLDI pipe and replace 12,000 lf (3658 lm) with a new 24 in. (61 cm) pipe
3. Replace the 30 in. (76 cm) CLDI pipe with a new 24 in. HDPE or PVC pipe
4. Replace 4,000 ft (1,220 m) of pipe at compromised locations and add a 24 in. (61 cm) redundant line (HDPE or PVC)
5. Slipline 12,000 lf (3,658 lm) of existing line, remove and replace the remaining 12,000 lf (3,658 lm), and add a new 24 in. (61 cm) redundant pipe

Option 1 replaces approximately 4,400 ft (1,340 m) of the 30 in. (76 cm) CLDI force main with new plastic pipe. In addition, the pipe would be retrofitted with air relief valves at all the high point locations. Low points (cleanout locations) would be replaced, including air release/vacuum relief valves and blowoffs. New isolation gate valves would be added, as well as provisions for using the high point air relief valve branches for bypass if necessary in the future.

Option 2 sliplines some of the 30 in. (76 cm) CLDI pipe with a 24 in. (61 cm) plastic pipe where feasible. The remaining portions of the old pipe would be removed and replaced with a new 24 in. (61 cm) pipe. Under Option 2, several lining options were considered, including sliplining, cured in-place lining, and epoxy lining.

Option 3 removes the 30 in. (76 cm) CLDI pipe and constructs a new 24 in. (61 cm) pipe (PVC or HDPE), with new manholes for air/vacuum valves and blow off manholes at low points.

Options 4 and 5 are dual-pipe solutions created by combining Option 3 with either Option 1 or Option 2. The advantage of a dual-pipe solution was to provide complete redundancy.

SELECTED ALTERNATIVE

The town selected Option 5 for a long-term sustainable solution. The permanent repair option included sliplining 12,000 lf (3,658 lm) of the 30 in. (76 cm) line with a 24 in. (61 cm) HDPE pipe, abandoning or replacing 12,000 lf (3,658 lm) of the 30 in. (76 cm) main, and installing a 24 in. (61 cm) HDPE/PVC pipe by open-cut excavation (Figure 3). In addition, a new 24 in. (61 cm) redundant pipe would be constructed parallel to the first pipe. The WSPS would be upgraded and rehabilitated, a project already scheduled before the force main ruptures. Final steps would be removal of the 50,000 lf (15,240 lm) of temporary bypass pipe and the temporary "outside pump station." This option gave the town a relatively rapid solution that would improve the alignment's hydraulic properties, provide a standby pipe for redundancy, and match the upgraded pump station with the new force mains.

To minimize the potential impacts of any future force main or valve problems, the new force mains were designed with several cross connections. Valves and fittings were strategically located to provide cross connections that allow sewage to quickly flow from one pipe to the other to bypass any problem areas without the need to first excavate a pipe for access.

CONSTRUCTION PROCESS

Daily construction challenges included working in the downtown area and on residential streets during the busy tourist season, alternating road closures and traffic detours, requisite night work within the Route 3 highway layout areas that included on/off ramps, and continuous public awareness that required advanced notification of upcoming work. The construction approach focused on sliplining the 30 in.

Water Street sewer force main discharge piping and drain lines into station wet well

Selected repair alternative including sliplining (above left) and cut and cover (above right)

Sliplining HDPE under Route 3 north on-ramp (exit 5)

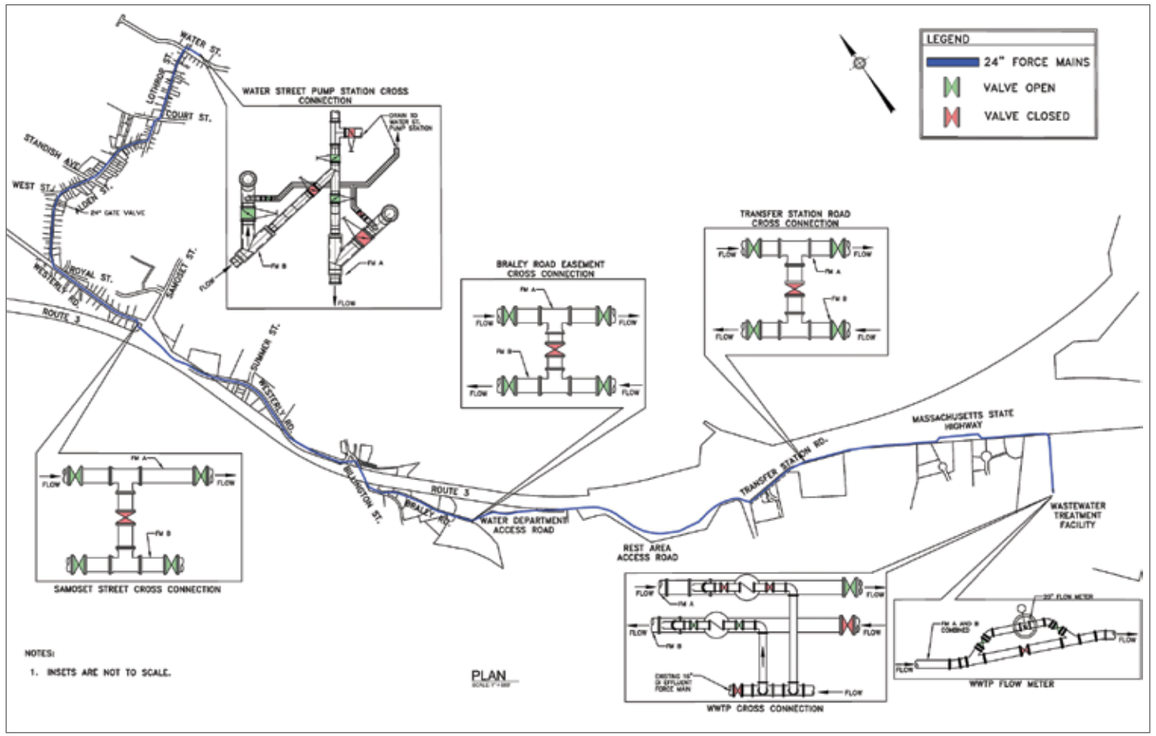

Figure 4. Various design features showing cross connections between the two force mains

(76 cm) CLDI pipe with 24 in. (61 cm) HDPE DR 11 pipe to expedite construction and minimize disruption.

To expedite the work, two utility contractors were hired. Both firms subcontracted with specialty companies to supply and fuse the polyethylene pipe and pull the slipliner. The sliplining method consisted of accessing the host pipe at pre-determined locations within the system and subsequently inserting pre-fused polyethylene pipe through the host pipe. Owing to the diameter difference between the new pipe—24 in. (60 cm), and the host pipe—30 in. (76 cm), cellular grout was pumped at the upstream end of the section through a water-tight bulkhead. Pressures were monitored to maintain minimum requirements and any water or residue was removed downstream. The grout was specified with a 28-day compressive strength of 300 psi (2068 kPa) and a density of approximately 55 lbs/ft^3 (880 kg/m^3).

Installation of the pipeline by cut and cover often required excavation and utility support and coordination. Working within the downtown area adjacent to existing and often-aged utilities was slow. The pipeline design included access to manholes at intervals to provide air release valves and other force main appurtenances for cleaning, segment isolation, and maintenance.

The replacement of the pipe was completed in December 2016 and the line was placed into service on January 10, 2017. Once it was tested and approved for full-time operation, the emergency contractor was cleared to disassemble all of the twin-barreled emergency pipe and fittings that had been installed only a year before. With the bypass pipe removed, the redundant pipe could then be constructed alongside the first pipe and the cross connections made sequentially as construction progressed. This work was completed on time in December 2017, along with much of the surface restoration.

Additional conditions were important to the Department of Public Works, such as exceptional quality control and development and implementation of value engineered construction innovations and techniques aimed at saving time and/or money. As a result of town input, the following new design features were incorporated:

- Five major cross connections between the two pipelines that allow the operators to isolate one or several pipeline segments for cleaning and maintenance (Figure 4)
- Various access manholes along the pipeline alignment that allow the operators to jet clean and inspect the pipeline while the pipe is out of service
- A cross connection at the wastewater treatment facility that allows the operators to direct the plant-treated effluent water into the pipeline that is out of service. Introducing plant water into the pipe helps to flush and clean the pipe that is out of service and provides additional wet well volume to achieve the desired flushing velocity through the pipeline that is in service.

CONCLUSION/SUMMARY

In December 2015, the sudden ruptures of the most critical wastewater conveyance infrastructure in Plymouth prompted the town to carefully and methodically re-evaluate long-term operational alternatives, including pipeline redundancy. Faced with these emergencies during a major holiday season and with pipeline replacement and repairs during two summers, the town evaluated trenchless options to replace the pipeline. Polyethylene DR 11 pipe was selected to minimize the impact to the downtown area and residential neighborhoods and expedite the repair schedule. Repair/replacement of the primary pipeline commenced in June 2016, and the pipeline was commissioned in January 2017.

ABOUT THE AUTHORS

- Ziad Kary is a senior project manager and principal at Environmental Partners Group with 22 years of experience in civil engineering and construction management. Mr. Kary has a mechanical engineering degree from Italy and a civil engineering degree from the University of Massachusetts. He is a registered professional engineer in New Hampshire and Massachusetts. Since joining Environmental Partners Group in 2006, he has worked on a wide range of projects including sewer pumping station rehabilitations, sewer force main assessment, design, and repairs, and transfer station upgrades. He is a member of NEWEA, the American Society of Civil Engineers, and Plymouth County Highway Association.
- Jonathan Beder has been the director of the Plymouth Department of Public Works since 2011, overseeing the operations of the geographically largest community in Massachusetts. The department has 12 divisions and an annual operating budget of $18 million, with three enterprise funds and 110 full-time employees. Prior to this role, Mr. Beder worked for the town of Stoughton, Massachusetts, first in the Engineering Department before becoming assistant superintendent of operations of public works. He has a Bachelor of Science degree in construction management from Wentworth Institute, and a Master of Public Administration from Bridgewater State College. He also holds licenses in water distribution and treatment.

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Innovative business case evaluation guides Portland through tough choices among CSO alternatives*

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ABSTRACT | In 2015, the city of Portland, Maine initiated the design process for the Back Cove South Storage Facility (BCSSF). For two years Portland progressed the design of the BCSSF, a single 10 ft (3 m) wide by 8 ft (2.4 m) high, 3.5 MG (13.3 ML) storage conduit along Marginal Way. Marginal Way is the location of a number of vibrant commercial establishments that depend on unobstructed access in order to compete in today's economy. During the design process, it became apparent that the construction cost estimate for the project was significantly more than the original planning estimate. As a result of the high costs of the proposed BCSSF, impact to business owners, and potential constructability concerns, the city elected to evaluate alternatives. Rather than repeating a typical engineering evaluation similar to the one used to select the BCSSF project, Portland applied a Business Case Evaluation (BCE) to better understand the totality of costs, including both project construction costs and economic, environmental, and social impact costs. The 3.5 MG (13.3 ML) conduit along Marginal Way became the base alternative in the evaluation process. Potential alternatives to the 3.5 MG (13.3 ML) storage conduit were evaluated based on typical engineering considerations, and construction cost estimates for each alternative were based on estimates prepared for the base alternative and/or unit costs for major components of the potential alternative. Monetary values for impacts were based on review of literature, standard guidance from state and federal agencies (e.g., economic guidance for TIGER grant applications), and best professional judgment. The BCE demonstrated that some of the impacts, accounted for using "non-monetary factors" in the process used to select the base alternative, had real costs that were appropriately included as part of the cost comparison among the alternatives. As a result of the BCE process, Portland has set aside the design of the 3.5 MG (13.3 ML) conduit along Marginal Way and has embarked on implementation of a 3.5 MG (13.3 ML) storage tank alternative.

KEYWORDS | Combined sewer overflow (CSO), CSO storage, alternatives evaluation, business case evaluation

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INTRODUCTION

The city of Portland, Maine is located in southern Maine as shown in Figure 1. The city has an area of 69.4 square mi (179.8 square km), of which 21.3 square mi (55.2 square km) is land and the remainder is water. Portland is a peninsula that extends into Casco Bay in the Gulf of Maine and Atlantic Ocean.

Portland has the highest population of all cities in Maine at approximately 67,000 persons as of the year 2017. The Greater Portland area is home to over 500,000 persons, which represents more than 1/3 of Maine's total population. The local economy is highly dependent on tourism.

The city of Portland Sewer Division is operated by the Public Works Division and manages over 200 mi (320 km) of sewer lines and over 100 mi (160 km) of storm drains. Combined sewers make up more than half of the city's sewer system. The service area is approximately 15.6 mi^2 (40.4 km^2) and serves nearly the entire city population. In addition to gravity sewer lines, the wastewater collection system includes 27 pump stations, of which six are considered major stations. As of the city's last CSO long-term control plan update there were 31 active CSOs remaining in the collection system.

All collected wastewater is tributary to the East End Wastewater Treatment Facility (EEWWTF), which is owned and operated by the Portland Water District. The EEWWTF receives about 20 mgd (75.7 ML/d) in dry weather and up to 80 mgd (303 ML/d) in wet weather. Flows in excess of approximately 37 mgd (140 ML/d) are bypassed around the activated sludge secondary treatment facilities and receive primary treatment and disinfection prior to discharge.

Portland is currently working on CSO control projects in Tier 3, the final tier of its long-term CSO control program. Upon completion, the program is estimated to cost over $200 million and over $100 million has been spent to date.

The city of Portland and the Portland Water District (PWD) are working under an Administrative Consent Agreement with the state of Maine Department of Environmental Protection (DEP) to abate combined sewer overflows (CSOs) in Portland. The city completed a Long Term Control Plan (LTCP) in 2013 that focused on alternatives to complete its combined sewer overflow (CSO) control program.

As part of the 2013 LTCP the concept for the BCSSF was defined. The concept was refined in a Preliminary Design Report (May 2015) which states that the BCSSF is to provide 3.5 MG (13.3 ML) of storage and reduce annual overflow volume from 150 MG (568 ML) to 18 MG (68.1 ML). Overflows from CSOs 017 and 018 would be controlled. The BCSSF was envisioned to be configured as a linear conduit that would be 10 ft (3 m) by 8 ft (2.4 m) and 3,425 ft (1,044 m) long under Marginal Way between Preble Street and Franklin Street and a 60 in. (152 cm) diameter conduit 1,064 ft (324 m) long between Franklin Street and Plowman Street. This combination of lengths and cross-sectional areas would provide the required 3.5 MG (13.3 ML) of storage and became the base alternative for the BCE.

Figure 1. Portland, Maine

As is common with most multi-stage CSO control programs, the most cost-effective projects are implemented first, and each successive project becomes more difficult to define and costly to implement

As is common with most multi-stage CSO control programs, the most cost-effective projects are implemented first, and each successive project becomes more difficult to define and costly to implement. The BCSSF in the heart of downtown Portland is an example of such a project. Because of higher than anticipated costs for the selected alternative during the design effort, the city of Portland decided in 2017 to conduct a BCE of viable BCSSF alternatives, which included reevaluation of alternatives previously considered as well as identification and evaluation of new alternatives. The BCE provided a framework for evaluating potential alternatives to meet project objectives. This BCE went beyond typical financial considerations by monetizing triple bottom line elements (economic, social, and environmental) for a more comprehensive analysis. This approach enabled Portland to better understand the totality of costs, including both project construction costs and economic, environmental, and social

Figure 2. Location of alternatives

impact costs. Proper assessment of the economic, environmental, and social impact costs was made possible by Portland applying the BCE methodology.

METHODOLOGY

A BCE is essentially a benefit-cost analysis that is used to monetize both the benefits and costs of alternatives. This enables a comparison to determine if the estimated benefits of an alternative are greater than the estimated costs. The BCE methodology provides decision-makers with information on the life-cycle costs and monetary benefits of each alternative for comparison. What makes this BCE unique is that the city decided to complete the evaluation after 90 percent drawings were completed for the BCSSF, with the intent of looking at any and all potential alternatives that would meet the CSO control goals and result in the lowest total costs when accounting for construction, economic, environmental and social impact costs.

This BCE was formulated as a cost-effectiveness analysis, to identify the least-cost alternative to achieve a specific objective. The total costs were calculated by adding the construction and operation and maintenance (O&M) costs to the monetized impacts of the alternatives. The net present value (NPV) was then estimated to compare the alternatives.

Identification of Base Alternative

As with all benefit-cost analyses, an important first step in the BCE methodology was to identify a base alternative. The other alternatives were compared to the base alternative to estimate the incremental costs and benefits. Since 3.5 MG (13.3 ML) of CSO storage was determined to be the required level of CSO control, a reasonable base alternative became the as-designed storage conduit.

Identification of New Alternatives

The next step was to identify new alternatives to the base alternative. The project team met to brainstorm alternatives, and nothing was considered to be off the table. As a result of brainstorming sessions, a total of 12 alternatives were identified. A screening process followed and seven of the alternatives were set aside. Reasons for setting certain alternatives aside included:

- Questionable ability to achieve the performance goal of 3.5 MG (13.3 ML) of CSO storage
- Perceived costs and/or impacts equal to or greater than more viable alternatives retained for further evaluation

Of the 12 alternatives initially identified, five were carried forward for more detailed evaluation. The five alternatives carried forward are briefly described below.

1. The as-designed BCSSF storage facility, which was defined as the base alternative. The base alternative conduit would be deep enough to enable flows tributary to the Franklin Street Pumping Station, adjacent to the proposed conduit, to be tributary to the conduit and the pumping station removed from service.
2. A 2.5 MG (9.5 ML) storage tank in Back Cove Park plus a shallow 84 in. (213 cm) conduit over a length of 1,968 ft (600 m) along Marginal Way between Franklin and Plowman Streets. The tank would control overflows from CSO 017 and the conduit would control overflows from CSO 018. The shallow conduit would not accept flows tributary to the Franklin Street Pumping Station, and that station would remain in service.
3. A 2.5 MG (9.5 ML) storage tank at Back Cove Park (for CSO 017) plus an 84 in. (213 cm) 1,968 ft (600 m) long conduit along Marginal Way at the same depth as the base alternative conduit (for CSO 018). The deep conduit would accept flows tributary to the Franklin Street Pumping Station, which would be removed from service.
4. A larger 3.5 MG (13.3 ML) storage at Back Cove Park that would control overflows from both CSO 017 and 018. Under this alternative the Franklin Street Pumping Station would remain in service.
5. Expansion of the Franklin Street Pumping Station for relocation of CSO 018. CSO 017 would be controlled either by a Preble Street to Franklin Street conduit or by a Back Cove tank. Excess flow above downstream conveyance and treatment capacity would be pumped and either stored at a downstream location or treated by an excess wet weather treatment facility at the EEWTP. An infrastructure cost estimate was not completed for this alternative as it was determined not to be viable based on collection system modeling results (discussed below) and due to the extent of work that would be required downstream.

