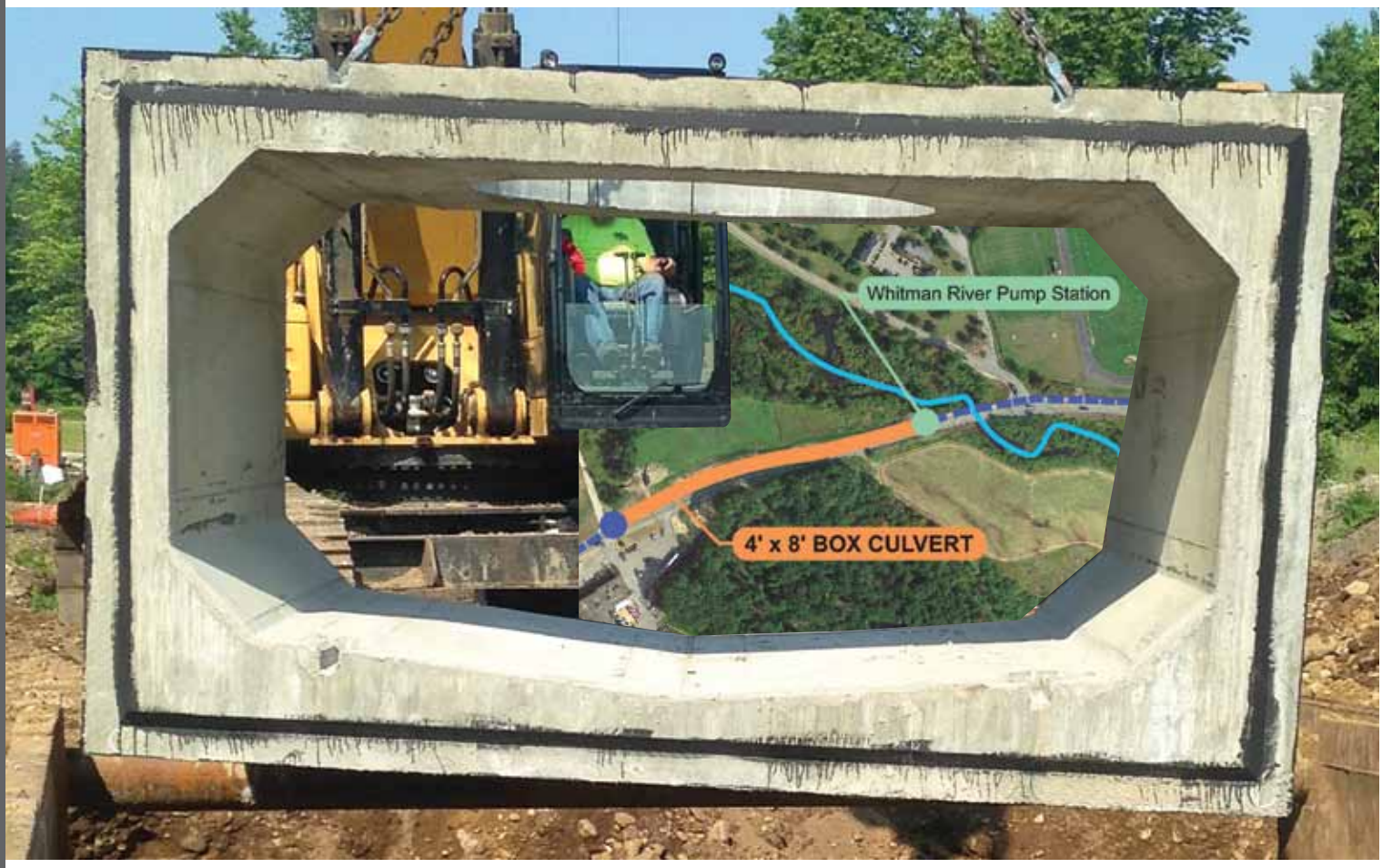
# JOURNAL

OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

VOLUME 52 NUMBER 2 / ISSN 1077-3002 SUMMER 2018




## ENGINEER PERSPECTIVES



NEWEA
WORKING FOR WATER QUALITY

Flow Tech

# Proudly Serving New England's Water and Wastewater Market!

# ABB Variable Frequency Drives

**ACQ550**

**ACQ800 ULH**

**Harmonic Mitigation**

## Your One-stop Shop for ABB VFDs.


**VFD RETROFITS**


**SERVICE & TRAINING**

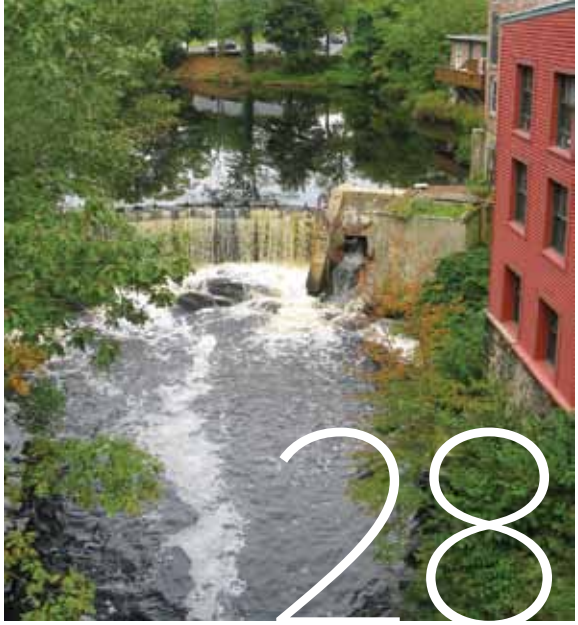
**FACTORY START-UP**

**STOCKED INVENTORY**

**Contact us for a free on-site evaluation of your VFD needs!**

**Phone: 860.291.8886 • Fax: 860.291.9908**

**Email: FlowTech@FlowTechInc.com • Web: www.FlowTechInc.com**




JOURNAL OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

VOLUME 52 NUMBER 2 I ISSN 1077-3002 SUMMER 2018

# Contents





**On the cover:** Westminster, Massachusetts—an overview of the project site is transposed into a photo of a box culvert during installation