The locations and key features of alternatives one to four as listed above are shown in Figure 2.

Engineering Analyses

Engineering analyses were completed as necessary to assess the five alternatives carried forward. Analyses consisted of developing preliminary layouts, collection system modeling to confirm that CSO capture requirements would be met, preliminary geotechnical review, and estimating costs for the alternatives.

Preliminary layouts indicated that the 2.5 MG (9.5 ML) and 3.5 MG (13.3 ML) tank options could fit on a parcel of city-owned land that currently supports a city soccer field. The site is in close proximity to the overflow conduit for CSO 017, the larger of the two outfalls to be controlled. This proximity would facilitate construction of connecting piping from CSO 017. For the 3.5 MG (13.3 ML) tank option, the piping connection from CSO 018 would involve a longer and more complex route.

Collection system modeling was focused on the alternative that would have expanded wet weather pumping out of the CSO 018 tributary area. Modeling results indicated that, while this may be a hydraulically feasible option, it would both increase the CSO volume to be stored for a comparable level of control at CSO 018 and would relocate the CSO control need to another location. Since the overflow volume to be stored would increase and since there was no apparent benefit to relocating the required CSO control volume away from the vicinity of CSO 018, this option was dropped from further consideration.

The geotechnical review determined that the subsurface soils consist of fill underlain by very soft to soft silt and then very soft to soft clay to a depth of 50 ft (15.2 m). Below 50 ft (15.2 m) the subsurface conditions consist of medium dense to very dense silty sand extending to a depth of 65 ft (19.8 m). As a result, additional design considerations were identified for the storage tank alternatives. These considerations, which impact the cost of the alternatives, would involve installing the excavation support system with intermediate bracing and extending it below the soft clay and into the dense silty sand layer below. In addition, the tank design would need to include provisions to counteract buoyancy when the tank is empty.

Construction costs, annual O&M costs, and construction durations were estimated for each alternative. Because the design for the base alternative was advanced through previous efforts, detailed construction cost data from those efforts were used to the extent possible to estimate costs for the new alternatives. Cost data from published sources (e.g., R.S. Means), other local projects, and parametric cost data (i.e., cost curves) were used as necessary to complete cost estimating for the new alternatives. Also, because the design of the base alternative was advanced, it was anticipated that construction activities could begin earlier than for the other alternatives. Construction durations and estimated construction start dates were used, along with annual O&M costs, to compute net present value in the economic analyses performed for each alternative. Net present value was computed based on both a 3 and 7 percent discount rate. While a 7 percent discount rate is typically used when evaluating projects for federal grant programs, the project team believed a 3 percent discount rate is more reflective of the current economy. By computing net present value using both discount rates it was possible to test sensitivity of findings from the economic analyses to discount rate.

Quantification of Benefits and Impacts

The benefits and impacts associated with each alternative were identified. For example, the alternatives that included a storage tank in Back Cove Park would reduce impacts to traffic and disruption to local businesses in comparison to the base alternative. However, the Back Cove Park storage tank alternatives would reduce recreational opportunities and require a replacement field during tank construction. Since construction of any of the alternatives could result in economic, social, and/or environmental impacts, these impacts were identified, monetized, and incorporated into the BCE.

Table 1. Estimated revenue percent reduction by business type and work zone

Business Type	Rolling Closure Scenario		Compressed Lanes Scenario	
	Inside Work Zone	Outside Work Zone	Inside Work Zone	Outside Work Zone
Restaurant	70	23	23	7
General Retail/ Public	40 – 50	13 – 17	13 – 17	4 – 5
Specific Retail	10 – 30	10 – 13	10 – 13	2 – 3
General Medical	5 – 10	0	0	0
Specific Office	5	0	0	0

Monetary values for impacts were based on review of literature, standard guidance from state and federal agencies (e.g., economic guidance for TIGER grant applications), and best professional judgment. For example, traffic delay was monetized and summed for each vehicle impacted during the construction period. Each alternative would have a different construction period, which would result in different traffic impacts.

For the base alternative, two scenarios (rolling road closure and compressed lanes with no road closure) were developed to capture the impacts of different construction approaches along Marginal Way

While the project team initially identified impacts for the alternatives, refining monetary impacts required input from stakeholders. Accordingly, a significant component of the BCE included discussions with stakeholders potentially affected by the various alternatives. Several stakeholder meetings were conducted in the spring of 2017 among city departments and business/property owners along Marginal Way. Through these meetings it was determined that the base alternative along Marginal Way, which would include lane closures, and limit access, would have significant impacts to business owners. These impacts would result in both temporary and permanent loss of business. The stakeholders worked with the project team to monetize the loss of business to be included in the BCE.

Three primary areas of impacts were identified for evaluation in the economic analysis:

- Impacts to traffic along Marginal Way
- Impacts to businesses located along Marginal Way
- Impacts to recreational use of Back Cove Park

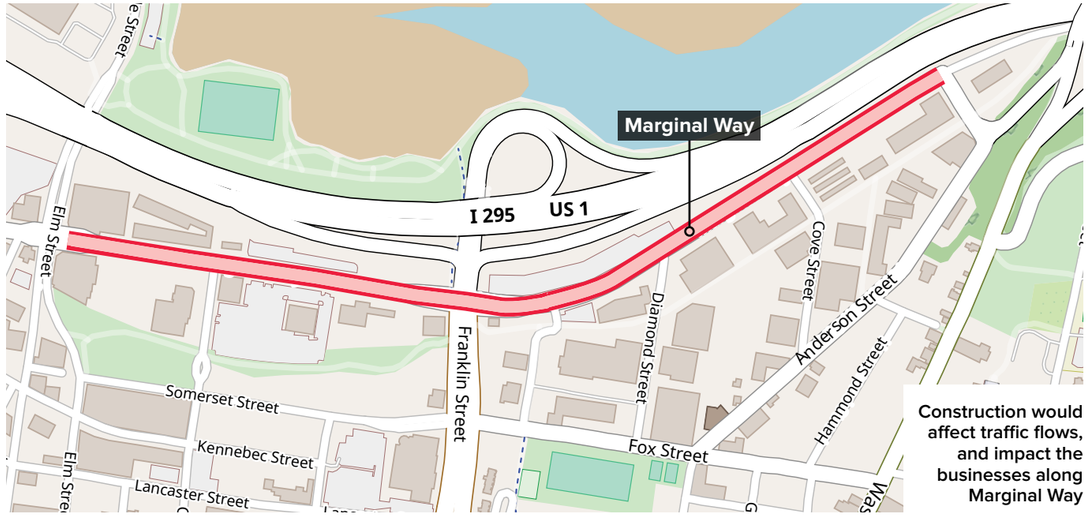
Each of these areas of impact is discussed below.

Traffic Impacts—While there may be other impacts of implementing the alternatives, these are the ones that were considered to have a significant effect on the outcome of the analysis. Construction along Marginal Way would impact traffic in the area, increasing congestion, resulting in detours, and thus increasing travel times and vehicle miles traveled (VMT). To evaluate the potential traffic impacts from the construction, the cost of increased travel time and VMT were estimated. Additional VMT and travel time incurred by detouring vehicles was obtained using Google Maps by comparing travel times and distances under normal conditions, and then under a detour scenario with traffic. Delay time was converted to hours and multiplied by the value of time ($14.36 per hour in 2017 dollars). The value of travel delay time was sourced from 2017 TIGER and INFRA BCA guidance.

For the base alternative, two scenarios (rolling road closure and compressed lanes with no road closure) were developed to capture the impacts of different construction approaches along Marginal Way between Preble Street and Franklin Street. For the rolling closure scenario, traffic traveling to businesses adjacent to the work zone would have the ability to access their destinations through secondary entrances. There would be open traffic conditions (normal traffic flow) in the non-work zone portion of Marginal Way. The compressed lanes scenario would keep two lanes open (one in each direction) during construction. Construction activities in the work zone would take place along one edge of the roadway while the traffic lanes would be located along the other edge of the roadway. While the rolling closure scenario would have a greater impact to traffic, the duration of construction for the compressed lanes scenario would be longer. These differences were reflected in the cost of traffic impacts in the BCE.

Business Impacts—Construction along Marginal Way would affect traffic flows, and thus would impact the businesses along Marginal Way. A portion of customers that frequent the business establishments along Marginal Way may go there less often, or switch to a different establishment because of reduced accessibility during the period of construction. This would result in lost revenue for the businesses along Marginal Way.

To estimate the potential loss of revenue to businesses along Marginal Way, businesses along the proposed construction area were identified. Then, area for the properties was obtained and annual revenue per unit area was estimated for each business from publicly available information. Annual reports and industry research reports were used to estimate revenue for chains owned by publicly traded companies, and information on



Construction would affect traffic flows, and impact the businesses along Marginal Way

industry peers was used to estimate revenue for smaller, privately owned establishments. Annual revenue per unit area was then multiplied by the area of the respective establishment to estimate total annual revenue. Where revenue per unit area was unavailable, revenue per location was estimated using publicly available information. Annual revenue for each establishment was converted to monthly revenue.

After the revenues were estimated, the reduction in revenue from construction activities was estimated. The impacts to the revenue of a particular business were estimated based on the type of business and whether the business was inside of the work zone or not.

The loss of revenue varied based on the type of business that was impacted. General public businesses (e.g., grocery store, restaurants, retail stores) would be anticipated to have the greatest percent loss of revenue because there are many other options for customers within the Portland area. However, office related businesses (e.g., health care, law firm) would receive less of an impact because customers/clients go to the establishments for a particular purpose and often have to schedule an appointment in advance.

Table 1 provides the estimated percent reduction in revenue by business type and work zone.

Recreational Impacts—Construction of storage tanks in Back Cove Park would impact use of the recreation facilities at the park and the users of the park. A meeting was held with the city of Portland, Department of Parks, Recreation and Facilities to discuss the impact that the storage tank alternatives would have on recreation at Back Cove Park (Figure 3).

Back Cove Park includes the Back Cove Trail, Preble Street multi-use field, a small field area (known as "baby Preble"), and natural and maintained landscaping. According to the Department of Parks, Recreation and Facilities, the Preble Street multi-use field is the most heavily used field in the city. The baby Preble area is used as a secondary field when the full-size field is being used and as a gathering and set-up area for events.

Back Cove Trail circles Back Cove and is heavily used by the public for walking, running, and biking. The trail has about 323,000 annual users.

Figure 3. Back Cove Park

All of the storage tank alternatives that were considered would require the temporary closure of Preble Street multi-use field during construction activities. The impacts of this closure were estimated for loss of field revenue and loss of recreational experience. It was assumed that the Back Cove Trail would remain open during any construction activities impacting Back Cove Park.

Table 2. Construction duration and cost of alternatives—in dollars ($)

Alternative	Total cost	2018	2019	2020
Alternative 1—Rolling Closure				
Duration (months)	**16**	**10**	**6**	**0**
Construction Cost	30,927,000	19,329,000	11,598,000	0
Annual O&M	25,000			
Present Value (3%*)	30,022,000			
Present Value (7%*)	28,414,000			
Alternative 1—Compressed Lanes				
Duration (months)	**24**	**10**	**12**	**2**
Construction Cost	32,224,000	13,427,000	16,112,000	2,685,000
Annual O&M	25,000			
Present Value (3%*)	30,981,000			
Present Value (7%*)	29,012,000			
Alternative 2				
Duration (months)	**12**	**0**	**12**	**0**
Construction Cost	28,099,000	0	28,099,000	0
Annual O&M	120,000			
Present Value (3%*)	28,042,000			
Present Value (7%*)	25,597,000			
Alternative 3				
Duration (months)	**12**	**0**	**12**	**0**
Construction Cost	27,180,000	0	27,180,000	0
Annual O&M	60,000			
Present Value (3%*)	26,398,000			
Present Value (7%*)	24,267,000			
Alternative 4				
Duration (months)	**12**	**0**	**12**	**0**
Construction Cost	24,262,000	0	24,262,000	0
Annual O&M	110,000			
Present Value (3%*)	24,295,000			
Present Value (7%*)	22,158,000			

*discount rate

Construction of a replacement field for the Preble Street multi-use field during the construction period was evaluated but found not to be cost-effective.

The Preble Street multi-use field is scheduled for 970 hours of use annually. The use is broken down into 570 hours of public use and 400 hours of use by Portland Public High School soccer and lacrosse teams. It is approximated that half of the public reservations are city residents and the other half are non-residents. Since construction of an alternative field was determined not to be cost-effective, Portland Public High School reservations would displace public reservations on an existing alternative field. As a result, there would be a loss of public reservations at both the Preble Street multi-use field and the nearest alternative field.

The lost revenue of 970 hours annually was split equally between residential and non-residential users. Residents pay $30 per hour and non-residents pay $60 per hour to reserve the Preble Street multi-use field.

In addition to the loss of revenue, there would also be a value for the loss of use. The unit day value (UDV) method was used to provide an approximation of the total value of foregone recreational opportunity to potential users. The UDV method uses a simulated market value for projected foregone use. The simulated value represents the user's average willingness to pay for a day of recreation activity at the Preble Street multi-use field based on the recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental quality. The UDV per user of $5.20 was based on general recreation field assessment values from the U.S. Army Corps of Engineers for the 2017 fiscal year (USACE, 2016).

It was assumed that for sports practices on the fields there would be 20 people using the field and for games there would be 75 people (including players, officials, and spectators). It was assumed that 50 hours of the public reservations were for games and the remaining hours were for practice.

The estimates of the number of users were combined with the selected UDV to derive an estimate of annual recreation benefits foregone. Since the field revenue also captures a portion of each user's value for the recreation, the annual recreation benefits foregone is the difference between the use value and annual field revenue.

Construction activities associated with the storage tank alternatives may cause additional impacts that were not quantified for inclusion in the economic analysis, such as loss of parking, further travel to an alternate field, and scheduling conflicts at alternative fields. These impacts would be partially offset by plans to use excavate from tank construction to raise the elevation of the soccer field which would increase its resilience against sea level rise.

Table 3. Results for traffic impact analysis—in dollars ($)

Alternative	7% Discount Rate			3% Discount Rate		
	2018	2019	Total	2018	2019	Total
Alternative 1—Rolling Closure						
Vehicle Operating Costs	112,000	0	112,000	117,000	0	117,000
Travel Time Costs	2,052,000	0	2,052,000	2,132,000	0	2,132,000
Total Traffic Impacts	2,165,000	0	2,165,000	2,249,000	0	2,249,000
Alternative 1—Compressed Lanes						
Vehicle Operating Costs	115,000	22,000	137,000	120,000	23,000	143,000
Travel Time Costs	2,885,000	539,000	3,424,000	2,997,000	582,000	3,579,000
Total Traffic Impacts	3,000,000	561,000	3,561,000	3,117,000	605,000	3,722,000

RESULTS

Results from the BCE are presented below and are organized by costs associated with construction and operation of the alternatives, costs associated with the impacts of the alternatives, and the total of construction, operation, and impact costs of the alternatives.

Construction and O&M Costs

The construction durations, construction costs, and annual O&M costs were estimated for each alternative (Table 2). The net present value is also presented for each alternative. Construction durations were estimated by year (2018 to 2020) and costs were also apportioned by year.

Impact Costs

As noted above, three primary areas of impacts were identified for evaluation in the economic analysis:

- Impacts to traffic along Marginal Way
- Impacts to businesses located along Marginal Way
- Impacts to recreational use of Back Cove Park

Costs associated with each of these areas of impacts are presented below.

Traffic Impact Analysis—Table 3 presents the costs associated with traffic impact analyses for Alternative 1, which is the only alternative that impacts traffic. Costs are presented in 2017 dollars using both 7 percent and 3 percent discounting.

Regardless of the scenario selected for traffic control during construction along Marginal Way (Alternative 1, rolling closure or Alternative 1, compressed lanes) traffic flow would be significantly impacted. This, in turn, would impact the businesses along Marginal Way. A portion of customers who frequent the business establishments along Marginal Way may go there less often, or switch to a different establishment because of reduced accessibility during the period of construction. This would result in lost revenue for the businesses along Marginal Way.

Recreational Impact Analysis—Table 4 provides the results of the recreation analysis for Alternatives 2, 3, and 4, as they are the alternatives that would impact the fields. Results are shown in 2017 dollars, using both 7 percent and 3 percent discounting.

Table 4. Result of recreational impact analysis—in dollars ($)

Alternative	7% Discount Rate			3% Discount Rate		
	Field Revenue	Lost Use	TOTAL	Field Revenue	Lost Use	TOTAL
Alternative 2	43,000	151,000	**195,000**	48,000	166,000	**214,000**
Alternative 3	43,000	151,000	**195,000**	48,000	166,000	**214,000**
Alternative 4	43,000	151,000	**195,000**	48,000	166,000	**214,000**

Table 5. Combined result of impact analysis—in dollars ($)

Alternative	Traffic Impacts	Business Impacts	Recreation Impacts	Total
7% Discount Rate				
Alt. 1 – Rolling Closure	-2,165,000	-13,577,000	0	-15,742,000
Alt. 1 – Compressed Lanes	-3,561,000	-8,173,000	0	-11,734,000
Alternative 2	0	-2,580,000	-195,000	-2,775,000
Alternative 3	0	-2,580,000	-195,000	-2,775,000
Alternative 4	0	0	-195,000	-195,000
3% Discount Rate				
Alt. 1 – Rolling Closure	-2,249,000	-14,126,000	0	-16,375,000
Alt. 1 – Compressed Lanes	-3,722,000	-8,620,000	0	-12,342,000
Alternative 2	0	-2,784,000	-214,000	-2,998,000
Alternative 3	0	-2,784,000	-214,000	-2,998,000
Alternative 4	0	0	-214,000	-214,000

Note: Values rounded to the nearest thousand dollars

Construction of storage tanks in Back Cove Park would impact use of the recreation facilities at the park and the users of the park. In particular, construction activities would require the temporary closure of the Preble Street multi-use field. The costs of recreational impacts were estimated for loss of field revenue and loss of recreational experience.

Factors that are traditionally considered "non-monetary" in evaluating and comparing alternatives can be monetized

Combined Impact Analysis—Table 5 combines the cost of traffic, business, and recreation impacts, in 2017 dollars, using both 7 percent and 3 percent discount rate. Alternative 1 – Rolling Closure and Alternative 1 – Compressed Lanes have the highest impacts among the alternatives, mainly driven by impacts to businesses. Alternative 4 has the lowest impacts, as there are no traffic or business impacts projected for this alternative.

Table 6 provides the NPV of each alternative, which combines the cost analysis and the impact analysis. As shown in the table, Alternative 4 has the lowest NPV (least negative), indicating that it is the least-cost alternative to complete the BCSSF. Alternative 1 – Rolling Closure is the highest-cost alternative.

Based on the results of the BCE, it was recommended that the city of Portland move forward with design and construction of Alternative 4, the 3.5 MG (13.3 ML) storage tank that would control overflows from both CSOs 017 and 018. In addition to being the lowest cost alternative, Alternative 4 would focus future O&M activities on one facility, which would be easier to manage, inspect, and maintain. In addition, Alternative 4 would avoid any potential impacts to traffic and businesses along Marginal Way.

CONCLUSIONS

This paper demonstrates how Portland, Maine, was able to step back at a critical point in the BCSSF design to re-evaluate the 90 percent design against other potential CSO alternatives with an open mind and through application of the BCE process in order to potentially identify a cost saving alternative. Lessons learned through the BCE evaluation process include:

- Time and money spent during the planning phase of project implementation can result in significant construction and lifecycle cost savings
- It is important to keep an open mind regarding project reassessment throughout the design process. It may not be too late to achieve significant cost savings
- Factors that are traditionally considered "non-monetary" in the process of evaluating and comparing alternatives can be monetized
- Monetizing factors such as traffic and business impacts can have a significant effect on the true cost of alternatives being compared

The city is currently moving forward with the design-build implementation of the recommended alternative.

Table 6. Combined net present value of cost and impact analysis of alternatives—in dollars ($)

Alternative	Costs	Impacts	Net Present Value
7% Discount Rate			
Alt. 1 – Rolling Closure	-28,414,000	-15,742,000	-44,156,000
Alt. 1 – Compressed Lanes	-29,012,000	-11,734,000	-40,746,000
Alt. 2	-25,597,000	-2,775,000	-28,372,000
Alt. 3	-24,267,000	-2,775,000	-27,042,000
Alt. 4	-22,158,000	-195,000	-22,353,000
3% Discount Rate			
Alt. 1 – Rolling Closure	-30,022,000	-16,375,000	-46,397,000
Alt. 1 – Compressed Lanes	-30,981,000	-12,342,000	-43,323,000
Alt. 2	-28,042,000	-2,998,000	-31,040,000
Alt. 3	-26,398,000	-2,998,000	-29,396,000
Alt. 4	-24,295,000	-214,000	-24,509,000

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WORKING FOR WATER QUALITY

Stormwater in the 21st Century

How the 2016 MS4 Permit will Transform Municipal Stormwater Management in Massachusetts

by Frederick Civian, Stormwater Coordinator, MassDEP

With the issuance of the Municipal Separate Storm Sewer System (MS4) permit in 2016 mandating that 260 Massachusetts cities and towns meet more than 200 permit requirements associated with reducing stormwater pollution, municipal stormwater management is ready for significant changes.

These requirements expand the scope of municipal functions that must become involved in stormwater management. They do so by mandating detailed actions for the screening for and removal of illicit discharges to stormwater systems and subjecting municipal quasi-industrial facilities to industrial stormwater rules. The regulations also establish a wide set of administrative and reporting requirements and impel towns to consider establishing stormwater enterprise funds to pay for these expanded functions. In addition, for the first time, the stormwater requirements incorporate actions from total maximum daily load (TMDL) studies as permit requirements.

Many cities and towns—particularly members of relatively new municipal stormwater coalitions—are responding to these requirements by expanding their stormwater management across municipal "silos" and using them to broaden their use of GIS systems.

Frederick Civian is responsible for assisting towns, developers and residents to reduce pollution carried by stormwater. He is available to answer questions about stormwater at 617-292-5821.

ENVIRONMENTAL CONTEXT

National efforts to reduce pollution from industrial and wastewater sources into in our nation's waterways have been remarkably successful. At the first Earth Day in 1970, only about one-third of our nation's surface waters were considered swimmable or fishable. The National Pollutant Discharge Elimination System (NPDES) program, which assertively reduced the pollutants allowed from a relatively small number of relatively large pipes and resulted in federal grant funding for public wastewater treatment facilities, has been remarkably successful: as of 2010, about two-thirds of our surface waters were deemed swimmable and fishable.

Yet, exceedances of federal and state water quality standards still occur routinely in many areas of the country. As NPDES reductions of "large pipe" pollution succeeded, national research into the source of those remaining pollution problems determined that, in many areas of the country, agricultural operations and stormwater runoff were the most common sources of pollution. Since agricultural uses enjoy significant NPDES exemptions, federal and state governments expanded their pollution reduction focus to include pollutants carried by stormwater.

REGULATORY CONTEXT

That "curse of knowledge"—data showing that numerous rivers, ponds, lakes, and streams are still too polluted to meet federal and state water quality standards and that, in Massachusetts, stormwater is the largest source of surface water pollutants—triggered a regulatory response. EPA required Boston and Worcester to obtain individual stormwater permits in the late 1990s and in 2003 required 240 cities and towns to obtain coverage under the MS4 permit.

That 2003 permit established broad requirements and nearly 40 specific requirements. Permit requirements are categorized by six general Minimum Control Measures (MCMs):

1. Public Education
2. Public Involvement
3. Illicit Discharge Detection and Elimination (IDDE)
4. Construction-period Controls
5. Post-Construction Controls
6. Good Housekeeping of Municipal facilities

EPA began proposing a successor to the 2003 permit for Massachusetts in 2010, a lengthy process that involved:

- Two draft permits (each for a portion of the state) that were withdrawn in 2012 and replaced by one proposed permit in 2014
- Permit adoption in April 2016 with implementation on July 1, 2017
- Permit appeal filed by Massachusetts cities and towns, a Massachusetts environmental advocacy group, and a Washington, D.C. boutique firm specializing in reducing regulatory burdens
- Postponement of the 2017 implementation date by EPA for a year
- Court appeal of that action
- Initiation of mediation of the permit appeal in 2018 that is ongoing
- Request for another year-long postponement
- EPA press release declaring 2016 MS4 permit will begin on July 1, 2018

WHAT DOES THE 2016 MS4 PERMIT REQUIRE?

While the 2016 permit retains the six MCMs, it significantly increases the number of specific requirements. The six MCMs now have 225 separate reporting and action requirements, significantly expanding the number and type of administrative and pollution-reducing actions that municipalities now need to initiate, implement, track, and place in annual reports. In addition, there are now specific TMDL-related actions, from more public education requirements to fully realized 20-year pollution reduction plans.

EPA says that the major drivers of permit-driven cost to municipalities will be in the Good Housekeeping and IDDE MCMs, together amounting to about 80 percent of program costs. Major changes to this MCM include annual street sweeping, tracking and optimization of catch basin cleaning, development of pollution prevention plans for quasi-industrial municipal operations such as waste management facilities and maintenance garages, and other actions required by municipal parks, schools, and land-use planning divisions.

In the IDDE MCM, the permit specifies how the identification and cure of illicit discharges must occur, requiring outfall prioritization and ranking-based dry weather screening of all outfalls in the first three years of the permit, with follow-up catchment investigations based on "system vulnerability factors optimized toward identification of human sewage."

The biggest driver of increased costs to municipalities (distinct from total program costs) will be how much a city or town is already doing relevant to the permit. For example, municipalities that already gather data on catch basin cleanings to optimize cleaning frequencies or that already routinely screen outfalls for dry weather flows, and then characterize those flows to identify significant pollutants, or that have already inspected their garages and are keeping those pollutants out of the stormwater system, will have less additional work to do than a city or town that has met only the 2003 permit's minimum requirements.

Land use project review rule changes, however, will cause virtually all MS4 towns to redo land-use bylaws. EPA, in section 2.3.6, requires municipalities to change how stormwater is managed for new development projects that disturb 1 ac (0.4 ha) or more by requiring cities or towns to adopt rules that require such developments to "retain" 1 in. (2.5 cm) of runoff on-site (with 0.8 in. [2 cm]) for redevelopments). This requirement is similar to but also disconnected from the state rules that apply inside wetlands jurisdictional areas. Each MS4 town will have to consider how to integrate its stormwater rules with the MS4 and the wetlands rules for geographic scope (where in towns shall these rules apply) and for threshold (at what acreage do these rules begin applying to projects).

Municipalities that already gather data on catch basin cleanings to optimize cleaning frequencies will have less additional work to do

TRANSFORMING TOWNS

Two major areas of change for municipalities are driven by the MS4 permit. The first is cost: Cities and towns will need to spend more to reduce pollution from stormwater. EPA estimates that costs for suburban towns will range from $454,000 to $1.3 million (source: www3.epa.gov).

"Stormwater utilities"—in which stormwater work is paid by fees based on the extent of impervious surface on properties rather than general taxes—may at first appear to be transformative. However, municipalities have used similar "enterprise funds" to pay for sewer, water, utilities, and the like for decades. Applying enterprise funds for stormwater work is, at the level of town finances, merely an incremental expansion of a common tool.

The other major change is more profound and will affect city or town governance in deeper and more lasting ways, for the MS4 permit is no longer the job of only the DPW. Historically, municipal officials have viewed MS4 work as DPW work—catch basin cleaning, street sweeping, and maintenance of stormwater systems are routinely performed by DPWs. But the expansion of stormwater system work into the environmental field, caused in large part by the MS4 permitting system, broadens the focus and the funding of stormwater systems across municipal departments.

That shift is particularly acute for smaller towns that lack resources and staffing, with larger towns better able to accommodate this change. Evidence for that difference comes from the pattern of growth of stormwater coalitions in Massachusetts.

Since 2012, about 140 municipalities have joined regional stormwater coalitions—voluntary groups of town officials, mostly DPW and other public works managers, in addition to some town administrators and environmental staff, who pool their stormwater expertise and resources to enhance local stormwater management. Started with seed money from state "good government" and Massachusetts Department of Environmental Protection (MassDEP)-administered grant programs, these regional coalitions have done the following:

- Produced training videos, public education materials, model ordinances, and reporting templates
- Held training sessions for town officials
- Implemented contracts for group purchasing of services from catch basin cleaning and disposal to maintenance of regional GIS data

The expansion of stormwater system work into the environmental field, caused in large part by the MS4 permitting system, broadens the focus and the funding of stormwater systems across municipal departments

Members of these stormwater coalitions tend to be smaller towns; of the 25 largest municipalities in Massachusetts, only eight are members of stormwater coalitions. Coalition members tend to be towns that need assistance in expanding stormwater services; they are too small to be "tubs that stand on their own bottoms."

The expanded MS4 permit's environmental requirements drive stormwater work into other areas of municipal governance, such as:

- Planning Board, Zoning Board of Adjustment, and Conservation Commission. Required changes to stormwater rules for development and redevelopment projects will increase involvement of these departments. Activities include various required land-use reports such as assessments of street design and parking lot guidelines and implementation of rainwater harvesting, green roofs, and infiltration practices, (for example rain gardens) and post-construction rules changes for new developments and redevelopments.
- Building Department or Permitting office. There are several construction-period rules changes, such as enhanced site plan review and inspections.
- Schools and Parks departments. "Good Housekeeping" requirements such as parking lot sweeping, catch basin cleaning, maintenance of vehicle storage areas, etc., would fall to other city or town entities depending on how the municipality is organized and if outside a DPW's jurisdiction.
- Public education. Requirements in this area could fall to almost any or several municipal departments, including two messages during the five-year permit term to each of four audiences—residents, industry, commercial, and construction.

Municipalities are already developing different approaches to accommodate this transformative change. These include shifting MS4 coordination into administrator offices, naming environmental coordinators or other staff with "cross silo " municipal responsibilities as MS4 leads, and establishing multi-department stormwater committees to implement MS4 requirements—or having existing committees, such as the Conservation Commissions, assume the MS4 lead.

Municipalities can also look toward other initiatives to implement the MS4 permit. Drinking water supplies, swimming ponds, and fisheries are all examples of important local resources to protect, and each has its own set of advocates whose time and energy can be harnessed for MS4 work, particularly when MS4 permit requirements overlap with actions to protect those resources.

The routine standards of professional care for engineers, scientists, planners, fiscal officials, and administrators, and their responsibility to do work for the public good, also play key roles in better managing stormwater. Many municipalities have for years proudly exceeded 2003 permit requirements, providing enhanced public information, building pollution reduction stormwater best management practices, and adopting more stringent stormwater rules that those of EPA or MassDEP. Those actions go well beyond what the rules require and show how deeply the environmental ethic has seeped into local public service.

CONCLUSION

Evaluating how the 260 Massachusetts MS4 municipalities respond to this pressure to act across municipal silos will be fascinating. We shall see if, as the 2003 permit did its job of inserting environmental considerations into municipal DPW work, the successor MS4 permit, which started on July 1, 2018, will improve stormwater management across local government.

NEBRA Highlights

About eight years after the one-time application of residuals, a stable native ecosystem takes over. All the open fields in the fore- and mid-ground are reclaimed with residuals.

Contrast—reclaimed asbestos (left) vs bare tailings

The rough residuals recipe covers the rocks, ready for seeding of a native grass and legume mix

The vegetation takes off and spreads—after three or four years, the vegetation fills in

Mine reclamation success in Asbestos, Quebec

"I don't think I've seen a more significant land reclamation project using biosolids anywhere in the Northeast," said Charley Hanson, Resource Management Inc. (RMI), during a tour on August 2 of the vast mine tailings plateaus at Asbestos, Quebec. There, biosolids, paper mill residuals, gypsum waste, and digestates are blended in agronomic recipes to reclaim tailings rubble—barren rock piles and gravel that extend for miles. Since 2004, Englobe, a soils and residuals management company and NEBRA member based in Sherbrooke, Quebec, has deployed nearly 400,000 tons (363,000 tonnes) of residuals to revegetate more than 500 ac (200 ha) of land that may now be used for wildlife, park land, and recreation. "Reclamation of this sort is the best environmental story ever for biosolids and residuals recycling. There is no downside, no viable argument against it. This is residuals being the solution," said Ned Beecher, NEBRA. Similar large mine reclamation projects have shown similar success elsewhere in Quebec and across North America.

Local research: water treatment residuals reduce phosphorus runoff in Vermont studies

According to the project final report, "With funding through the Vermont Natural Resources Conservation Service (NRCS) Conservation Innovation Grant (CIG) program, Northern Tilth and RMI completed agricultural field trials and a soil incubation study investigating the effectiveness of a Vermont-generated water treatment residual in reducing labile phosphorus concentrations in high phosphorus soils. The field trials included applying the alum-based water treatment residual (Al-WTR) to replicated plots on fields planted to silage corn on two Vermont farm fields (one in Essex and one in Williston), monitoring several labile forms of phosphorus, basic soil fertility, soil health parameters, and crop yield and tissue analysis over two field seasons.

"Both the field trials and the incubation study demonstrated that Al-WTRs can be effectively used to significantly reduce water soluble and modified Morgan phosphorus and, to a lesser extent, Mehlich III phosphorus and phosphorus saturation indices.... The Al-WTRs had no negative impacts on soil health or soil quality. In general, this research project indicates that Al-WTRs can be practically applied to soils in targeted, phosphorus sensitive agricultural areas (setback areas, buffer strips, and vegetated treatment areas) to reduce potential negative impacts from phosphorus on water quality, while improving soil health. Work completed for this study included a survey of Vermont water treatment plants to

WTR continued on page 60

PFAS: perfluorinated compounds drawing attention and affecting biosolids and wastewater programs

"We are going to find it everywhere. We need to be ready for that," said Peter Walke, Vermont Department of Natural Resources, at the EPA Region 1 PFAS community engagement meeting on June 26, 2018, in Exeter, New Hampshire. PFAS are polyfluorinated and perfluorinated alkyl substances, including perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). NEBRA has been tracking the PFAS topic for 18 months, advancing awareness and understanding that there are traces of these chemicals in biosolids and other residuals—in addition to "everywhere" else.

PFAS have been around for four decades—in wastewater and biosolids and humans. In the past decade, the most prominent ones—PFOA and PFOS—have been mostly phased out. NEBRA's perspective, shared by other water quality groups, is that regulatory actions related to PFAS are important but must be strategic and carefully thought out to avoid excessive disruptions and costs for municipalities managing drinking water, wastewater, and residuals. Recent NEBRA letters to EPA, NEBRA's perspective fact sheet, and more can be found on NEBRA's website.

PFAS has become a political issue. This spring, even as the New Hampshire Legislature settled on just one bill out of 12 addressing PFAS, PFAS was also swept up in national partisan politics because of a new Centers for Disease Control (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) *Toxicological Profile* for four PFAS chemicals that, some said, was held up by EPA because its findings were concerning. The report's conclusions suggest that a lower cautionary level for PFAS in drinking water may be needed—although it does not include specific drinking water screening values and includes language that indicates that the health science is still debated and the risks are not certain. The media and concerned groups emphasize that EPA's current public health advisory level of 70 ppt for PFOA plus PFOS in drinking water "should be 7 to 10 times lower," according to an Environmental Working Group press release. The ATSDR report is a draft, and states, federal agencies, and other experts are reviewing it. While media statements say the ATSDR report is clear in its findings, other voices say otherwise. For example, a New Hampshire state epidemiologist said at the regional PFAS community engagement that "they do not yet have the data to link exposure to PFAS to negative health outcomes," according to a New Hampshire *Union Leader* article.

The Region 1 PFAS community engagement session followed a May 22–23, 2018 EPA national PFAS summit in Washington, D.C. There, EPA Administrator (at the time) Scott Pruitt outlined a four-step plan that includes possibly setting a maximum contaminant level (MCL) for drinking water and listing some PFAS as hazardous wastes, which would allow federal law to require those who cause PFAS contamination to pay for clean-up. The National Association of Clean Water Agencies (NACWA) was invited to the summit, and NACWA biosolids lead Chris Hornback noted that EPA Region 1 Administrator Alexandra Dunn was "talking about the need to proceed carefully when identifying/addressing sources and to avoid the temptation to act blindly without having all the information in terms of relative contributions, risk, etc."