**NEWEA Journal ISSN #1077-3002**
Published four times annually by New England Water Environment Association, Inc.
This is Volume 52 Number 2
Periodical postage paid at Woburn, MA 01801, and at additional mailing offices

**New England Water Environment Association, Inc.**
10 Tower Office Park, Suite 601
Woburn, MA 01801-2155
Telephone: 781-939-0908
Fax: 781-939-0907
Email: mail@newea.org
Website: newea.org

**Postmaster:**
Send address changes to:
NEWEA Journal
10 Tower Office Park, Suite 601
Woburn, MA 01801-2155

**Journal Committee Chair & Editor**
Joseph Boccadoro
Joe.Boccadoro@aecom.com

**Journal Committee**
Alan Slater, Alexandra Bowen
Charles Tyler, Susan Landon
Dan Coughlin, Don St. Marie
Eric Staunton, Geraldine Ciardelli
Helen Gordon, James R. Barsanti
Mac Richardson, Matthew Hross
Meredith Zona, Michael Sullivan
William Murphy, Marie Rivers
Robert Mack

**Guest Editor**
Clayton (Mac) Richardson
mrichardson@lawpca.org

**Copy Editor**
Thomas Heinlein

**Photography Editor**
Charles Tyler
charleswtyler@msn.com

**Graphic Designer**
Robert Randazzo

**Photo credits**
*YP* (page 7)
Mike Spring

*Specialty conferences*
(page 56–58)
Janice Moran

*Design winners*
(page 55)
Nicholas Tooker


**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.

**Professional Wastewater Operations Member (PWO)**—shall be any individual who is actively involved on a day-to-day basis with the operation of a wastewater collection, treatment or laboratory facility, or for facilities with a daily flow of <1 million gallons per day. Membership is limited to those actually employed in treatment and collection facilities.

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

**WEF Utility Partnership Program (UPP)**—NEWEA participates in the WEF Utility Partnership Program (UPP) that supports utilities to join WEF and NEWEA while creating a comprehensive membership package for designated employees. As a UPP a utility can consolidate all members within its organization onto one account and have the flexibility to tailor the appropriate value packages based on the designated employees' needs. Contact WEF for questions & enrollment (703-684-2400 x7213).

## BECOME A NEWEA MEMBER

- Complete and mail the membership application form on pages 67–68
- Download a membership application from **newea.org** by clicking—*How Do I Join?*
- Join online at **wef.org** by clicking—*Become a Member*

### 2018 RATES

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

Water Environment Federation®
the water quality people®

**New England Water Environment Association | Statement of Ownership, Management and Circulation**

| | |
|---|---|
| Publication Title | The NEWEA Journal |
| Publication | #24559 |
| Issue Frequency | Quarterly (four per year) |
| Annual Subscription Price | $20 (included with membership dues) |
| Complete Mailing Address, Known Office of Publication, General Business Office, Editors and Owner (non profit organization) | NEWEA, 10 Tower Office Park, Suite 601, Woburn, MA 01801 |
| Contact Person/Managing Editor | Mary Barry, NEWEA Executive Director |
| Tax Status | No change during the preceding 12 months |

Issue date for circulation data below: 07/24/2017

| Publication title: The NEWEA Journal | Extent and nature of circulation: Technical/ Educational/ Environmental | Average no. copies each issue during preceding 12 months | No. copies of single issue published nearest to filing date |
|---|---|---|---|
| Total number of copies | | 2,500 | 2,500 |
| 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 | 2,208 |
| Copies not distributed | | 292 | 292 |
| Total | | 2,500 | 2,500 |
| Percent paid and/or requested circulation | | 100 | 100 |

**Janine Burke-Wells**
Executive Director of the
Warwick Sewer Authority
City of Warwick, Rhode Island
Janine.Burke-Wells@warwickri.com

# President's Message

By the time you read this, my term as NEWEA president will be half over—wow! It has been a whirlwind so far, and time is flying by, but I am having fun. To date, I have had the pleasure of attending three significant state events, as I describe below.

On March 1, I participated in the Maine legislative event in Augusta, a terrific collaboration of organizations representing the entire water cycle. Maine Water Environment Association President Paula Drouin and her crew did a great job, welcoming new EPA Regional Administrator Alex Dunn. Maine has been a leader in government affairs and hosted these events for longer than most in New England, and I was impressed by the displays of old and new water infrastructure gadgets and slide shows of newspaper headlines about water infrastructure failures and capital needs. As the lead organizer for the annual Rhode Island legislative event, I am totally stealing these ideas!