Both summits enabled citizens from communities where PFAS contamination from industrial and military activities has been most significant to voice their concerns. Some citizens noted that their voices have been raised for some time, and actions by EPA and states are not coming fast enough. This may be because scientists, state regulators, and EPA are stymied by the complications, uncertainties, and challenges of these chemicals, which are ubiquitous, numerous, difficult

PFAS is an issue to address, especially at sites with direct industrial and military discharges creating very high levels in drinking water. But risk from PFAS does not appear to be as great as risk from such long-known threats as lead, mercury, arsenic, and radon.

to measure, and may or may not be significant threats to human health. PFAS are almost the only chemicals of concern in the environment—and the only common ones—being regulated at the parts-per-trillion level in drinking water. (A part per trillion (ng/kg) is equal to about 1 second in 32,000 years.) This means the science, especially the epidemiology and risk assessment modeling, has uncertainties. In contrast, a health expert panel in Australia released a report this spring advising its government that there is "limited, or in some cases no evidence, that human exposure to PFAS is linked with human disease.... It is not practically possible to prevent all PFAS exposure due to the large number of sources from which people may still get very low exposures. Internationally, everyone generally has low levels of PFAS chemicals in their blood." The hedging language of the U.S. CDC/ATSDR report and the Australian report are more similar than not.

Meanwhile, New Hampshire has been one of a few states (along with Michigan, Minnesota, New Jersey, and Vermont) taking aggressive measures to understand and address PFAS concerns. But these states are stymied by the complications of the PFAS issue. The New Hampshire Department of Environmental Services (NHDES) provided updates about its efforts at an air and water regulatory conference coordinated with New Hampshire businesses and industry on May 31 in Manchester. As he had done at the national PFAS Summit in Washington in May, Brandon Kernen, the lead on PFAS at NHDES, mentioned wastewater and biosolids as sources of PFAS. NEBRA urged a more accurate perspective: wastewater and biosolids *convey* PFAS that are in our daily living environments. Other scientists speaking at the conference raised concerns about jumping too quickly to conclusions about human health impacts and fate and transport of PFAS in soils and waters. Other states in this region have taken different approaches from that of New Hampshire. Most are going

PFAS continued on page 60

WTR continued
determine the amount of WTRs potentially available for use in agricultural projects. Results indicate that the amount available could be limiting.... Also included in this report are Best Management Practices using WTRs as a conservation practice to reduce phosphorus run-off from agricultural production."

Global GAP

The Global Good Agricultural Practices (Global GAP) is an international food quality assurance program that gives food retailers confidence in the quality and sustainability of farm practices. Currently, the Global GAP quality standard precludes biosolids use, based on retailer perceptions that consumers object to biosolids use.

Over the past decade, biosolids groups have occasionally tried to communicate with food-producing and marketing organizations about the benefits of biosolids use, to advance acceptance of properly treated biosolids as a "normal agricultural practice" (as the Pennsylvania Supreme Court has described it), acceptable in food quality assurance schemes and, indeed, beneficial for meeting sustainability goals. For example, in 2014, NEBRA and others reached out—unsuccessfully—to Whole Foods Market when they announced an anti-biosolids policy.

Now, Greg Kester of the California Association of Sanitation Agencies (CASA) leads a national working group to reintroduce biosolids for consideration under the Global GAP's Harmonized Produce Safety Standard (HPSS). NEBRA is part of this working group. On June 28, Mr. Kester met with a U.S. technical working group for Global GAP, proposing that Global GAP adopt a similar standard as what the U.S. Food and Drug Administration did under the Food Safety Modernization Act: accepting biosolids when compliant with U.S. federal regulations at 40 CFR Part 503. These U.S. standards can provide a safe and efficient baseline of testing, treatment, and management of biosolids anywhere in the world. Mr. Kester's proposal met with some resistance from the technical working group, because, they said, food companies—marketers and distributors—are concerned about the perception related to biosolids.

Soon after, NEBRA learned of a parallel effort in Europe. NEBRA, CASA, and other U.S. biosolids groups had worked with some European stakeholders in 2016 on an initial outreach letter to Global GAP. That partnership has been reignited and, in August, a joint proposal from biosolids groups and other stakeholders, including WEF and the Sustainable Phosphorus Alliance, was submitted to Global GAP. The proposal is to allow biosolids use if the biosolids meet metals limits mostly equivalent to new European fertilizer standards, which are far stricter than Part 503 limits, are Class A, and are produced and/or distributed by an organization that is ISO 9001 or 14001 quality certified. Mr. Kester will join European counterparts at the Global GAP Crops Technical Committee meeting in Cologne, Germany, in September to advance the proposal. The Global GAP board has agreed to consider the technical committee's recommendations at its November meeting.

By adopting such a standard for the farmers who ascribe to the Global GAP system, this updated policy would advance the export/import of agricultural products, including those grown with the aid of biosolids.

PFAS continued
more slowly, understanding the uncertainties, as well as the potential for unintended, disruptive consequences of rushed regulatory actions.

While PFAS has become a well-known issue in some of the environmental field, it is still not front and center for most people. Although some individuals and groups of citizens, state regulatory agencies, and associated consultants have been working intensely for more than two years on the issue—especially around highly contaminated sites (e.g., Pease International Tradeport, Merrimack, New Hampshire, Hoosick Falls, New York, and North Bennington, Vermont)—and some have been addressing it for more than 15 years, much of the media coverage is still just introducing the topic, and public understanding is still forming.

At the same time, NHDES and other agencies are finding more and more challenges and complications daily: new sites with high PFAS from fire-fighting training, car washes, and more; a wider variety of PFAS chemistries; and more challenges with analyzing and understanding the fate and transport of PFAS.

As has happened with concerns raised about other trace contaminants conveyed in wastewater and biosolids, after initially jumping to conclusions that traces in biosolids may be a concern, regulators and experts are beginning to realize that, with PFAS too, sources and human exposures are far greater in our daily lives, and wastewater and biosolids are rarely significant routes of potential exposure. Still, more research is needed.

It is notable that at the EPA summit and community engagement sessions (more are being conducted around the country), one of the key agenda items has been risk communications. EPA and states recognize that communicating the PFAS topic is important. Yes, PFAS is an issue to address, especially at sites with direct industrial and military discharges creating very high levels in drinking water. But risk from PFAS does not appear to be as great as risk from such long-known threats as lead, mercury, arsenic, and radon. More risk communications are needed. The gap between how experts view the complexity of PFAS issues and the simplicity expressed by some concerned citizens and the media seems to be widening, possibly making it more difficult to find responsible, balanced policies and actions. A test of this will come when NHDES develops new water quality standards for PFAS later this year, as required by the legislature. Stakeholders with widely divergent perspectives are likely to be involved.

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For additional news or to subscribe to NEBRAMail, NEBRA's email newsletter, visit nebiosolids.org

nebra
North East Biosolids & Residuals Association

Spotlight: **Cohasset Wastewater Treatment Plant**

The town of Cohasset is a small, residential, coastal community southeast of Boston with a population currently estimated at 8,500. The town has a small industrial and commercial base and can be generally classified as a highly aesthetic, bedroom community known for its majestic coastal and inland vistas.

Cohasset Wastewater Treatment Plant
43R Elm Street, Cohasset, Massachusetts

Cohasset Board of Sewer Commissioners
Town Hall, Cohasset, Massachusetts

SUEZ Contract Operations
Suez Project Manager: ***Scott Papa***
Suez Regional Manager: ***John Marcin***

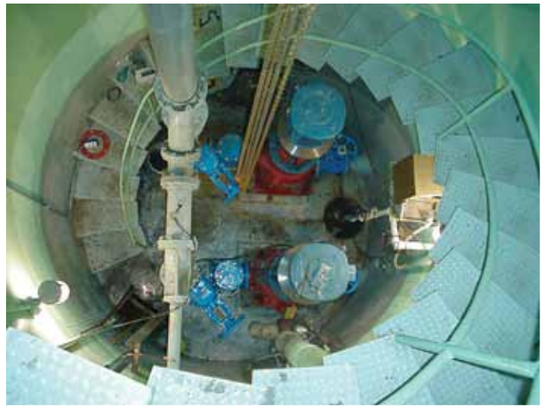
Consulting Engineer:
Coughlin Environmental Services, LLC

SYSTEM

The Cohasset Wastewater Treatment Plant (WWTP) is publicly owned and managed by an elected board of sewer commissioners. The WWTP has a design capacity of 450,000 gpd (1.7 ML/d), processing an average of 315,000 gpd (1.2 ML/d) and discharging it to Cohasset Cove/Harbor, a Class SA designated water body. The town's sanitary sewer collection system spans its entire coastline and major water bodies as well as the town center. The system includes a primary lift station adjacent to the WWTP with a capacity of 2 mgd (7.6 ML/d), seven remote lift stations, 30 miles (48 km) of sanitary sewer (both gravity and low pressure), and nearly 850 wastewater grinder pumps.

HISTORICAL PERSPECTIVES

The WWTP, originally constructed in 1979 as an extended aeration activated sludge facility, was constructed in the middle of Jacobs Meadow (a saltwater marsh) and was designed for only 72,000 gpd (272,500 L/d) to accommodate approximately 200 service connections in the congested town center. In 1979, the commonwealth of Massachusetts filed suit against the town under the Massachusetts Clean Water Act to force an expansion of the system, to address failing septic systems elsewhere within the town. The town entered into a Judicial Judgment with the commonwealth to evaluate needs and implement an expansion solution. Over the next 10 years through several amendments to the Judgment, the town evaluated its options, which were concentrated on costly comprehensive town-wide sewer systems and regional treatment alternatives. Simultaneously during this period, the Federal Construction Grants program was slowly phased out, essentially eliminating the 85 percent grant funding originally available for wastewater system construction. The financial implications related to the elimination of grant funding were considerable for this small residential community, and in the early 1990s the town evaluated and implemented a reduced scale "local solution." To reduce operational costs, the town contracted operations of the facility. By the mid-1990s, a local solution sent a portion of its flow (for about 300 dwellings) in the northern part of the town, abutting Straits Pond (a designated Area of Critical Environmental Concern), via a low-pressure sewer system to the town of Hingham (for pumping) and the town of Hull (for treatment and disposal). Various innovative and alternative technologies were examined for the WWTP upgrade and expansion, but its isolation within a saltwater marsh limited any footprint expansion. In 2000, the WWTP was expanded through retrofitting the aeration tanks to accept submersible hollow fiber membrane cassettes and thereby expand the facility capacity to 300,000 gpd (1.14 ML/d), within the same footprint. The collection system was also expanded, adding nearly 1,000 new users to the system through both gravity and low-pressure sewer collection mains. In the early 2000s while still under a modified version of the Judicial Judgment, a further system expansion addressed the Little Harbor area of the community. In 2007 through 2010, 450 dwellings were added to the system via low-pressure sewers, and the WWTP was again expanded using newly upgraded membranes to expand it to its current design capacity of 450,000 gpd (1.7 ML/d).



TREATMENT PROCESS

The WWTP includes the following unit treatment processes:

- Influent screening
- Aerated grit removal
- Primary anoxic tank
- Activated sludge membrane bioreactors (two tanks)
- Ultraviolet (UV) disinfection
- pH adjustment
- Alkalinity feed
- Sieve drum sludge thickener with polymer addition
- Sludge holding tank

Sludge is thickened to 4–5 percent at the facility and then hauled to a regional treatment facility for further processing and disposal. The effluent is pumped to Cohasset Cove/Harbor and discharged outside the navigable reach through three flexible duck-bill diffusers, set a few degrees off the horizontal, to promote horizontal and vertical dispersion through the receiving waters that allow it to achieve a 30:1 dilution ratio. The treatment process was enclosed in a building during the upgrades in 2000 and a separate blower/control building was also erected. The facility has full emergency power generation capabilities.

The capacity increase achieved was obtained with the membranes by expanding the reactor tank height and volume, by designing the process for a reactor mixed liquor for upwards of 10,000 mg/l and eliminating primary and secondary settling requirements. The WWTP does not accept outside sludge or septage. The NPDES permit limits the facility to 20 mg/l BOD and TSS monthly average, but the effluent quality is typically less than 2 mg/l and often non-detect for these parameters. Fecal coliform limits are 14 MPN, but the effluent is typically 1 or less. Total Nitrogen is a seasonally monitored parameter and typically averages around 8 mg/l. The NPDES is still under review by EPA for renewal. The Cohasset WWTP was recognized in 2013 with the Award for Excellence for Plant Performance by the Massachusetts Water Pollution Control Association, Inc., for its high pollutant loading removals and consistency in performance.

NEWEA Humanitarian Assistance Grant

Connecticut River Conservancy and Deerfield River Watershed Association *Monitoring Program*

RECIPIENT'S REPORT by Kathy Urffer, River Steward, Connecticut River Conservancy, Brattleboro, Vermont

In 2017, Connecticut River Conservancy (CRC) Water Quality Monitoring Coordinator Ryan O'Donnell started a water quality monitoring program nearly from scratch in the Deerfield River watershed. Deerfield River and many of its tributaries start in southeastern Vermont before heading into northwestern Massachusetts and emptying into the Connecticut River. The Deerfield River Watershed Association (DRWA) had recently joined up with CRC, becoming a regional chapter of sorts. Operating on a shoestring budget, its new program went without many supplies of its own during its first year. Despite the lack of supplies and equipment, it successfully engaged volunteers and conducted water quality sampling during the summer swimming season. Owing to this success, the program expanded this year. In addition to this relationship with DRWA, CRC also supports the monitoring program of the Southeastern Vermont Watershed Alliance, which monitors several Connecticut River tributaries in Windham County, Vermont. Overall these monitoring efforts assess water quality in the Deerfield, Green, West, Saxtons, and Williams rivers, and Whetstone Brook—essentially covering much of the drainage area of southeastern Vermont and part of Massachusetts.

The grant allowed water quality monitors to use new equipment that helped them run a professional program

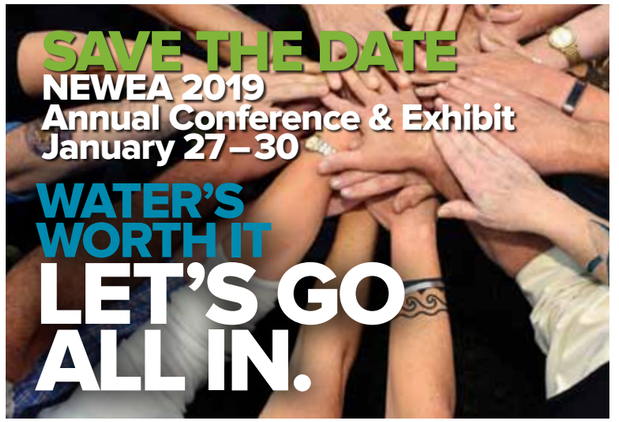
The NEWEA grant received by CRC allowed DRWA water quality monitors to use new equipment that helped them run a professional program. A Garmin GPS unit replaced the often inaccurate and woefully water-susceptible smartphone to map where water quality samples were taken. Purchasing an up-to-date conductivity standard solution allowed them to accurately calibrate the conductivity meter used for testing. Two telescoping sampling poles and supplies to build 6 ft (1.8 m) sampling poles allowed volunteers to take accurate samples from the safety of the river bank when necessary. Chain bungees made sure that thermometers did not float away while sampling. The NEWEA grant also enabled the purchase of large coolers to keep the samples cold and safe on their trip to the lab for processing. Finally, small coolers were purchased that feature the CRC and DRWA logo for volunteers to use to keep samples cold en route to centralized collection locations and as a thank you for the monitors' hard work and dedication.

To inform the public about water quality at swimming and boating sites up and down the Connecticut River, sampling results are shared on the website connecticutriver.us/site/content/sites-list. These results help to identify problem areas where land use, leaking septic systems, or other issues may be contributing to water quality degradation, and subsequently it enables CRC to reach out to solve those problems.

On behalf of DRWA and the Southeastern Vermont Watershed Alliance, CRC is grateful to NEWEA for supporting our collective efforts to monitor and steward our waterways.

The NEWEA Humanitarian Assistance Grant funds humanitarian and community-type projects that help fulfill NEWEA's mission—"to promote education and collaboration while advancing knowledge, innovation, and sound public policy for the protection of the water environment and our quality of life." Grant applications must be submitted by a NEWEA member. For details and an application visit newea.org.

Upcoming Meetings & Events



NEWEA WEFTEC RECEPTION
September 29, 2018
New Orleans, LA

WEFTEC
September 29 – October 3, 2018
New Orleans, LA

RESIDUALS & MICROCONSTITUENTS CONFERENCE & EXHIBIT
October 15, 2018
UMASS Lowell, MA

GOLF TOURNAMENT BENEFIT
October 22, 2018
LeBaron Hills Country Club, Lakeville, MA

CSO/WET WEATHER ISSUES CONFERENCE
October 29 – 30, 2018
Holiday Inn by the Bay, Portland, ME

NEWEA ANNUAL CONFERENCE & EXHIBIT
January 27 – 30, 2019
Boston Marriott Copley Place Hotel, Boston, MA

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

20TH ANNUAL NEW ENGLAND INDUSTRIAL PRETREATMENT COORDINATORS WORKSHOP
October 24 – 25, 2018
Lowell, MA

GMWEA FALL TRADESHOW
November 8, 2018
DoubleTree Hotel, S. Burlington, VT

RI NWPCA ANNUAL HOLIDAY PARTY
December 6, 2018
Potowomut Golf Club, East Greenwich, RI

This is a partial list. Please visit the state association websites and NEWEA.org for complete and current listings.

Measurement unit conversions and (abbreviations) used in the *Journal*

U.S.	International System of Units (SI)
Liquid volume	
gallon (gal)	liter (L)
cubic feet (ft^3)	cubic meters (m^3)
cubic yards (yd^3)	cubic meters (m^3)
acre-feet (ac ft)	cubic meters (m^3)
Flow	
million gallons per day (mgd)	million liters per day (ML/d)
for larger flows (over 264 mgd)	metric volume per day (m^3/d)
gallons per minute (gpm)	liters per minute L/m
Power	
horsepower (hp)	kilowatts (kW)
British Thermal Units (BTUs)	kilojoules (kJ) / watt-hours (Wh)
Velocity	
feet per second (fps)	meters per second (m/s)
miles per hour (mph)	kilometers per hour (km/h)
Gas	
cubic feet per minute (ft^3/min)	cubic meters per minute (m^3/min)

U.S.	International System of Units (SI)
Length	
inches (in.)	centimeters (cm)
feet (ft)	meters (m)
miles (mi)	kilometers (km)
Area	
square feet (ft^2) or yards (yd^2)	square meters (m^2)
acre (ac)	hectare (ha)
square miles (mi^2)	square kilometers (km^2)
Weight	
pounds (lb)	kilograms (kg)
pounds per day (lb/d)	kilograms per day (kg/d)
ton – aka short ton (tn)	metric ton or tonne (MT)
Pressure	
pounds/square inch (psi)	kiloPascals (kPa)
Inches water column (in wc)	kiloPascals (kPa)
feet of head (ft-head)	kiloPascals (kPa)

The Stockholm Junior Water Prize

This year's state winners from New England

The Stockholm Junior Water Prize is the world's most prestigious youth award for a water-related science project. National and international competitions are open to young people between the ages of 15 and 20 who have conducted water-related projects of proven environmental, scientific, social, or technological significance. The projects aim to increase students' interest in water-related issues and research, raise awareness about global water challenges, and improve water quality, water resources management, water protection, and drinking water and wastewater treatment.