On April 13, I spent the day at the New Hampshire Water Pollution Control Association's annual trade show in Nashua. President Tim Vadney and his board are doing a great job rejuvenating this event. Mr. Vadney invited me to do the raffles, and I had a delightful time. I was also proud to recognize New Hampshire water pollution control professionals who had received EPA and NEWEA awards at the 2018 NEWEA annual conference. I hung out with Charlie Tyler (5S) and many other old NEWEA friends.

On April 26, the Connecticut Water Pollution Control Association held its annual trade show, which I have attended annually since I was NEWEA vice president. I love going to this show. Mike Bisi (5S) has been a great host, and he is handing over the reins to E. Ray Weaver of Manchester. It is inspiring to see leaders such as Mr. Weaver stepping forward, and from what I saw he will make a great operator association president.

I plan to visit events in Massachusetts, Vermont, and Rhode Island before the year is over, and I still need association pins from Massachusetts and Connecticut to complete my regional collection.

Thanks to the Narragansett Water Pollution Control Association, I represented Rhode Island at the D.C. Fly-in on April 17 and 18, along with NEWEA Past President Ray Willis (5S) and Steve Soito from Providence Water. We met with our state's senators and congressmen personally. We already knew that they care about many of the same things we do, so it was like preaching to the choir, but we had great conversations about water infrastructure and work force needs. Even (and especially) if your federal delegates are not exactly sitting in that choir, participation in the Fly-in is important to ensure governmental support for our industry,

*Feeling the power* at The Young Professionals Summit at the 2018 Annual Conference

## "The Young Professionals Committee is the bomb"

and meeting with the New England delegation year after year pays dividends; to keep those dividends growing, we need to keep at it and to increase the number of NEWEA members going to Washington each year. All New England states participated, and the Government Affairs Committee luncheon was well-attended. New Hampshire Senators Maggie Hassan and Jeanne Shaheen both spoke eloquently about their state's water infrastructure needs. In total, NEWEA representatives visited 12 senators and 16 representatives over the span of two days. Wow!

I am also happily busy with monthly Senior Management Team (SMT) conference calls and quarterly Executive Committee Meetings (ECMs). I look forward to the September ECM at Roger Williams University in Bristol, Rhode Island. It is a beautiful setting on Mount Hope Bay. And, apparently, we have a sizeable Roger Williams alumni contingent within NEWEA that will make it even more special.

A lot of other great work is going on within NEWEA. The Laboratory Practices Committee will be introducing NEWEA's newly revised laboratory certification program in October. The ad-hoc Website Committee has renewed its charge and is poised to become a full-fledged standing committee. The Sustainability Committee also has new life and is proposing an award for sustainable planning, design, construction, and operations practices. The Young Professionals Committee is the bomb—it has such enviable energy! This committee is so impressive that we have delegated to them a community service project to be performed while we are in Newport for the spring conference in June. The committee members not only eagerly raised their hands, they took the ball and ran with it. Rest assured, with this sort of talent rising, the NEWEA future is bright.

As president, I am copied on new member lists and on welcoming emails when people volunteer for committees. So far in 2018, we have 190 new members and 45 new volunteers. Welcome to all of you, and please reach out to your NEWEA officers and staff for further information on how to leverage your participation to further benefit all of us. Together, let's go all in!

We are also at work on the NEWEA mission, and the SMT has been focused on a couple of words lately: collaboration and innovation. On the collaboration front, I am following up on Past President Jim Barsanti's (5S) effort to initiate formal collaborations with the New England Water Works Association. We hope very soon to sign a Memorandum of Agreement (which I volunteered to draft) that outlines our organizations' respective responsibilities for proposed efforts related to government affairs, young professionals, a "One Water" award, and possibly joint specialty conferences on cross-cutting issues such as SCADA systems, asset management, and safety.

Past President Howard Carter (5S) is leading the effort around innovation. The dictionary.com definition of innovation is simply, "introduction of new things or methods." Change—oh no!—can be hard but is necessary for survival. What that means for NEWEA is not exactly clear yet, but we must investigate the opportunities that abound to determine when and if we are ready to grab them. Mr. Carter and his outside-the-box task force are grappling with the steps NEWEA should take regarding innovation. He has also led productive discussions with the New England Water Innovation Network (NEWIN) about collaboration.

Speaking of changes, NEWEA will soon need to fill long-time Office Administrator Linda Austin's (5S) shoes. The Management Review Committee is working on that challenge along with creating a new communications specialist position. It is time to put our money where our mouth is—Water's Worth It! Let's go all in!

Finally, I need to thank the home front. I could not do what I have the honor of doing this year without unwavering backing at home. I am grateful for the support of Warwick Sewer Authority staff, including NEWEA Rhode Island State Director Scott Goodinson and NEWEA member Lynn Owens. Speaking of family, I would like to hear more from NEWEA members who are part of a family legacy in working for clean water. I know about the Firmins, the Bowens, the Gaipos, and the Garrisons, but I believe there are more of you out there. Although it appears that the Wells-Burke professional legacy will begin and end with me, the cultural inheritance will live on, as Roberta and Billie know better than most that "it's a toilet, not a trash can" and that Water's Worth It. Let's go all in!