Connecticut

Filtration of Heavy Metals from Drinking Water with Used Coffee Grounds Embedded in Discarded Polyurethane Sponges

Verna Yin
Greenwich High School
Greenwich, CT

Continued contamination of water, particularly by heavy metals such as lead, highlights the need for an easy-to-fabricate, low-cost, rapid filtration device. Previously, researchers have pointed out the usefulness of used coffee grinds for removing heavy metal contaminants directly from water. However, with such a filtering device, heavy metal removal is accompanied by the direct exposure to coffee, and likely caffeine, in the filtrate. Other researchers have created a coffee-based bio-elastomeric soaking sponge that requires sophisticated laboratory synthesis and at least 30 hours (of soaking time) to create potable drinking water from a typical heavy metal contaminated resource.

In this research, a new polyurethane-coffee sponge "filter" was engineered via the combination of a 30 cm^3 (1.8 $in.^3$)used polyurethane sponge, 2 grams of spent coffee grinds, and 4 grams of phenol binder/stabilizer. Produced only with physical mixing and low temperature heating that is easily produced in the field (without the need for sophisticated laboratory equipment), the filter is created in only one hour, at around 25¢ per device.

To verify the efficacy of the PUF-C filter at removing lead (Pb) contamination in water, 15 ml of 1,000 ppb Pb-contaminated water was passed through a 30 cm^3 sponge filter (inserted into a consumer 60 cc syringe housing). Lead content in the resulting filtrate was reduced to 13.8 ppb, well below the EPA water action level of 15 ppb (below which water is deemed potable). Re-filtration of a single-pass filtrate: Fourier transform infrared coupled with attenuated total reflectance analysis (FTIR-ATR) of "coffee-only" filtrate highlights the presence of coffee in the Pb-reduced water. The Pb content was reduced to near negligible amounts (2.0 ppb) with three additional passes through the filter. The heavy metal chelating properties of the coffee grinds were realized through comparison of the PUF-C remediation results with those of the PUF sponge control. In these experiments, Pb content was marginally reduced from 1,000 to 681 ppb, with four passes through the sponge filter.

PUF-C sponge filter longevity and usefulness for meaningful volumes of contaminated water were evaluated by passing 1 L of 1000 ppb through the 30 cm^3 sponge, at 15 ml intervals. Once again, for each filtrate, Pb content was reduced to ~13–14 ppb, so that 986 µg Pb was removed for the entire 1 L sample. This corresponds to a removal efficiency of 33 µg-Pb/gram of PUF-C sponge filter, or, regarding the incorporated coffee grinds specifically, 1.4 mg-Pb/gram of coffee grinds.

Finally, (FTIR-ATR) of the PUF-C sponge filtrates highlights the purity of the now "lead-free" water source, that is free of color and free of contaminants from an otherwise stable, long-term filtering device. Scanning electron microscope analysis of the used PUF-C sponge reinforces the notion that the coffee grinds are intact within the polyurethane architecture, held in place by the phenol binder. Important to note is that filtration with only coffee grinds leads to coffee-colored water, with coffee components.

Thus, a new, coffee-based sponge filter was engineered to act as an inexpensive and easily fabricated Pb heavy metal filter that can be fabricated in one hour from waste coffee grinds and used polyurethane sponges, with no external lab resources, at a final cost of about 25¢ per filter.

Massachusetts

What is in Your Water? Using Variable Water Temperature as a Method of Limiting Synthetic Fabric Microfibers

Elise Mizerak
Wachusett Regional High School, Holden, MA

Plastic microfibers have been recently found in tap water around the world and in the ocean. Both humans and ocean wildlife could potentially be ingesting these materials. This type of plastic pollution is especially concerning because plastic is not biodegradable. These microfibers are thought to stem from synthetic fabrics, which are man-made primarily from recycled plastic. Owing to the small size of microfibers, conventional purification systems sometimes cannot filter the fibers out. Thus, they end up in tap water and ocean water. This pollution issue will not stop clothing companies from using plastic, because it is much more cost-efficient to use synthetics rather than natural fibers. This project focuses on what the average American household can do to limit the use of plastic microfibers.

Water temperature and types of synthetic fabric were chosen as independent variables because both can be easily changed by anyone. A multifaceted experiment was designed to see the effect that water temperature has on microfiber release when clothes are washed in different temperatures.

To simulate a washing machine, small samples of each type of fabric were stirred in water at various temperatures. A 0.5 mL sample was observed under the microscope and used to count plastic microfibers. Although each fabric reacted differently, the temperature that the fabrics were washed in did not influence the amount of fibers produced in each fabric. However, the average amount of microfibers produced by each fabric did differ. Nylon produced on average the fewest microfibers. The temperature exhibited no discernible effect on microfiber production in nylon. Rayon produced the next fewest plastic microfibers. In the Rayon fabric, however, there was no correlation between the fibers produced and the temperature that the fabric was washed in. Acrylic had the third largest average microfiber production. Similar to the nylon and rayon fabrics, the amount of fibers produced compared to the temperature that the fabric was washed in showed no correlation. The polyester and polar fleece fabrics showed interesting trends. In polyester, more fibers were produced in the two coldest temperatures tested, 10°C and 20°C, compared to the two warmest temperatures tested. This was an especially notable trend because this directly contradicted the initial hypothesis. Polyester produced the second-most fibers out of the five tested. The polar fleece fabric samples resulted in outcomes similar to those in the polyester samples. More fibers were produced in the two coldest temperatures compared to the two warmest temperatures. Polar fleece also produced the most fibers out of all the fabrics that were tested.

Other possible studies would be to see how microfiber production changes in subsequent washes or if adding laundry detergents affects microfiber production. Continued diligence and research will hopefully offer more answers or give more options for cleaner, safer water.

Vermont

Neutralization of Pharmaceutical Pollution in Lake Champlain

Sunthoshini Premsankar
Champlain Valley Union High School, Hinesburg, VT

Pharmaceuticals, road salt, and motor oil are all examples of nonpoint source pollutants that contribute to the contents of Lake Champlain. Of these harmful pollutants, the acetaminophen compound in pharmaceuticals is particularly dangerous to the plants (e.g., duckweed) found in the lake as it inhibits the plants' ability to go through photosynthesis. This project aimed to find substances or solutions that could be introduced into the lake to protect the plants.

In this experiment, duckweed—a plant commonly found in Lake Champlain—was kept as the determining component. Identified as potential solutions through research, activated charcoal, alumina, and silica gel were used as adsorbents of acetaminophen. The effectiveness of each absorbent was found by using chromatography to measure the resulting levels of pharmaceutical content after filtration. It was concluded that activated charcoal was a very good adsorbent and filtered out the solution well while activated alumina and silica gel failed to do so.

Maine

Infusing Cellulose-Based Materials with Layered Double Hydroxides for Remediation of Phosphorus from Stormwater

Mei Tian
Bangor High School
Bangor, ME

With less than 0.3 percent percent of Earth's water available for human consumption, the decreasing availability of freshwater is one of the world's biggest problems. Excess phosphorus, brought into a body of water by stormwater runoff, leads to the rapid acceleration of eutrophication, causing harmful algal blooms to spread across bodies of water. This research attempted to answer, Can cellulose-based materials infused with layered double hydroxides effectively remediate phosphorus from stormwater?

The first cellulose-based material tested for phosphate removal was cellulose nanofibers (CNF), one of the most advanced biomass materials in the world. Layered double hydroxides (LDH) are a mineral that uses ion exchange to facilitate phosphate removal. Two treatments—CNF infused with LDH and CNF alone—were tested. Results from this test showed that the CNF was contributing phosphate to the solutions, most likely because phosphate is initially present in the CNF, which is derived from wood pulp.

The next step was to find a material that would effectively carry the LDH while contributing to the adsorption of phosphate from stormwater. This led to the testing of bacterial cellulose (BC), which is synthesized by bacteria and is widely known for its chemical purity. BC infused with LDH and BC alone were tested, and the following results were obtained.

After 24 hours, the BC alone removed on average 54.9 percent of phosphate from the phosphate solutions, suggesting that unlike the CNF alone, BC alone did not contribute phosphate to the solutions. The BC infused with LDH removed on average 97.5 percent of phosphate from the phosphate solutions. Furthermore, the BC with LDH removed 98.8 percent of phosphate from the 1 ppm phosphate solution. That is 988 ppb of phosphorus. To put this into context, stormwater detention ponds typically have concentrations of phosphorus between 150 and 420 ppb, showing that BC infused with

(continued on next page)

Rhode Island

Waddle We Do Without Duckweed? Phytoremediation of Heavy Metals in Water Using Aquatic Macrophytes

Margaret O'Brien
Mt. Hope High School
Bristol, RI

Phytoremediation, or the use of living plants to remediate contaminated water and soil, is highly regarded for its reasonable expense and sustainability. This project aimed to investigate the ability of three aquatic macrophytes—duckweed (Lemnoideae), azolla (Azolla pinnata), and water lettuce (Pistia stratiotes), to absorb zinc chloride ($ZnCl_2$), copper chloride ($CuCl_2$), and strontium chloride ($SrCl_2$) in water.

In Trial 1 of the experiment, duckweed and azolla were added to 1.0, 0.1, and 0.01 molar mass (MM) solutions of $ZnCl_2$, $CuCl_2$, and $SrCl_2$ for 20 days. Results of Trial 1 indicated that duckweed and azolla could survive only in 0.01 MM solutions. Therefore, in Trial 2 of the experiment, duckweed and water lettuce were added to 0.01, 0.001, and 0.0001 MM solutions of $ZnCl_2$, $CuCl_2$, and $SrCl_2$ for five days.

X-ray fluorescence results indicate that in Trial 1 the duckweed extracted more metal from the water in the $ZnCl_2$ and $CuCl_2$ solutions, but the azolla extracted more metal from the $SrCl_2$ solution. In Trial 2, the water lettuce extracted more metal from the 0.01 MM solution, and duckweed extracted more metal from the .001 and .0001 MM solutions. Concentrations of metals increased in all sampled plants after their exposure to the solutions, and all sample solutions decreased in metal concentrations after plant exposure.

The results demonstrate that water lettuce would be the most effective of the sampled plants in higher concentration areas, possibly because of their larger leaf size. Further experimentation and research could be done to determine why water lettuce is better in higher concentrations than the other macrophytes and at what concentration water lettuce becomes more effective than duckweed and azolla. Additionally, the results suggest that azolla is more effective at absorbing strontium than zinc or copper. Further research is needed to determine why azolla easily absorbs strontium (perhaps having to do with the plant's physiology or nutritional/growth needs). Overall, this experiment validated the hypothesis that if three aquatic macrophytes—duckweed, azolla, and water lettuce—are exposed to different dilutions of heavy metal solutions of $ZnCl_2$, $CuCl_2$, and $SrCl_2$, the plants will hyperaccumulate the metals from the water by increasing the concentration of the exposed metal in their tissue, thus decreasing the concentration of metal in the water. Thus, depending on the type and concentration of metals in a contaminated water body, each of the three plants tested here could prove useful for phytoremediation.

New Hampshire

An Economical Approach for Detecting Water Contamination at Homes —Preventing a Public Drinking Water Crisis

Meghana Avvaru
Nashua High School South
Nashua, NH

Contamination in water poses a serious and mostly undetected threat. People must have an economical option for testing the water they drink in their homes. The presence of toxins in water today can be tested in several ways; however, existing methods are either expensive or inaccurate. Even outsourced laboratory tests cost around $100 for each sample. Store-bought test kits are also insufficient for testing toxins in water as they provide inaccurate results. Thus, an inexpensive and reliable method to test drinking water in homes is needed.

A testing device was devised using infrared spectroscopy, Raman spectroscopy, and surface enhanced Raman scattering (SERS). The following explains these methods:

- Infrared spectroscopy studies the interaction of infrared radiation with molecules.
- Raman spectroscopy is the inelastic scattering of a photon by molecules excited to higher vibrational or rotational energy levels.
- SERS uses metals such as gold or silver to enhance Raman scattering signals.

Colloidal silver is widely available for purchase and was used as the SERS substrate.

Essentially, molecular bonds absorb energy and vibrate when exposed to infrared light. The vibrating bonds scatter light transmitted through them and cause a frequency shift depending on the frequency of the transmitted light, also known as Raman scattering. If various frequencies of light are passed through an excited molecule, each frequency of light will scatter differently. Therefore, a molecular fingerprint can be created for a toxin by measuring and plotting the scattering of various frequencies of light. The molecular fingerprint may be used to detect the toxin in a water sample. Since Raman scattering signals are weak, making them difficult to detect with a low-cost light sensor, SERS was used to amplify these signals.

The testing device consists of two parts. The first part includes a data capturing device, which uses an Arduino Uno microprocessor connected to a light sensor, an LED Neopixel Ring, infrared LEDs, and a Bluetooth module. The second part includes an iPhone app, which processes the light sensor values obtained and calculates the toxin content in a spot test sample. Before using the device, a spot test sample must be created by adding a few drops of the water being tested and a drop of a toxin indicator reagent on filter paper. After it is dried, the spot test is then placed over the device, which will begin to take readings once initiated through the iPhone app. Six light frequencies shine on the spot test sample before and after five minutes of infrared light exposure. The light sensor reads the frequencies and sends them to the iPhone app. The differences between the frequencies of light before and after infrared light exposure determine the concentration of a specific toxin based on prior calibration. The device was calibrated for lead and fluoride testing.

This device successfully produced accurate measurements for each sample. The Pearson's R test was used to further analyze the results. The lead test indicated an *r* value of 0.975 with a P value of less than 0.0001, indicating that the probability of correlation between actual and obtained concentrations due to chance is less than 0.1 percent. The fluoride test data indicated an *r* value of 0.973 with a P value of less than 0.0001.

This device is an economical option for households everywhere. The manufacturing cost of the device based on the best retail prices and usage of professional components would be less than $26. Thus, this solution is affordable and reliable for testing the water supply at homes.

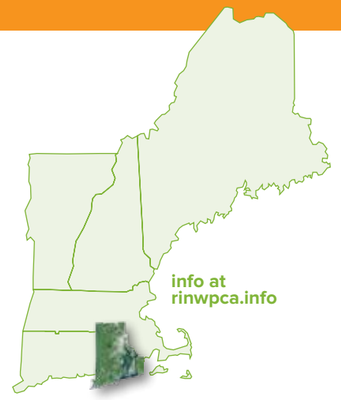
Maine (continued)

LDH has the capacity to significantly reduce this phosphorus concentration. Statistical analysis was conducted, and t-tests showed a significant difference between the BC with LDH and the BC alone as well as a significant difference between the BC with LDH and the CNF with LDH with p-values of 0.0001 and 0.0066, respectively.

In conclusion, stormwater pollution and eutrophication are two of the world's biggest problems, and bacterial cellulose infused with layered double hydroxides is a potential solution to the long-term goal of purifying the Earth's water and providing potable water to all. Future work will design a 3D-printed housing for easy deployment; removal of the BC in detention ponds and testing will also be done to examine the kinematics of phosphate adsorption by BC with LDH as well as its capacity to remove other contaminants such as heavy metals and dyes.

Rhode Island State Director Report

by Scott Goodinson
Scott.c.goodinson@warwickri.com



As the Narragansett Water Pollution Control Association (NWPCA) Rhode Island state director, I am pleased to report that things are going extremely well in the Ocean State. The exhilaration and energy continues as we celebrate our very own Ocean State Alliance's recent first place win at the Operations Challenge regional competition, which was held during NEWEA's Spring Meeting in our very own backyard—Newport, Rhode Island. Congratulations, again, to the team and best of luck in New Orleans at WEFTEC.

I recently attended a meeting at the Westerly Education Center (WEC) to investigate the probability of our wastewater industry (NWPCA) partnering with the WEC. The WEC is a public–private collaboration that brings together higher education, business, industry, and community partners to provide high-quality educational programs to meet projected workforce growth in the region.

The center currently partners with the University of Rhode Island, Community College of Rhode Island, Rhode Island College, the Office of the Postsecondary Commissioner, and the Rhode Island Department of Labor and Training. Private partners include companies such as Electric Boat and other Rhode Island businesses. The meet and greet/brainstorming meeting included Jeffry Ceasrine from the town of Narragansett, Peter Eldridge, superintendent at Narragansett and NWPCA president, Janine Burke-Wells, NEWEA president and Warwick Sewer Authority executive director, Glenn Wilcox, workforce development project coordinator at WEC, and Amy Grzybowski, executive director of WEC. Stay tuned for more updates on this exciting opportunity.

Recent Events

Congratulations to the **Rhode Island 2018 Stockholm Junior Water Prize Winner**, Mt. Hope High School's Margaret O'Brien, and her awesome project, "Waddle We Do without Duckweed?" Phytoremediation of Heavy Metals in Water Using Aquatic Macrophytes. Congratulations Ms. O'Brien, well done.

NWPCA's board members for 2018:

- Peter Eldridge, Town of Narragansett, President
- Peter Connell, Inland Waters, Vice President
- James Lauzon, CH2M–Woonsocket Water Pollution Control Facility (WPCF), Treasurer
- Nora Lough, Narragansett Bay Commission, Secretary
- Bernard Bishop, West Warwick WPCF, Executive Board
- Anthony Calenda, Suez–Newport WPC, Executive Board
- Mike Bedard, West Warwick WPCF, Executive Board
- Jason Trenholm, Veolia–Cranston WPCF, Executive Board
- Chris Campo, Seacoast Supply, Director of Vendor/Consultant & Coordination
- Steve Buckley, Blake Equipment, Director of Vendor/Consultant & Coordination
- Paul Desrosiers, Narragansett Bay Commission, Operator Certification Board Representative
- Scott Goodinson, NEWEA State Director and NWPCA Past President

April 17–18, National Water Policy Forum & Fly-In—Janine Burke-Wells accompanied Mary Barry to the WEF Government Affairs meeting. She also attended NEWEA's Congressional Clean Water Briefing held at the Capitol Visitors Center. From there, Ms. Burke-Wells and the Rhode Island contingent visited with Congressmen Jim Langevin and David Cicilline, and Senator Jack Reed. The following day, the Rhode Island contingent met with Senator Sheldon Whitehouse. The group had good discussions about the need for infrastructure funding and workforce development programs.

On June 23, 47 attendees enjoyed hamburgers, hot dogs, corn-on-the-cob, baked beans, and many more delicious sides at the **Annual PawSox Family Baseball Outing** at McCoy Stadium. The kids especially enjoyed the awesome fireworks after the game. This event continues to grow every year.