# From the Editor

**Joe Boccadoro, P.E., Senior Project Manager – Water, AECOM**

While attending NEWEA's Spring Meeting in Newport, Rhode Island, in June, I was reminded that we are an organization of people working in a variety of interrelated sectors. Our conferences are opportunities for our vendors, operators, engineers, public works/municipal representatives, and young professionals to network, exchange ideas, and work together to promote the importance of the water environment. Seeing this collaboration and energy firsthand made me proud the *Journal* team chose to highlight discipline categories in 2018. This is our opportunity to raise awareness of the contributions made by these sectors. In the spring issue of the *Journal* we featured operators. In this summer issue we focus on engineers. Please refer to the table for other disciplines that will be highlighted in future *Journal*s.

| ***Journal* themes & submission deadlines** |
|---|
| Fall 2018—**Public Works/Municipal** (June 29) |
| Winter 2018—**Young Professionals** (September 28) |

To pay tribute to engineers, I thought I would provide a brief history of the profession as well as a few other interesting facts. As we know, engineering is one of the world's oldest fields, and its history traces back to early times. Though many specialties exist, the primary engineering roles in the water environment relate to sanitation, water resources, hydraulics, wastewater treatment, and the like, and evidence suggests that early engineers performed these roles.

The first water engineering can be traced back 3,000 to 4,000 years to Greece, where underground water and sewer pipes were first used (Wikipedia, History of water supply and sanitation), and to Maka, which is near the Persian Gulf and now known as Oman, and was the site of ancient water irrigation systems that supplied water to arid areas. Aqueducts were also built in Rome approximately 2,300 years ago. The Archimedes Screw, invented around the same time as the aqueducts, was an early innovation that made it easier to move water from one elevation to another. Though predating the term, those designing these systems were the forefathers of today's engineers.

In modern times, water environment engineers were grouped in the civil engineering discipline, which includes environmental and water resources engineering. In the United States in the 1800s, Norwich University was the first school to offer engineering courses. The first civil engineering degrees were awarded by Rensselaer Polytechnic Institute (RPI) in the 1830s. Civil engineering was also offered at universities in England in the 1830s (Wikipedia, Civil Engineering).

Here are a few more milestones and facts relating to the history of engineers and engineering:

- Early Incan engineers designed and built an innovative water aqueduct system in the 1400s
- In the 1700s, the term civil engineering was first used to differentiate it from military engineering
- There are more than a dozen civil engineering sub-disciplines, including environmental and water resources engineering
- John Smeaton of England was the first self-proclaimed civil engineer (1700s)
- The first civil engineering society, the Institution of Civil Engineers, was formed in England in 1818
- Civil engineering was first recognized as a profession in England in 1828
- The Boston Society of Civil Engineers was founded in 1848 and is the oldest such society in the United States
- The American Society of Civil Engineers (ASCE) was formed in the United States in 1852
- In 1887, the Lawrence Experiment Station was established as a research center for sanitary engineering
- The first woman to receive a degree in civil engineering was Nora Stanton Blatch from Cornell University in 1905
- In 1914, Ardern and Lockett presented their paper on the activated sludge process
- The Federation of Sewage Works Associations (aka WPCF; WEF) was founded in 1928
- The New England Sewage Works Association (aka NEWEA) was founded in 1929
- Civil engineers have saved more lives than all the doctors in history—through the development of clean water and sanitation systems (engineeringcivil.com/history)
- Many of the early engineers were educated at MIT, the first institution in the United States to combine the related branches of learning for sanitary engineering
- The National Society of Professional Engineers was founded in 1934
- Quabbin Reservoir was constructed from 1930–1939
- In 1951, the National Society of Professional Engineers organized the first Engineer's Week (next year it will be held from February 17–23, 2019)
- Court-ordered cleanup of Boston Harbor began in 1986 (mwra.state.ma.us/harbor/html/bostonharborproject.htm)

Today, civil engineering and its water environment subdisciplines are offered at hundreds of colleges and universities throughout the country, many located here in New England. With a rich tradition in engineering education, it is not a surprise that our region attracts and retains many engineers. We are fortunate to have so many talented individuals as NEWEA members.

Since the start of early civilization, engineers in the water environment field seemingly have had a hand in solving the world's significant challenges: transmitting clean water to population centers; conveying the resultant wastewater to different locations; treating that wastewater to prevent sickness and disease; and managing stormwater. Engineers are certainly not the only discipline to contribute greatly to further advancing our field; however, in this issue of the *Journal* we provide a forum for this group to draw on its background to present topics of interest to our membership and others who either work in or are related to the water environment business.

# Industry News

Camp Edwards and the Joint Base Cape Cod

## Comment Period for Proposed Remedy Selection Plan for Multiple Training Areas at Joint Base Cape Cod

*– Emily Bender, EPA Region 1 News Release*

EPA is seeking public comment on its proposal indicating no further action is needed for several training areas on the Camp Edwards portion of Joint Base Cape Cod (JBCC). EPA's proposal is based on an Army National Guard study required by a Safe Drinking Water Act Administrative Order and requiring EPA and the Massachusetts Department of Environmental Protection (MassDEP) oversight.

A 30-day public comment period on this proposal began on April 11 and ended on May 10 for the Remedy Selection Plan, which outlines the proposed no further action decisions and limited follow-up investigations at the training areas.

"EPA is committed to making progress at hazardous waste sites across New England," said Alexandra Dunn, regional administrator at EPA New England. "We look forward to receiving public comment on the proposed remedy for these training areas at Camp Edwards, an important next step in the process."

Information on the proposed Remedy Selection Plan was presented at the JBCC Cleanup Team public meeting on April 11. EPA, MassDEP, and Army representatives attended this meeting and responded to questions. Now that the comment period is complete, EPA is considering public comments received, consulting with MassDEP, and will issue a Decision Document that contains response actions required for each range. With the issuance of the Decision Document, EPA will include a Responsiveness Summary to provide responses to comments received during the public comment period.

The Army National Guard's Impact Area Groundwater Study Program (IAGWSP) has investigated potential soil and groundwater contamination at the training areas. IAGWSP's investigations at these sites determined that they were not expected to have significant environmental impacts. The proposed remedy recommended is for no further action. No further investigations or response actions are recommended for many of the training areas. No Further Action (NFA) recommendations are area-specific and based on the associated risk-screening evaluation using results of the soil, groundwater, surface water, sediment, and munitions data collected and analyzed for each area. In most instances, the environmental analyses indicated that contaminants related to military training were absent or present at very low concentrations comparable to background. Future actions, including additional data review, geophysical surveys, and/or confirmatory sampling, are proposed at five training areas.

More information is available: A Remedy Selection Plan fact sheet has been developed, and the investigations and findings at the training areas are presented in an Investigation Report. Both documents can be found on EPA's JBCC website (epa.gov/superfund/otis) along with instructions for public comment on the Remedy Selection Plan.

## EPA Announces Improvements to Keep Massachusetts and New Hampshire Waterways Clean

*– David Deegan, EPA Region 1*

On May 10, 2018, EPA announced a major step forward for water quality in New Hampshire and Massachusetts with improved stormwater management requirements as well as training and implementation tools to assist municipalities with implementation. A new permit for each state will update stormwater management across the states' urbanized areas to better protect rivers, streams, ponds, lakes, and wetlands from harmful pollutants in many communities. While updating ecological protection, the permit for each state also maximizes flexibility for municipalities to tailor efforts to their individual needs and local conditions.

"EPA has worked very hard with local and state officials to develop permits that reflect a practical, common-sense approach to protect and restore New Hampshire and Massachusetts waterways," said EPA's Ms. Dunn. "We will continue to work closely with our partners to ensure we provide communities with a great deal of flexibility in local management practices and maintain the highest water quality."

Stormwater is the leading cause of impaired water quality in both Massachusetts and New Hampshire. It carries a wide range of pollutants to the states' waterways, including bacteria and viruses that close beaches and shellfish beds, toxic metals, and excessive phosphorus and nitrogen that can stimulate algae blooms in ponds, lakes, rivers, and coastal waters. In addition to water quality impacts, changing rain patterns have increased the stormwater volume small municipal separate storm sewer systems (MS4s) must handle, increasing flooding risk throughout the two states.

To address these issues, EPA has issued updated permits for Massachusetts and New Hampshire that will help clean up the states' waters and alleviate flooding by improving stormwater management in municipalities. Working closely with the MassDEP and New Hampshire Department of Environmental Services (NHDES), and with extensive community input, EPA developed permit requirements that will:

- Find and eliminate illegal sewage discharges from stormwater systems
- Implement common-sense practices to keep pollution out of stormwater—for example, better street sweeping and cleaning of stormwater catch basins
- Make sure that new development incorporates modern stormwater management, to avoid adding to the problem

EPA has worked closely with MassDEP and NHDES to conduct training and outreach to help municipalities prepare for the new permits. Topics have included permit overview presentations, Notice of Intent preparations, town meeting attendance, and GPS training. In addition to the training, EPA has also produced tools to help municipalities implement the permit requirements, such as a stormwater management plan template, templates for illicit discharge procedures, and ordinance examples. The permits take effect on July 1, and the first submittal for municipalities will be the Notice of Intent for coverage under the respective permit, due 90 days later.

The other New England states—Connecticut, Maine, Rhode Island, and Vermont—are "delegated" states and, thus, will be issuing their own similar permit updates for their regulated communities.

Respective lists of Massachusetts and New Hampshire municipalities (with regulated area maps) that are covered under the permit, including the few that were not subject to the 2003 MS4 permit, can be found on the following websites:

- epa.gov/npdes-permitsregulated-ms4-massachusetts-communities
- epa.gov/npdes-permits/regulated-ms4-new-hampshire-communities

Additional information related to the permit is also available at the epa.gov and epa.gov/region1 website pages.

## States and EPA Coordinate on Best Approaches to Nutrient Permitting

*–WEF Member Association Newsletter*

*Mark Patrick McGuire, Environmental Program Manager, ACWA*

*Katie Foreman, Environmental Program Associate, ACWA*

In early December 2017, representatives from 24 state clean water programs that manage nutrient pollution as well as headquarters and regional staff from EPA met in Boise, Idaho, to discuss nutrient permitting issues. The three-day workshop was the first in a series of seven meetings to be held between 2017 and 2021 by the Association of Clean Water Administrators (ACWA), with support from WEF, as part of a cooperative agreement with EPA.

The workshops aim to assist with achieving several objectives and environmental outcomes by bringing together state, tribal, territorial, federal, and other stakeholders. The goals are to identify challenges and barriers to nutrient permitting program implementation, highlight opportunities for program improvement and enhancement, showcase innovations and achievements, and identify and attempt to solve the most intractable issues.