NWPCA held its **annual golf outing** on June 25. This event was held at the Potowomut Golf Club, in Warwick. At only $135 per player, which included green fees, cart, barbecue lunch, dinner, and prizes, the event sold out in just two weeks. These guys and gals know how to do golf.

After years of continued success, our **golf and bowling leagues** are still thriving, and everyone is welcome to participate. For golfers, for just $22 you are playing nine holes at the beautiful Richmond Golf Club. Afterward, we all meet in the clubhouse for a few cold ones and a bite to eat. Or, if you prefer bowling, for around $2 per game with shoes included you can practice on your lane skills while sharing a pitcher of your favorite "aiming fluid" or enjoying something to munch on from the full snack bar at the conveniently located Cranston Lanes. Both are great, inexpensive ways to network, and get to know one another within NWPCA and in the Rhode Island wastewater community. Reach out to any of us for more information on these or any of our events.

Just a Reminder—Scholarship Time

NWPCA is pleased to provide several scholarships annually to college students, sponsored by our members. Scholarships range from $500 to $1,000 depending on the number and quality of applications received.

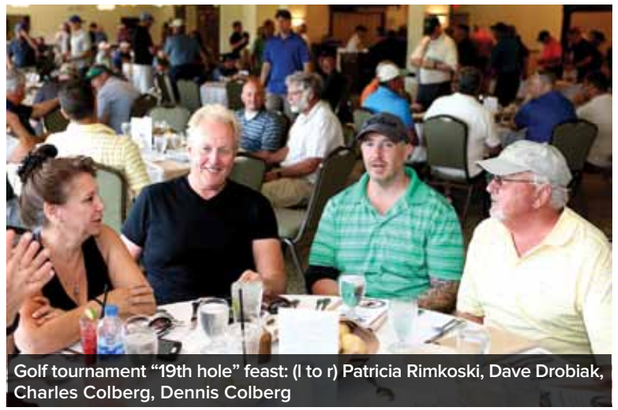
Miscellaneous

Our NWPCA Facebook page (facebook.com/NWPCA) is doing well, with 218 likes and 217 people following us. Also, be sure to check out our newly revamped website at rinwpca.org.

I look forward to my continued work with the other state directors, committee members, and NEWEA in the upcoming years. Getting our message out and serving our members while promoting our ever-changing industry is paramount for the continued success for all of Rhode Island, NEWEA, and WEF.

Golf tournament participants: (l to r) Susan Sullivan, Roberta Wells, Janine Burke-Wells, Jenn Lachmayr, Amy Anderson

Golf tournament participants: (l to r) Melissa Mooradian, Peter Connell, Tracy Pina, Melissa Desautel



Golf tournament "19th hole" feast: (l to r) Patricia Rimkoski, Dave Drobiak, Charles Colberg, Dennis Colberg

Upcoming Event	Date	Location
General Business Meeting	October 9	Warwick Sewer Authority
General Business Meeting	November 19	Warwick Sewer Authority
Annual Holiday Party	December 6	Potowomut Golf Club

New Hampshire State Director Report

by Sean Greig
sgreig@newmarketnh.gov

This past spring has been a busy and successful season for the New Hampshire Water Pollution Control Association (NHWPCA).

The NHWPCA began its year with its annual Legislative Breakfast on March 7. The theme of the breakfast was as follows: New Hampshire's economy, jobs, and "quality of life" all depend on water. The keynote speaker, Alex Ray, founder of the Common Man Restaurants, spoke about the importance of water to his business. Mr. Ray was followed by Clark Freise, assistant commissioner of the New Hampshire Department of Environmental Services (NHDES). The 95 attendees enjoyed a hearty breakfast, listened intently to the presentations, and asked excellent questions. Thank you to Shelagh Connelly, Fred McNeill, and all the others who made this such a great event.

On April 13, NHWPCA had its 38th annual Trade Fair at the Radisson Hotel in Nashua. Operators from around the state mingled with vendors and exchanged stories with fellow operators. The two technical sessions offered were Protective Coatings and Innovations for Water and Wastewater Environments, and Cost Advantages of Mechanical Seals Versus Packing. The Trade Fair and technical sessions were followed by a lunch and presentation of awards. The event was well attended and successful.

NHWPCA has had a booth at Discover Wild New Hampshire Day for as long as I can remember. Some may say, and sometimes rightly so, that my memory is not very good; however, in this case I know that NHWPCA has had a booth for at least 10 years. This event is produced by the New Hampshire Fish and Game Department. The day was fun, with attendees exploring New Hampshire's wildlife resources and legacy of outdoor traditions. Participants from more than 60 organizations from around the state interacted with the thousands, yes thousands, of attendees. NHWPCA received a lot of exposure during this activity. Our volunteers answered questions and raffled off a fishing pole every half hour. I recommend that everyone put this event on his or her calendars to attend next year.

The New Hampshire Poster Contest was successful with 10 schools participating and submitting 167 poster entries. This year's theme, "Quality of Water, Quality of Life," was embraced by all participants. The winners and their families attended the annual Proclamation Signing by Governor Christopher Sununu at the State House on May 16. NHWPCA President Tim Vadney opened the ceremony with introductory remarks and then handed over to John Aide of NHDES who spoke about the importance of water. The governor spoke of his concern for water, the environment, and its importance to New Hampshire. The Proclamation was followed by an awards dinner across the street at the New Hampshire State Library. At the dinner, NHDES Director Eugene Forbes spoke further to the children about the importance of clean water. This year's poster contest event is the largest to date with 63 registered attendees for the Governor's Proclamation Signing and Dinner. Many thanks to Geri Ciardelli and Dave Mercier for their hard work that has made the event such a continued success. Thank you to NHDES for sponsoring the event dinner.

It is unfortunate that NHWPCA did not have an Operations Challenge team this year. Previously, NHWPCA had a team every year consecutively since 2001. Operations Challenge is a great way to test and improve your skills, meet different operators, and go and see different places. A team requires four operators, who do not need to be from the same wastewater treatment plant (WWTP). There is a training day every March for New England teams to go over the five competitive events. The teams will practice on their own and then compete in June at the NEWEA Spring Meeting. The top three teams from the competition travel to compete nationally at WEFTEC in October. If you are an operator or other technician and are looking for skill and leadership development, I recommend Operations Challenge. For more Information or for help in forming a team, you can contact long-time participant Iron Mike Carle mcarle@town.hampton.nh.us from the Hampton WWTP.

On June 22, NHWPCA members converged on Ellacoya State Park for the 2018 Summer Outing. It was a picture-perfect day to enjoy fabulous food and each other's company. Charlie Tyler was there snapping pictures of the members who were having a good time playing corn-hole, conversing, and sharing laughs and camaraderie. Many thanks to Mike Theriault and his crew for their hard work that produced such a great event.

SCHOLARSHIP WINNERS

NHWPCA is proud to award $750 scholarships this year to the following individuals:

Virginia Mercier, Pinkerton Academy. Ms. Mercier will enter the biology program at the University of New Hampshire. In her advanced biology classes she has studied cell development, with an eye toward nutrient uptake. She is looking forward to learning about how to harness nature to use it to our advantage.

Hannah Gordon, Merrimack Valley. Ms. Gordon wants to pursue her passion in molecular biology research when she enters college full-time, developing ways to make clean drinking water more accessible. At Merrimack Valley, she impressed her teachers with her strong leadership skills.

Cody Richardson, White Mountain Community College. Mr. Richardson was awarded this year's College Scholarship. A former high school science teacher, he would like to join our profession as a lab technician, using his background in science. At the completion of his program, he will be ready to sit for his Grade I wastewater exam.

Congratulations and good luck to all of our scholarship winners!

New Hampshire Governor Christopher Sununu. The kids around him are winners and honorable mention students who participated in the annual NHWPCA Poster Contest for Clean Water Week 2018.

Vermont State Director Report

by Chris Robinson
chris.robinson@gmwea.org

In Vermont, the Green Mountain Water Environment Association (GMWEA) has been busy on many water, stormwater, and wastewater issues. GMWEA continues to offer training opportunities, educational outreach to the public, and proactive outreach on government affairs.

Spring Meeting

The GMWEA Spring Meeting took place in Killington on May 24. Around 200 participants attended this event. Nine training sessions were offered, followed by the annual business meeting. Election of officers took place, with four candidates vying for the open director seats. The following are the elected members of the 2018 GMWEA Board of Directors: President, Tom DiPietro; 1st Vice President, Nate Lavallee; 2nd Vice President, Mike Barsotti; Secretary, Chris Cox; Treasurer Wayne Elliott; Past President, Rick Kenney; and Directors Steve Crosby, Bob Fischer, Amy Macrellis, Ryan Peebles, Chris Robinson, and Eileen Toomey. Welcome to new directors Amy Macrellis and Eileen Toomey.


GMWEA President Tom DiPietro addresses the membership

GMWEA's annual awards were presented. NEWEA President-elect Ray Vermette re-presented the following awards (originally presented at the 2018 NEWEA Annual Conference in Boston): NEWEA Vermont Operator to John Alexander; NEWEA Alfred E. Peloquin to John Lazelle; USEPA Operations & Management to the town of Milton; USEPA Operator to Nate Lavallee; and USEPA Energy Management Achievement to the village of Essex Junction Wastewater Treatment Facility.

Clean Water Week

Since 2014, GMWEA has celebrated Water Quality Day in May, but this year we presented it from July 29 to August 4. We changed the date to build synergy with Clean Water Week, a statewide initiative promoted by the Vermont Department of Environmental Conservation (DEC) to boost public awareness of Vermont's natural waters and the institutions that help to keep them clean—especially our water, wastewater, and stormwater facilities.

GMWEA members participated by hosting facility tours/open houses during the last week of July. Participating facilities were provided posters, press releases and other promotions, blog postings, signs, Water Quality hats and T-shirts, and $50 for snacks for visitors. Last year, 250 Vermonters attended nine members' open houses; this year, with the Vermont DEC's support, the turnout was better than ever.

For more information on Clean Water Week, visit dec.vermont.gov/watershed/cwi/clean-water-week.

For information about Water Quality Day, check out gmwea.org/water-quality-day.html.

George Dow Memorial Golf Tournament

Each year around 100 players and sponsors take part in the annual George Dow Memorial Golf Tournament. This year the event was held on August 17 at the Cedar Knoll Country Club in Hinesburg. This event was a great success—the downpour held off until everyone was in the clubhouse. The proceeds from this event help fund the GMWEA scholarship administered by the Vermont Student Assistance Center.

Governor's Cup Fishing Derby

For the past five years, GMWEA has participated in this social event hosted by Lake Champlain International. This event enables four GMWEA members to spend a few hours socializing with Governor Philip Scott and a few State Representatives in a laid-back atmosphere. This year's event took place on June 13 and had about 40 participants. Attending for GMWEA were Erik Bailey, Kendall Chamberlin, Jennifer Garrison, Kevin McLaughlin, and Bob Fischer, although Mr. Fischer did not fish. The team was in first place for most of the day until a large fish was caught by another team during the contest's final moments.

59th Annual STEM Vermont Fair/ Stockholm Junior Water Prize

GMWEA board members volunteered again this year to judge water-related projects at the Science, Technology, Engineering, and Mathematics (STEM) fair on March 24 at Norwich University. GMWEA uses this venue to select a candidate for the Stockholm Junior Water Prize. Congratulations to Sunthoshini Premsankar from Champlain Valley Union High School for being chosen to represent Vermont in the Stockholm Junior Water Prize national competition with her project, "Neutralization of Pharmaceutical Pollution in Lake Champlain."

Operation Water Worker's Charity Motorcycle Ride

Ten GMWEA members, and family and friends gathered for this first annual motorcycle ride. The 148-mile ride, held on June 23, took riders through many of Vermont's beautiful hills and valleys. Proceeds from this event help association members (anonymously) who have experienced recent hardships and could use a helping hand.

Government Affairs

GMWEA's Mr. Fischer, who is also the NEWEA Government Affairs chair, has been successful in scheduling quarterly regulator meetings. The meetings with Vermont's Agency of Natural Resources (ANR) and Department of Environmental Conservation's (DEC) staff have proven mutually beneficial for all. The two-hour meetings are held in Montpelier and typically have around 25 attendees. Other meetings attended include the following:

- February 22, GMWEA participated with various Water Quality advocacy groups at the Vermont Statehouse for Clean Water Day
- May 15, Mr. Fischer Attended a Clean Water Network Meeting and Legislative Wrap-up


Village of Essex Junction WWTF employees with the NEWEA Energy Management Achievement Award: Howard Kimball, Chelsea Mandigo, and Bernard Fleury

panel discussion at ECHO, Leahy Center for Lake Champlain

- June 5, Mr. Fischer attended the NEWEA Spring Conference as a GMWEA representative at the Affiliated State Association meeting and the NEWEA Government Affairs meeting

Owing to the impasse between Republican Governor Scott (who vowed not to raise taxes or fees this year) and the Democrat-controlled Legislature, S-260, which was intended to provide funding to comply with the Lake Champlain Total Maximum Daily Load (TMDL) and included a per-parcel stormwater fee, did not pass. Only one water quality funding source was added by this year's legislation (approximately $2 million annually from the unclaimed bottle return fund will now go toward Water Quality needs). Currently, the state plans on using capital funds for water quality improvement for the next two years, but failure to enact a permanent source of funding will violate provisions of the Lake Champlain TMDL implementation plan as required by the Vermont Clean Water Act.

Upcoming Events

The GMWEA Fall Trade Show and Conference will take place on November 8, 2018, at the new Doubletree Hotel and Conference center (formerly the Sheraton) in South Burlington.

The third GMWEA/NEWEA Young Professionals POO & Brew/No Water, No Beer event, intended to bring together young operators, Northeast regional industry representatives, and municipal and state officials, is being planned. The event begins with an instructive tour of an industry colleague's facilities (water reclamation for POO & Brew, drinking water purification for No Water, No Beer) followed by a social gathering and tour at one of Vermont's finest breweries nearby. The event is scheduled to coincide with the Fall Trade Show, and information will be forthcoming through various channels, including the GMWEA website. To participate, register early since attendance is limited and this event sells out quickly every year.

Connecticut State Director Report

by Virgil Lloyd
vlloyd@fando.com

Governor Signs Statute Establishing Continuing Education Requirement for Licensed Wastewater Operators

Both the Connecticut Water Pollution Abatement Association (CWPAA) and Connecticut Association of Water Pollution Control Authorities (CAWPCA) are thrilled to announce that on the last day of the legislative session, the State Senate joined the State House in passing by a large margin a statute (PA 18-97) creating a continuing education requirement for all Connecticut wastewater treatment operators. This legislation became law in early June upon the signature of Governor Dannel Malloy.

Ray Weaver of CWPAA presents testimony in support of continuing education bill at legislative hearing

The statute requires all operators to obtain six hours of continuing education every year. It is a self-monitoring program, with each operator, as well as the facility at which they are employed, required to maintain a record of their annual continuing education classes and training. The records are also to be made available to Connecticut Department of Energy and Environmental Protection (DEEP) inspectors upon request.

The new requirement goes into effect October 1, 2018. CWPAA and CAWPCA have established a dialog with DEEP and the Certification Advisory Committee (CAC), as well as the New England Interstate Water Pollution Control Commission to develop course offerings as well as other qualifying training opportunities.

CWPAA Welcomes New Leadership at Annual Product Show

The CWPAA Annual Product Show was held on April 26 at the New Life Church in Wallingford. More than 130 people attended this year's product show, which featured around 60 vendors. This is a popular event to network with other operators, DEEP staff, and design engineers, as well as to learn about new product developments. The Operations Challenge team from Greater New Haven Water Pollution Control Authority (WPCA), the Franken Foggers, provided a demonstration of the laboratory event as well as a summary of its experience last fall at WEFTEC in Chicago.

CWPAA officers were elected at the Business Meeting, which this year featured the passing of the gavel. Everett (Ray) Weaver of Manchester was elected president of the association, replacing Mike Bisi of Glastonbury. Mr. Bisi was recognized for his distinctive service and leadership over the past eight years as president and vice president, leading the organization through an expanding program and growing prominence in legislative affairs. Also elected was Chris Lund of the town of Groton as vice president. Jane LaMorte of Stafford and Serdar Umur with GA Fleet will continue in their current positions of treasurer and secretary, respectively.

CAWPCA Spring Workshop

CAWPCA held its Spring Workshop on May 4 at the AquaTurf Club in Plantsville. The event was well attended, with 130 attendees. One highlight of the workshop was the presentation of CAWPCA's prestigious Presidential Excellence Award to Peter Grose of Fuss & O'Neill, in recognition of his many contributions to Connecticut's wastewater industry. The program also included presentations on the application of fuel cells at the Waterbury treatment facility and New Haven's extensive use of green infrastructure. Between the city and the Greater New Haven WPCA, more than 300 bioswales have been constructed or are scheduled for implementation. The presentation highlighted the innovative siting of bioswales between the curb and sidewalk in both residential and downtown neighborhoods. Besides improving stormwater water quality and reducing runoff quantity, green infrastructure has been popular with many residents.

Upcoming Event	Date	Location
Fall Workshop	Nov. (TBD)	Plantsville
Manager's Forum	Oct. 26	MDC Training Center

Second Annual Operator Appreciation Day

CWPAA conducted its second annual Operators Appreciation Day social mixer on May 18. This year's event, which was conducted in Branford at the Stony Creek Brewery, attracted more than 30 attendees. This event, open to all operators, is funded through the generous sponsorships of our corporate partners and CWPAA.

2018 Sewer Open

The Sewer Open Golf Tournament hosted 116 golfers and was played under a perfect sky on June 15 at Skunkamaug River Golf Club in Coventry. This popular event raised $1,000 for the Operations Challenge team, as well as $3,600 for the CWPAA Scholarship Fund. Six $500 scholarships were awarded at this year's event to college-bound students pursuing an environmentally related field.

Manager's Leadership Program Is Back

After a one-year hiatus, Connecticut will be conducting a 2018–19 Manager's Leadership Program. This successful leadership program began in 2013–14. Starting later this month, 18 individuals will meet one day each month for 10 months to acquire the skills and knowledge to manage a wastewater treatment facility effectively. The cost of tuition is partially underwritten by CWPAA.

The achievements of this program are impressive. The first four classes had 20 students each. Thus, counting this year's group, the nearly 100 individuals benefiting from the program make up a significant percentage of the approximate total of 730 licensed operators in Connecticut. Many of the graduates have risen to positions of responsibility and leadership in their facilities. Among the biggest benefits graduates cite is the development of a close network of professional colleagues throughout the state.

Incoming CWPAA President Ray Weaver recognizes outgoing President Mike Bisi for contributions to the association

CAWPCA President Denis Cuevas presents Peter Grose with the Presidential Excellence Award

Trade show attendees milling in exhibit area

Massachusetts State Director Report

by Justin deMello
jdemello@woodardcurran.com

In 2013, a Massachusetts Water Pollution Control Association (MWPCA) survey revealed the median age of its membership was 54 years old. Five years later, that median age has climbed to 57 years old, and the trend shows no signs of reversing. The state of the industry lies firmly on our shoulders, and we as industry professionals must do our part in promoting the industry, being proud of what we do, and communicating its importance. Reversing this trend is nothing that we can do on our own, and the necessary group capability is just one of the many benefits of being an MWPCA member. Together, the MWPCA consists of 700 operators and water professionals across Massachusetts. Collectively, our voice and message can make a difference. If you are a member, thank you, and please sign up your friends. If you are not a member, please join and be active.

Our Next Executive Director

The MWPCA board of directors has identified the association's next executive director, longtime member and past president Mickey Nowak of Springfield, Massachusetts. The board performed a regional search and after final interviews offered the position to Mr. Nowak, who will be retiring from his current position after 40 years in various operations and facility management positions. The board is confident that Mr. Nowak is ready to manage several key initiatives, including expanding training and educational opportunities, advocating for the industry, promoting membership involvement, and increasing networking opportunities. Lynn Foisy, who has held the position for several years, will help to welcome Mr. Nowak and to ensure a successful transition into his challenging new role.

Washington, D.C. Fly-In

On April 17 and 18, 12 water professionals from Massachusetts joined nearly 40 from across New England in Washington, D.C., as part of the Water Week 2018 National Water Policy Fly-In. The event was organized nationally in cooperation with the National Association of Clean Water Agencies (NACWA) and WEF. Representatives from all 50 states gathered on Capitol Hill to meet with state legislators to discuss the importance of water and to encourage the continued investment in our most precious resource. Representing Massachusetts and MWPCA were Ray Willis of Onsite Engineering and Justin deMello of Woodard & Curran. The extended Massachusetts contingent included NEWEA and Massachusetts Water Works Association (MWWA) members. During the two days, the Massachusetts team met with Senator Edward Markey, Senator Elizabeth Warren, Congressman Michael Capuano, Congresswoman Katherine Clark, Congressman William Keating, Congressman Joseph Kennedy III, Congressman Seth Moulton, and Congresswoman Niki Tsongas. While most of our discussions focused on continued investment in our municipal infrastructure through grants, The Water Infrastructure Finance and Innovation Act (WIFIA), and the State Revolving Fund (SRF) program, we also used this opportunity to discuss our aging workforce, the Water Warriors Initiative, and the looming Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) requirements. It was an incredible opportunity to meet face to face with legislators, and to get on our soap box and remind our leaders that while the taps keep flowing and the toilet water keeps disappearing, we must not be forgotten, and investment in water is necessary and worth it.

Massachusetts delegation at Representative Niki Tsongas's office (l to r): Jim Falconieri, Justin deMello, Alan Cathcart, Rep. Tsongas, and Kate Biedron

Legislative Event

On May 15, MWPCA hosted its annual legislative event at the State House in Boston together with MWWA and the American Council of Engineering Companies of Massachusetts (ACEC/MA). For the second straight year, the three organizations teamed up to create a strong, united message around the importance of water and infrastructure investment. The event included meetings with State Representatives and legislators in the morning followed by a networking lunch that included riveting presentations on the importance of the environment and investment in water from Representative Carolyn Dykema and Secretary of Energy and Environmental Affairs Matthew Beaton. Hot topics included infiltration/inflow (I/I) regulation changes, MS4, aging workforce, lead in drinking water, and climate resiliency. With more than 100 attendees, our presence resonated, and our message was clear. We hope to build upon the successes of this year's event and double the turnout next year.

Spring Meeting

MWPCA hosted its western area quarterly meeting on June 13, 2018, at the Log Cabin in Holyoke. The meeting was technically focused with presentations from Spray-Roq, coatings and structural liners; Crane Pumps, wipes and solids management; and Abel, severe duty, high-concentration sludge pumps. The event was well attended, with 65 members partaking in the technical sessions, the always-delicious catered lunch, and networking.

Golf Outing

On June 19, MWPCA hosted its Annual Golf Tournament at Shaker Hills in Harvard. The smell of fresh-cut grass, the buzz of golf carts, the "pings" off the tee, and the echoes of FORE could be heard throughout the day. The venue is spectacular, and the turnout was good. We have already renewed for next year's tournament on June 18, 2019, so sign up early.

Management Training

New England Interstate Water Pollution Control Commission, Massachusetts Department of Environmental Protection (MassDEP), and the Massachusetts Water Pollution Control Association will be starting another Massachusetts Wastewater Management Training Program either this fall or early in 2019. This one-year program develops essential skills to propel candidates into management positions. Topics include introduction to management, advanced process control, working with the media, NPDES permitting and state regulations, engineering design and blueprint reading, preventive maintenance, microbiology, finance and budgeting, and job shadowing.

One of the golf tournament teams: (l to r) Tom Hazlett, Jeff Kalmes, David Garabedian, and Lauren Hertel

Operator Exchange

This September, MWPCA and the Maine Water Environment Association (MEWEA) will exchanged wastewater operators as part of this year's Operator Exchange. The all-expenses paid trip will included a lucky operator from Massachusetts being chauffeured around to several facilities across Maine. The tour took place over three days and aligned with the MEWEA Annual Conference at the Sunday River Grand Summit Resort Hotel, in Newry. This is an incredible opportunity for an operator to tour several facilities, learn about different technologies, network with peers, and build lasting friendships within the industry. MWPCA typically selects an operator in the summer for this autumn event.

Water Warriors Initiative

This program promotes jobs in the water industry for returning members of our armed services. The MWPCA committee, led by Jeremiah Murphy, has eight members. It is working with MassDEP to allow up to two additional years of education credit toward wastewater treatment certification for applicants with military backgrounds. We encourage those with military backgrounds and others interested in advocating for this program to become involved in this valuable initiative.

Upcoming Event	Date	Location
Winter Meeting	December 5	Bristol Community College, Fall River

Maine State Director Report

by Clayton “Mac” Richardson
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While summer has come and gone here in the rooftop of New England, when the turnpike was busy northbound on Fridays and southbound on Sundays, and the grass was crying for water, I used this article to reflect on the spring activities of the Maine Water Environment Association (MEWEA). It is both surprising and humbling to recall how much effort our members put in to benefit Maine and our amazing water resources.

On March 29, a few of our members spoke at the **Maine Sustainability and Water Conference** in Augusta. This event attracts a wide range of students, academics, non-profit workers, government employees, and others interested in making Maine and its waters better. I gave an overview of modern wastewater treatment, including the gains we have made and the challenges ahead, that led into presentations from Zach Henderson and Fred Dillion on integrating stormwater management and integrated water protection planning. With the number of people not intimately familiar with the work we do every day, this conference is an excellent means to reach a wider audience. Our president, Paula Drouin, chaired the well-attended session, entitled “One Water.”

In April, we learned that a team of students from Noble High School (serving North Berwick, Berwick, and Lebanon in the extreme south of our state) was one of 10 finalists in the **Samsung Solve for Tomorrow Contest**. The team’s project focused on removing manganese from the Salmon Falls River. Clearly these young people understand that Water is Worth It!

Also in April, we held our **annual Spring Conference** at the Four Points Sheraton Hotel in Bangor. We were delighted that NEWEA President Elect Ray Vermette and NEWEA Executive Director Mary Barry made the commitment (and the long drive) to attend the proceedings.

The following Tuesday I was off with four Maine colleagues to the **Washington Fly-In**.

Maine representatives in Washington, D.C. (l to r): Allison Fisher, Portland; Stacy Thompson, Saco; Paula Drouin, Lewiston-Auburn; Shiloh LaFreniere, Jay

Ms. Drouin, Allison Fisher, Shiloh LaFreniere, and Stacy Thompson made the rounds to each of our Senators and House Representatives as well as attended the NEWEA luncheon (where Ms. LaFrenier explained superbly why funding for water infrastructure is such a challenge for many of Maine’s small and “mid-size” communities). As always, the trip was fun, exhilarating, and exhausting.

If that were not enough for one month, MEWEA (as the largest non-profit group running for the fifth year in a row) again participated and dominated the **Urban Run Off 5K** and neighborhood family festival at Portland’s Deering High School.

On May 18, our vice president, Ms. Thompson, led discussions on all things water at the **Southern Maine Children’s Water Festival** at the University of Southern Maine. Ms. Drouin stopped by to lend her support after chairing the MEWEA Executive Committee meeting that morning.

As June came around, MEWEA was again on the move with Past President Matt Timberlake stepping up at a State House press conference, supported by more than 100 organizations, to make the case for **bond funding to support Maine’s infrastructure**. Months of work and diligent follow up finally paid off when $30 million was set aside for clean water and drinking water infrastructure work critically needed in our state as part of an overall bond package that will be decided by the voters in November. Special thanks to Tim Haskell, our Government Affairs Committee chair, for the long hours and manifold frustrations he lived through during the last legislative session.

Clean Water Week Poster Contest winners (l to r): Skye Loring-Dymond, 3rd grade; Hunter Roberts, 3rd grade; Chayse Howarth, 8th grade; Jaelin Roberts, 10th grade

Also in June, MEWEA was well represented at the **NEWEA Spring Meeting** at Gurney Resort in Newport. The conference location and the hospitality could not have been better—thank you to the Narragansett Water Pollution Control Association for hosting a great Spring Meeting. We were pleased to have 13 of our members either participate in or work on the Operations Challenge events in Newport. Lest we forget, a big thank you to Mr. Vermette and the Dover wastewater treatment facility for hosting this year’s Operations Challenge training day.

On June 14, the **Brunswick Sewer District** held a very successful open house that served both to showcase its recent facility upgrades and to provide a forum to celebrate our Clean Water Week Poster Contest winners. Alex Buechner coordinated the contest this year, and managed handling and judging more than 600 posters.

In August, MEWEA participated in the **“paddle after hours”** trip on the Androscoggin River in cooperation with Androscoggin Land Trust. The fun started at 5:30 p.m. on the river and wrapped up with finger food and beers at the Gritty’s brew pub in Auburn.

On August 17, the **Executive Committee** met in Millinocket. This meeting is a part of our efforts to get out to all parts of our state. While Millinocket is roughly an hour north of Bangor, some may be surprised that Millinocket is the centroid (or approximate middle) of Maine. Clearly our geography and population distribution are a challenge for MEWEA.

Our **Fall Convention** at Sunday River Resort in Newry took place in late September. The event included our annual golf tournament on the links set before the picturesque Mahoosuc Mountains as well as many technical sessions, networking opportunities, and vendor displays.

In October, we will continue our outreach to youngsters at the **Northern Maine Children’s Water Festival**. The event will be held at the University of Maine in Orono on October 9.

As this is my last *Journal* update as Maine director, I thank everyone in both MEWEA and NEWEA who makes these organizations great. There is always plenty, and sometimes too much, to do, but I have always found that I get much more from both organizations than I put in. I urge you to be involved and to encourage others to pitch in as well. I guarantee your involvement will deepen your love of our amazing New England waters.

2018 SPRING MEETING & EXHIBIT *Proceedings*

The New England Water Environment Association held its Annual Spring Meeting on June 3–6, 2018, at Gurney's Newport Resort & Marina in Newport, Rhode Island. Meeting registrants totaled 241. Registrants included 165 members, 30 non-members, 15 Operations Challenge participants, and 16 guests. The meeting also featured 15 exhibit booths.

A full NEWEA Executive Committee meeting with Committee Chairs was held on Sunday, June 3, 2018, with NEWEA President Janine Burke-Wells presiding.

In addition to the Opening Session, there were eight technical sessions.

BREAKFAST & GENERAL OPENING SESSION

Moderator:
- Amy Anderson, NEWEA Program Committee Chair, Arcadis

Welcome
- Janine Burke-Wells, NEWEA President, Warwick, RI Sewer Authority

Featured Speaker:
- Sheldon Whitehouse, United States Senate, Rhode Island

SESSION 1
KEEPING IT LOCAL—HOT BUTTON ISSUES IN RHODE ISLAND

Moderators:
- Kate Goyette, Kleinfelder
- Mike Bonomo, ADS Environmental

Newport's Effective Use of Mobile GIS for Field Services
- Eamon Duane, City of Newport, RI
- Edwin Roworth, Jacobs/CH2M

How the Goal of Resiliency is Influencing Rhode Island's Wastewater Utilities
- Jan Greenwood, Woodard & Curran
- Jon Himlan, Woodard & Curran

Planning and Progress for Newport's Long Term CSO Control Program
- Peter von Zweck, Jacobs/CH2M
- Julia Forgue, City of Newport, RI

Climate Change & Resiliency in Rhode Island—Where We've Been & Where We're Going
- Elizabeth Stone, RI DEM

SESSION 2
OUTREACH AND VOLUNTEERISM—WHAT YOU CAN DO

Moderators:
- Kate Biedron, CDM Smith
- Deb Mahoney, Hazen and Sawyer

A Comprehensive Public Education and Outreach Program—One Community's Approach
- Ken Carlson, Woodard & Curran
- Jeff Kalmes, Town of Billerica, MA

Engaging the Public—Groton, CT's Outreach Program
- Chris Lund, Town of Groton, CT

Let's Go All In—the Classroom in the Year of the Volunteer—Learn How to be the Best
- Meg Tabacsko, MWRA
- Elena Proakis Ellis, City of Melrose, MA
- Lenny Young, MWRA

Out of Sight, But Not Out of Mind
- Robert Rak, Bristol Community College, Fall River, MA

SESSION 3
MUNICIPAL FACILITIES AND STORMWATER MANAGEMENT

Moderators:
- Lauren Hertel, Woodard & Curran
- Denise Descheneau, Upper Blackstone WPAD

Collaborating for Public Facility Stormwater Success
- Marc Gabriel, Nitsch Engineering
- Jennifer Johnson, Nitsch Engineering
- Sean McCarthy, Town of Scituate, MA

MS4 Permitting in EPA Region 1—The Existence of a TMDL Does Not Justify Imposition of Requirements Upon all MS4 Dischargers
- John Hall, Hall & Associates
- Gary Cohen, Hall & Associates

The Changing Tide in Regulations, Permits and Environmental Standards—Where Will it Flow?
- Paul Hogan, Woodard & Curran

Refining Stormwater Rates and Improving Community Support
- David Hyder, Stantec

SESSION 4
DESIGNING WITH RESILIENCY IN MIND

Moderators:
- Kate Edwards, Arcadis
- Tom Loto, Kleinfelder

Bringing Flood Resiliency into MassDOT Asset Management
- Tim Dexter, MassDOT
- Samantha Roddy, MassDOT
- Roy Schiff, Milone & MacBroom

Analysis and Communication of Flood Damage Cost Avoidance in the Lamprey River Watershed
- Dan Boudreau, Geosyntec Consultants
- Cameron Wake, University of New Hampshire

Considering Climate Resiliency in Common Stormwater Designs
- Matthew Jones, Hazen and Sawyer

Restoring Flood Resiliency with a 120-MGD Flood Pump Station in Lowell, MA
- Tiffany Labrie, Tighe & Bond
- Michael Stuer, Lowell Regional Wastewater Utility
- Mark Young, Lowell Regional Wastewater Utility
- Todd Brown, University of Hartford

SESSION 5
ALTERNATIVES TO TRADITIONAL PLANT OPERATIONS

Moderators:
- Tom Hazlett, Woodard & Curran
- Meghan Moody, CDM Smith

How to Harden Your Plant—One Storm at a Time
- Kevin Cini, City of Groton, CT

Alternative Project Delivery Methods for Water/Wastewater Facility Projects
- Todd Moline, Stantec
- Bryan Canzoneri, Stantec

1. Relaxation around a fire pit with a view of the scenic Claiborne Pell Bridge **2.** Keynote speaker Senator Sheldon Whitehouse with Mary Barry and Janine Burke-Wells **3.** The Opening Session breakfast drew a full house **4.** Tired guests return from the day-long program **5.** Rachel Watson (Microconstituents) and Ben Stoddard (Young Professionals) at the Executive Committee meeting




1. Speakers Julie Stein and Adriana Caldarelli at the Wednesday breakfast **2.** Meg Tabacsko and Ron Tiberi **3.** Jim Li and Bernadette Callahan at the Tuesday evening dinner reception **4.** Mandy and Paul P. Casey with Ken Carlson

1. Margaret Kurth presents an Army Corps perspective on stormwater management **2.** The numerous technical sessions were well-attended **3.** Meg Tabacsko gives pointers on successful classroom presentations **4.** Gary Cohen speaks on TMDLs and stormwater requirements **5.** Bill Patenaude takes in a technical session on resiliency in Rhode Island

Comparative Energy Evaluation of Nutrient Recovery Technologies as an Alternative to Traditional Fertilizers and Nutrient Removal Technologies
- Ranjani Theregowda, US EPA
- Alejandra González-Mejía, Bangor University
- Xin (Cissy) Ma, US EPA
- Jay Garland, US EPA

Use of Ballasted Flocculation for Phosphorus Removal to Ultra Low Levels
- Craig Wagner, CDM Smith
- William Lengyel, CDM Smith
- Walter Veselka, City of Bristol, RI
- Dustin Payanis, City of Bristol, RI

SESSION 6
COLLECTION SYSTEMS—TOOLS FOR INSPECTION AND REHABILITATION

Moderators:
- Peter Garvey, Dewberry
- Matt Formica, AECOM

Pump it, Grind it, Screen it—Current Best Practices in Handling Collection System Modern Trash
- Robert Domkowski, Xylem, Inc. – Flygt

Using GIS to Manage and Visualize Sewer System Inspections
- Lindsey Donbavand, CDM Smith
- Brittney Gibbons, CDM Smith

Trenchless and Conventional Technologies Utilized for Installation of 5,550 Linear Feet of 30- and 40-inch Relief Sewer in Connecticut
- John Ososkie, Jacobs/CH2M
- Jason Waterbury, The Metropolitan District Commission
- Eric Muir, Jacobs/CH2M

The Pipe Work is Done—Why Are You Still Here? (Using Sewer Separation to Leave the Neighborhood Better Than We Found It)
- Francis McPartlan, Kleinfelder

SESSION 7
STORMWATER MANAGEMENT FOR THE BUILT AND NATURAL ENVIRONMENT

Moderators:
- Scott Lander, Retain-It
- Helen Gordon, Environmental Partners Group