Topics at this first workshop included nutrient removal technologies, nutrient reduction strategies, variances, water quality trading, watershed-based and adaptive management approaches, and integrated planning. The workshop focused on three issues:

- Implementing nutrient removal technology at water resource recovery facilities (WRRFs). Participants named significant barriers to technology integration as affordability, resource constraints, operator expertise, and political will. They also identified solutions, including targeted technical training and greater public education for such technologies at WRRFs.
- Overcoming impediments to permitting for nutrients. Participants identified affordability, lack of data, and resource constraints as permitting challenges. One solution included changing the five-year National Pollutant Discharge Elimination System (NPDES) permit cycle to 10 years. Other solutions included increasing flexibilities for states, implementing stronger regulations for nonpoint sources, integrating planning to identify issues and priorities for regulators and the regulated community, increasing support and technical training, and educating the public.
- Integrating total maximum daily loads (TMDLs) with permits. Participants acknowledged communication gaps as a major barrier to integration. They identified communication gaps between regulators and stakeholders, and with permitting and TMDL staff. Many participants described better communication among the various interested parties as important for overcoming this challenge.

This workshop showed that states manage nutrient pollution through permitting in myriad ways. For example, Montana, Iowa, and North Carolina approach nutrient permitting via numeric nutrient criteria, performance-based actions, and water quality trading, respectively.

**Montana** adopted numeric nutrient criteria in 2014 to combat nutrient pollution. Development of the criteria included identifying geographic zones for specific criteria, understanding the cause-effect relationships between nutrients and beneficial uses, and characterizing water quality for reference sites. Because nutrient concentrations vary naturally, Montana tested different geospatial frames and reference sites for nutrient concentration variation. To develop permit limits based on the criteria, Montana used EPA's 1991 Technical Support Document for Water Quality-based Toxics Control. Ongoing work in Montana will lead to other large-river nutrient standards and additional site-specific wadeable stream standards.

**Iowa** employs a nutrient reduction strategy to combat nutrient pollution. In Iowa, numeric nutrient criteria development presents significant challenges. Therefore, in lieu of adopting numeric nutrient criteria, the state hopes to achieve nutrient load reductions through performance-based

actions. Working closely with the regulated community to adopt performance-based discharge limits, Iowa establishes limits based on the effect of the pollutant in the water and the feasibility and reasonableness of treating the pollutant. It focuses on major and minor municipal WRRFs and industries that treat more than 3.8 million L/d (1 mgd). Through this approach nutrient pollution has been reduced at point sources throughout the state.

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

ACWA and WEF plan to further address the issues discussed at the Boise workshop and others at the next six nutrient permitting workshops. In 2018, workshops are planned for summer and autumn; visit acwa-us.org for more information.

## LIFT Program Expands with Water Technology Innovation Clusters

*– Morgan Brown, WEF Water Innovation Cluster Manager, WEF Member Association Newsletter*

WEF supports innovation in the water sector. One of its critical objectives is to "establish the conditions that promote accelerated development and implementation of innovative technologies and approaches." As part of this initiative, WEF and the Water Research Foundation (WRF) jointly created the Leaders Innovation Forum for Technology (LIFT) program more than five years ago to facilitate the adoption of water technologies and move innovation into practice.

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

### What Are Water Clusters?

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

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

### Building on Past Efforts

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

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

Also at WEFTEC 2017, an Innovation Pavilion session, "The Water Council's BREW (Business – Research – Entrepreneurship – in Wisconsin) Accelerator," held a business-pitching session modeled after the successful show *Shark Tank*. BREW participant companies pitched for three to five minutes, after which a panel grilled them about their business model, technology, intellectual property, marketing strategy, and more.

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

As a follow-up to the Erie Hack, the Cleveland Water Alliance branched out into another water innovation competition, the Internet of H2O Challenge. This competition seeks to leverage next-generation networking and sensor technology to monitor and manage nutrients in Lake Erie and beyond. The goal was to generate robust and resilient nutrient monitoring pilots with the potential to scale across the Great Lakes. The alliance partnered with DigitalC as well as US Ignite, which spurs the creation of next-generation applications and smart cities, and the National Science Foundation.

### Moving Innovation Forward

Water Technology Innovation Clusters are uniquely making a difference locally and regionally. Even though each cluster is a separate entity, and the clusters are located in various regions, this network brings cluster leaders together so they can work on a national scale. For example, the cluster leaders have worked together to produce reports such as *Overcoming Barriers to Water Innovation in the U.S. and Building a Successful Technology Cluster.* For more information on the Water Technology Innovation Clusters program, visit wef.org/techclusters.





## Gravity Flow Membrane Reactor Article—Free Download Available

*– Travis Loop WEF News Release*

The open access article in the February 2018 issue of *Water Environment Research (WER)* evaluates the efficiency of a gravity flow membrane reactor to treat a municipal wastewater stream.

"Using a gravity flow membrane bioreactor called the biomass concentrator reactor, Platten, *et al.* achieved 93 percent COD and 99 percent ammonia removal," *WER* Editor-in-Chief Tim Ellis said. "Total nitrogen removal (46 percent) was hindered by limited COD to drive denitrification. Membrane fouling occurred on two occasions (after approximately 100 and 200 days of continuous operation, respectively), and the membrane was easily cleaned with a combination of bleach and acid. As a gravity flow system, only 1 in. (2.5 cm) of pressure head was required to operate the membrane bioreactor."

Selected *WER* articles such as this are free to the public monthly through an open access program. In addition, authors can pay a fee to make their accepted articles open access.