Green Stormwater Infrastructure Parks: All Sizes, Designs and Funding Sources
- Julie Stein, HDR
- Derick Tonning, HDR

Distributed Green Stormwater Infrastructure Systems—Philadelphia, PA
- Bernadette Callahan, Stantec

National Green Infrastructure Certification Program
- Adriana Caldarelli, Water Environment Federation

Matrix Approach to Stormwater Management for a Resilient Built Environment
- Margaret Kurth, US Army Corps of Engineers
- Igor Linkov, US Army Corps of Engineers
- Cate Fox-Lent, US Army Corps of Engineers

SESSION 8
UTILITY MANAGEMENT—EFFICIENCY IS KEY

Moderators:
- Miles Moffatt, Tighe & Bond
- Charlie Tyler, MWRA (retired)

Utilizing Enterprise Data Management Systems to Enhance Operation Efficiency
- Brett Milburn, Langan Engineering & Environmental Services
- Ricardo Ceballos, Greater New Haven WPCA

Optimizing Operations Through Small Investments and Human Capital
- Robert Pontau, Brunswick Sewer District

The $25M Upgrade to the Middleborough Water Pollution Control Facility—From the Owner and Owner's Project Manager Perspective
- Paul Millett, Environmental Partners Group
- Chris Peck, Town of Middleborough, MA

Integrating Asset Management Principals and Emergency Preparedness to Assess Risk
- Corinne Ketchum, Arcadis
- Marc Delzio, Arcadis
- Kevin Slaven, Arcadis
- Andrew Ohrt, Arcadis

OPERATIONS CHALLENGE

Operations Challenge Committee:
Travis Peaslee, Chair
Scott Goodinson, Vice Chair

Operations Challenge was held on Tuesday, June 5. Three teams participated in the competition:

Connecticut – Franken Froggers
Jason Nenninger (Captain), Christopher Findley, Dan Sullivan, Dan Wolff

Maine – Force Maine
Alex Buechner (Captain), Shelby Carver, Riley Cobb, Nate Melanson

Rhode Island – Ocean State Alliance:
Eddie Davies (Captain), Ryan Patnode, Peter Rojas, Kim Sandbach

The Operations Challenge Awards Reception was on Tuesday, June 5. Committee Chair Travis Peaslee and each event coordinator, assisted by NEWEA President Janine Burke-Wells, presented trophies to the winning teams of each event and to the overall first-, second-, and third-place winning teams. The results of the competition are reported as follows:

First Place Individual Events
- Process Control – Rhode Island
- Safety – Rhode Island
- Collection Systems – Rhode Island
- Laboratory – Rhode Island
- Pump Maintenance – Connecticut

Overall Competition
- Third Place – Maine
- Second Place – Connecticut
- First Place – Rhode Island

During the reception, it was announced that NEWEA would support the first-, second-, and third-place teams in the 2018 WEF National Operations Challenge competition to be held October in New Orleans.









1. Shelby Carver readies a solution during the Force Maine Lab Event **2.** Judge Patty Chesebrough monitors Alex Buechner and Riley Cobb during the Process Control Event **3.** Early birds gather for the Tuesday morning bike ride **4.** Jason Nenninger wields a pipette during the Franken Foggers' lab event

Event Coordinators
- Process Control – Paul Dombrowski, Michael Harris
- Safety – André Brousseau
- Collection Systems – Michael Armes
- Laboratory – Marylee Santoro
- Pump Maintenance – Dan Laflamme

Scorekeeping
- Overall – Travis Peaslee, Vivian Matkivich

Judges
- Process Control – Paul Dombrowski, Mike Harris, Susan Guswa
- Safety – Rick Hartenstein, Jason Swain, André Brousseau
- Collection Systems – Tim Vivian, Mike Armes, Mike Smith, Eliza Morrison, Patty Chesebrough
- Laboratory – MaryLee Santoro, Margie Bower, Nora Lough, Walter Palm, Jim Galasyn, Phyllis Rand
- Pump Maintenance – Dan Laflamme, Jay Pimpare, Jim Barsanti

Miscellaneous
- Trophies – Joseph Kruzel, Michael Burke
- Shirts – Hoyle, Tanner, & Associates

Select Society of Sanitary Sludge Shovelers

During the Monday evening reception, Influent Integrator Charles W. Tyler inducted 12 new members into the Select Society of Sanitary Sludge Shovelers:
- Chuck Applebee
- Linda Austin
- Mary Barry
- Joe Boccadoro
- Mike Burke
- Brad Hayes
- Fred McNeill
- Janice Moran
- Mac Richardson
- Marylee Santoro
- Mike Spring
- Mary White

MISCELLANEOUS:

A variety of committee meetings were held throughout the Spring Meeting. The Annual Spring Meeting Golf Tournament was held at the Green Valley Country Club. Attending spouses and guests enjoyed a number of recreational and social activities during the meeting.

MEETING PLANNERS
- Conference Arrangements – Ron Tiberi
- Program – Amy Anderson
- Registration – Kerry Reed and NEWEA Staff
- Operations Challenge – Travis Peaslee
- Guest Program – Joy Lord
- Golf Tournament – Dennis Vigliotte

MEETING MANAGEMENT
- Director – Elena Proakis Ellis
- Sponsors – Dennis Vigliotte

1. Champions Ocean State Alliance with their trophies: Kim Sandbach, Ryan Patnode, Janine Burke-Wells, Eddie Davies, and Peter Rojas **2.** The captain's daughter cradles a trophy **3.** Christopher Findley spins a mean valve during the maintenance event **4.** Pete Rojas and Kim Sandbach prep the equipment table during the Pump Event **5.** Pete Rojas concentrates during the Ocean State Alliance Lab Event

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Tata & Howard
Ted Berry Company
Tetra Tech
The MAHER Corporation
Tighe & Bond
Weston & Sampson
Woodard & Curran
Wright-Pierce

New Members June–July 2018

Susan Viera
Massachusetts Water Resource Authority
Boston, MA (STU)

Troy Locke
Spring Point Solutions
Portland, ME (PRO)

Rachel Bouvier
Portland, ME (PRO)

Audrey Degnan
GHD
Hyannis, MA (YP)

Claire Moss
Town of Wakefield
Wakefield, MA (YP)

Glen Ritchie
Columbia, CT (PRO)

Zachary Shepard
Richmond, RI (STU)

Leland Jones
Broad Brook, CT (PRO)

Sally Carroll
Massachusetts Water Resource Authority
Boston, MA (PRO)

Christopher Goodwin
Massachusetts Water Resource Authority
Boston, MA (PRO)

Richard McKinnon
Boston Water & Sewer Commission
Roxbury, MA (PRO)

Kristie Wagner
CDM Smith Inc.
East Hartford, CT (PRO)

David Geng
Manchester, CT (PWO)

Sabrina Castaneda
Boston, MA (STU)

Nicholas Severino
Weston & Sampson Services
Peabody, MA (YP)

Marc Shaffer
Swampscott, MA (YP)

James A Sherrard
Town of Williston
Williston, VT (YP)

Jason Gagnon
North Conway Water Precinct
North Conway, NH (PWO)

Joseph W Brennan
Johnston, RI (YP)

Russell Macgregor
Norwich Public Utilities
Norwich, CT (PWO

Montgomery Sedlak
Bridgeport, CT (PWO

Stephen J. Clark
Conshohocken Sewer Authority
Conshohocken, PA (PRO)

Janelle Bonn
Woodard & Curran
Providence, RI (PRO)

Kristin Dee
Pepperell, MA (PWO)

Jacob Fortin
Colchester, CT (STU)

Wayne Graham
Lancaster, NH (PWO)

Patrick McLaughlin
Carver, MA (YP)

James Plummer
NEIWPCC
Lowell, MA (YP)

Jonathan Garrity
Somerville, MA (YP)

Rory Polera
Somerville, MA (YP)

Joseph Siviski
Portland Water District
Portland, ME (PRO)

William Lunt III
Portland Water District
Portland, ME (PRO)

Raina Jain
Riverside, CT (STU)

Paloma Lenz
Danbury, CT (STU)

Nicholas Liu
Greenwich, CT (STU)

Ella Marin
Woodbridge, CT (STU)

Nicholas Woo
Greenwich, CT (STU)

Verna Yin Cos
Cob, CT (STU)

Elise Mizerak
Holden, MA (STU)

Madeline Brookings
Bradford, ME (STU)

Andrea Grossman
Holden, ME (STU)

Kieran Gallison
Portsmouth, RI (STU)

Joey Hook
Portsmouth, RI (STU)

Olivia Kelly
Wakefield, RI (STU)

Margaret O'Brien
Bristol, RI (STU)

Alanna Nash
South Burlington, VT (STU)

Sunthoshini Premsankar
Williston, VT (STU)

Bambi Zhuang
South Burlington, VT (STU)

Isabel Azevedo
Reading, MA (STU)

Kale Connerty
Groton, MA (YP)

Thomas Goode
Norwell, MA (PRO)

Thomas Hyde
Town of Stratford WPCA
Stratford, CT (PRO)

Mason Kelly
Nobleboro, ME (PRO)

Brendan Lundy
Salisbury, MA (PWO)

Elizabeth Lux
Cumberland, RI (STU)

Brian Olsen
Woodbridge, CT (PRO)

Rachel Osborn
Woodard & Curran Inc.
Portland, ME (PRO)

Mary Prescott
Auburn, MA (YP)

Ben Smith
Environmental Operating Solutions, Inc.
Londonderry, NH (YP)

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Professional WW/OPS (PWO)
Student (STU)
Young Professional (YP)

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For more information contact Mary Barry
Email: mbarry@newea.org
Call: 781-939-0908

NEWEA
WORKING FOR WATER QUALITY

Advertiser Index

Upcoming *Journal* Themes
Winter 2018—**Young Professionals**
Spring 2019—**Stormwater**
Summer 2019—**Wastewater Treatment**
Fall 2019—**Collection Systems**
Winter 2019—**Safety**

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Employment Information (see back page for codes)

1. ORG Code | Other (please specify) | 2. JOB Code: | Other (please specify)

3. Focus Area Codes | Other (please specify

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NEWEA/WEF* Membership Application 2018

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To help us serve you better, please complete the following:
(choose the one that most closely describes your organization and job function)

What is the nature of your ORGANIZATION?

(circle one only–required) (ORG)

1
Public/Private Wastewater Plants and/or Drinking Water and/or Stormwater

2
Public/Private Wastewater Only

3
Public/Private Drinking Water Only (e.g. municipality, utility, authority)

4
Industrial Systems/Plants

5
Consulting or Contracting Firm

6
State, Federal, Regional Government Agency

7
Research or Analytical Laboratories

8
Educational Institution

9
Manufacturer of Water/Wastewater/ Stormwater Equipment or Products

10
Water/Wastewater/Stormwater Product Distributor or Manufacturer's Rep.

11
Public/Private Stormwater (MS4) Program Only

12
Public Financing, Investment and Banking

13
Non-profits

99
Other _____
(please specify)

What is your Primary JOB FUNCTION?

(circle one only) (JOB)

1
Management: Upper or Senior

2
Management: Engineering, Laboratory, Operations, inspection, Maintenance

3
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4
Scientific and Research Staff

5
Operations/Inspection Maintenance

6
Purchasing/Marketing/Sales

7
Educator

8
Student

9
Elected or Appointed Public Official

10
Other _____
(please specify)

What are your KEY FOCUS AREAS?

(circle all that apply) (FOC)

1
Collection Systems

2
Drinking Water

3
Industrial Water/Wastewater/ Process Water

4
Groundwater

5
Odor/Air Emissions

6
Land and Soil Systems

7
Legislation (Policy, Legislation, Regulation)

8
Public Education/Information

9
Residuals/Sludge/Biosolids/Solid Waste

10
Stormwater Management/ Floodplain Management/Wet Weather

11
Toxic and Hazardous Material

12
Utility Management and Environmental

13
Wastewater

14
Water Reuse and/or Recycle

15
Watershed/Surface Water Systems

16
Water/Wastewater Analysis and Health/ Safety Water Systems

17
Other _____
(please specify)

Optional Items (OPT)

Years of industry employment? _____
1 (1 to 5) **2** (6 to 10) **3** (11 to 20)
4 (21 to 30) **5** (>30 years)

Gender? _____
1 Female **2** Male

Education level? (ED) _____
1 High School **2** Technical School
3 Some College **4** Associates Degree
5 Bachelors Degree
6 Masters Degree **7** JD **8** PhD

Education/Concentration Area(s) (CON) _____
1 Physical Sciences (Chemistry, Physics, etc.)
2 Biological Sciences **3** Engineering Sciences
4 Liberal Arts **5** Law **6** Business

Water quality professionals, with fewer than 5 years working experience and under the age of 35, are eligible to join WEF as an Active Member, while participating in the NEWEA/WEF Young Professionals Program. This program allows up to 50% off of the Active Member dues, valid for the first three years of membership. This program is available for new member applicants and Student Members.

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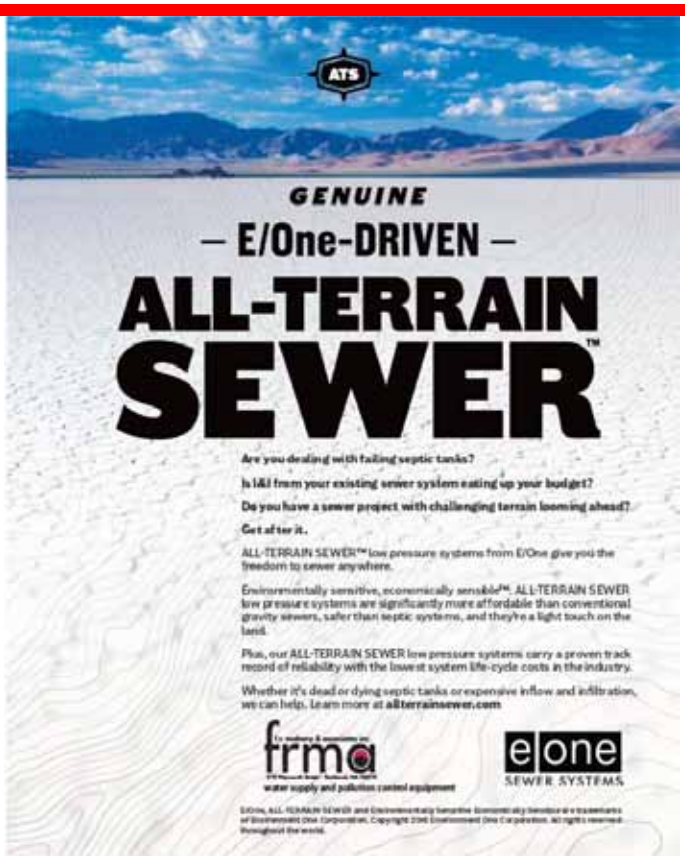

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2017 Operational Data

Month	Influent TKN	Effluent TKN	Effluent TN
February	62	1.6	1.6
March	31	1.2	1.2
April	59	2.1	3.5
May	26	.92	.92
June	62	1.6	1.92
July	24	.84	.84

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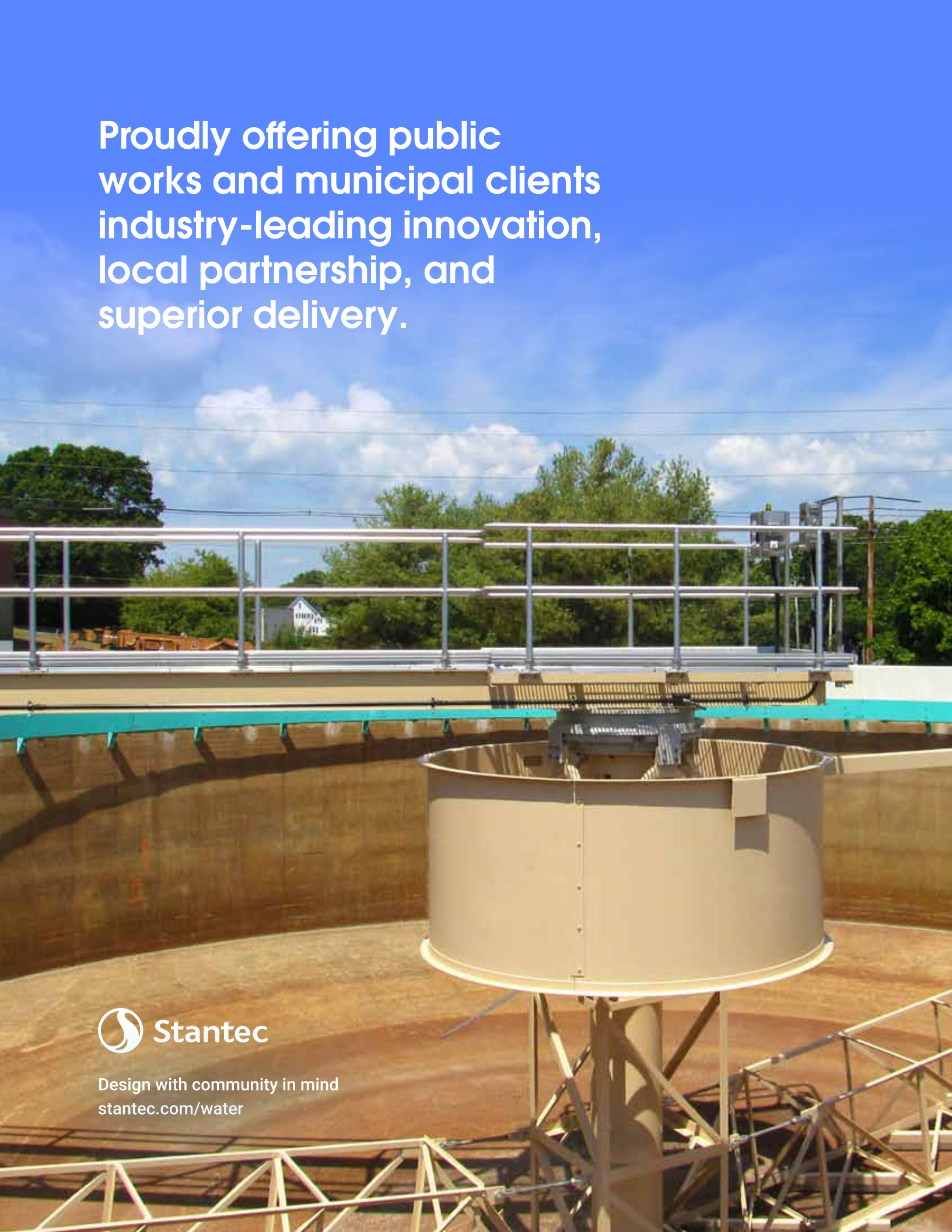
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