Go to ingentaconnect.com to download "Evaluation of a Gravity Flow Membrane Bioreactor for Treating Municipal Wastewater," by William E. Platten, Pablo Campo, Makram T. Suidan, and Albert D. Venosa.

## WEFTEC Operator Ingenuity Contest

*– WEF Member Association Newsletter*

**Editor's Note: The deadline for contest entries was June 1, 2018. It is too late to apply this year, but it is not too early to start thinking about what you might present next year.**

WEFTEC 2018 will host the seventh annual Operator Ingenuity Contest. Not all innovations come from a research lab. Sometimes you need to tackle a persistent problem using just what is at hand, along with a big shot of ingenuity. The competition is open to all clever ideas related to:

- Treatment processes
- Maintenance practices
- Safety measures
- Collection systems
- Laboratory practices
- Stormwater
- Administration
- Human resources
- Anything else associated with the water sector—even if you are not sure that your innovation qualifies, submit it.

### Drawing Inspiration from Past Winners

This contest has discovered about 40 award-winning fixes in its first six years. Entries are judged on safety, resourcefulness, and how transferable the ideas are. The criteria are kept simple to encourage all kinds of entries. Past winners have included painting buildings different colors to make deliveries easier, building a replica manhole, lateral, and cleanout cap to show customers how smoke inspections work, and a device to safely and easily lift the clarifier skimmer in the winter to prevent the skimmer from freezing to the grease box. Selected inventors will be invited to give a 10-minute presentation at WEFTEC 2018 in New Orleans. Submitters do not have to write a full WEFTEC paper. Award winners and select other entries will be converted into articles for the Operator Ingenuity section of *Water Environment & Technology.* For more inspiration, here are some of the 2017 winners:

**Vacuum Virtuoso Award**

Andy Loudermilk from the Bigfork, Montana Water and Sewer District received this award for his invention of the "scum sucker." Mr. Loudermilk repurposed an old rotary-lobed positive displacement blower to provide a vacuum source to enable removal of scum from the top of the facility's membrane bioreactor tanks for deposit into the facility's solids holding pit.

**Alternate Acid Activist Award**

Zenon Kochan and Matt Seib from the Nine Springs Wastewater Treatment Plant in the Madison, Wisconsin Metropolitan Sewerage District received their award for a low-cost, safe, and efficient acid pumping system. Instead of carrying 55 lb (25 kg) bags of powdered acid to the top of a 30 ft (10 m) tall reactor, operators now use a portable pump that Mr. Kochan built to deliver a liquid acid directly into the process tankage.

**Chemical Capture Chief Award**

Mark Cataldo from Suez (Paramus, New Jersey) and the Killingly Water Pollution Control Plant (Danielson, Connecticut) earned his award for installing a trough to catch any spills during sodium hypochlorite deliveries. Mr. Catalado attached a simple trough to the wall beneath the inlet pipe to replace the previous setup (a bucket propped up with a board).

**Thinkers Who Tinker Award**

Kevin Barry, Jeff Leonard, and Jim Wilson from Woodard & Curran (Portland, Maine) and the Pine Hills Wastewater Treatment Facility (Plymouth, Massachusetts) won for applying the motto "work safer, not stronger" to find safer, more efficient approaches to routine tasks. Their changes include using davits and hoists throughout the facility to lift heavy equipment.

**Root Assassin Award**

Tony Hale from the Cottonwood Improvement District (Sandy, Utah) won for devising an in-pipe spot applicator for chemical herbicides. He built a floating rig that holds a camera and a swiveling nozzle to help deliver foaming root removal chemicals precisely where they are needed. This halved the chemical amount needed for the job.

**Tidy Tester Award**

Jason Patty, Ron McClure, Pat Fountain, Glen Holz, and Brad Gillis from the El Dorado, Kansas Wetlands and Water Reclamation Facility received this award for building a simple and effective return activated sludge (RAS) sampling station. The operators plumbed the RAS line to a bucket, which has a hole in the bottom that is plumbed to the sump pit. Closing the drain valve on the bucket and opening the RAS flow line fills the bucket. After sampling, opening the bucket drain valve sends the RAS into the sump.

# Planning for Change

## CSO/WET WEATHER ISSUES

**October 29 – 30, 2018 • Holiday Inn, Portland, Maine**

**2018 SPECIALTY CONFERENCE & WORKSHOP SERIES**

**Exhibit opportunities will be available**

**Watch for registration information**

**The federal and state regulatory environment** on wet weather flow challenges continues to change, sometimes creating overlapping enforcement requirements on CSOs, stormwater, sanitary sewer overflows (SSOs), and collection system capacity, management, operation, and maintenance (CMOM) as mechanisms to achieve water quality goals. In addition, climate change and the resiliency of systems to protect against it continues to be an emerging hot topic.

To respond to the complex variety of wet weather and water quality challenges, some communities are developing integrated plans for capital improvements programs to address municipal stormwater, wastewater treatment, conveyance system, and CSO abatement objectives.

This two-day conference is an opportunity to share our national and regional working knowledge and experience to discuss these changes and how to meet these challenges.

NEWEA
WORKING FOR WATER QUALITY

# High-strength wastewater from biopharma operations—an emerging issue

WAYNE E. BATES, PhD, P.E., Principal Engineer, Tighe & Bond, Westwood, Massachusetts
WILLIAM POTOCHNIAK, P.E., Project Manager, Tighe & Bond, Westwood, Massachusetts

**ABSTRACT** | Historically, high-strength wastewater discharges from biotechnology/ pharmaceutical (biopharma) manufacturing operations containing high levels of organics, nitrogen, and phosphorus posed little concern to municipal wastewater recovery facilities (WWRFs). However, with more stringent state and federal wastewater discharge regulations for nutrients, local WWRFs discharging to impaired waterways are being required to invest large sums of capital to upgrade and install additional unit operations for nutrient removal. In combination with these significant WWRF upgrades to meet lower nutrient discharge limits, industrial pretreatment programs in these municipalities will also look upstream at high nutrient load discharges from industries such as biopharma manufacturing companies. This paper provides an overview of the biopharma industry, its typical wastewater discharges, and the challenges that both the industry and municipally owned treatment plants will face assessing and treating high-strength wastes.

**KEYWORDS** | Biotechnology, industrial wastewater treatment, wastewater characterization, treatability, pharmaceutical waste, R&D, scale-up laboratory


Eutrophic Stream

## IMPORTANCE OF BIOPHARMA IN SOCIETY AND THE LOCAL ECONOMY

The biotechnology and pharmaceutical (biopharma) industries play a significant role in society and help to improve the quality of life for many people in developed and developing nations. Biopharma companies provide many life-improving developments, from vital research on common and rare diseases to mass production of over-the-counter drugs for the common cold. Large populations affected by a disease or disorder rely on the hope that new and existing drugs offer a better quality of life.

The biopharma industry also supports a major portion of the national and local economy. According to the Massachusetts Biotechnology Council (MassBio) Industry Snapshot 2017, the Massachusetts biopharma industry has grown more than 28 percent over the past 10 years. In 2016, it employed 66,000 people for a total of $9 billion in wages or an average annual wage of $138,768. This growth has also supported the professional services and construction industries with the addition of new and renovated commercial laboratory space. Facility space increased from 16.7 million ft$^2$ (473,000 m$^2$) in 2008 to 28.2 million ft$^2$ (799,000 m$^2$) in 2017. Also in 2016, Massachusetts received the highest per capita funding from the National Institutes of Health (NIH) at $378 per capita. This funds the growth of research at Massachusetts' world-renowned colleges, universities, and research hospitals.[1]

**Table 1. Clinical research phase studies FDA**

| Phase | Participants | Length of Study | Purpose | Common Results | 2016 MA Statistics[6] |
|---|---|---|---|---|---|
| Phase 1 | 20 to 100 healthy volunteers or people with disease/condition | Several months | Safety and dosage | Approximately 70% of drugs move to next phase | 447 drugs in Phase 1 trials |
| Phase 2 | Up to several thousand people with the disease/condition | Several months to 2 years | Efficacy and side effects | Approximately 33% of drugs move to the next phase | 367 drugs in Phase 2 trials |
| Phase 3 | 300 to 3,000 volunteers who have the disease or condition | 1 to 4 years | Efficacy and monitoring of adverse reactions | Approximately 25-30% of drugs move to the next phase | 98 drugs in Phase 3 trials |

## BIOPHARMA INDUSTRY REGULATIONS

### General impact of regulations

Before a drug can be sold to consumers, it must be proven that the benefits outweigh the known and potential risks associated with its use. In the United States, regulations that establish the rigorous drug approval process can result in it taking 12 years for a drug to make it from the experimental stage to the market. According to MassBio, on average only one in 5,000 drugs that enter preclinical testing end up making it to market.[2] With drug patents typically lasting only 20 years from the time the drug is discovered, drug manufacturers have only about eight years to recover the development costs and turn a profit before other companies can make generic brands.

The stakes are high, but the returns can be higher for drug discovery and development companies. According to a study by *JAMA Internal Medicine,* a journal of the American Medical Association, of 10 cancer drugs developed and manufactured between 2006 and 2015, it took approximately eight years and approximately $650 million to bring these new drugs to market.[3] Offsetting these research and development (R&D) costs are the potential returns if the drug is approved for production. JAMA's research found that total revenues from the 10 companies it evaluated were nearly $67 billion from the time their drugs were approved.

### FDA drug approval cycle

According to the Food and Drug Administration (FDA), the development of a drug must follow a five-step process that includes these steps:[4]

**Step 1** – Discovery and Development (research for a new drug in the laboratory)
**Step 2** – Preclinical Research (laboratory and animal testing to answer basic questions about safety)
**Step 3** – Clinical Research (human testing to make sure the drug is safe and effective)
**Step 4** – FDA Review (examination of research data and decision to approve or not to approve)
**Step 5** – Post-Market Safety Monitoring (post-approval monitoring for safety)

Of the five steps, the preclinical and clinical research steps, Steps 2 and 3, are where a new drug undergoes intensive review and testing before it can be produced for sale. During preclinical research, Step 2, drugs undergo rigorous laboratory *(in vitro)* and animal *(in vivo)* testing to answer basic questions about safety. Preclinical researchers are regulated under the FDA Good Laboratory Practices, which set the minimum basic requirements for studies, facilities, equipment, procedures, and study reports.[5] Before moving to clinical research, Step 3, drug developers must submit an Investigational New Drug application to the FDA. If approved, the clinical research stage is used to test new drugs on increasingly larger human populations over a three-phase study process that can take up to six years. According to MassBio, in 2016 964 drugs were in preclinical research and 912 drugs in clinical research in Massachusetts. Table 1 summarizes the clinical research phases and 2016 Massachusetts statistics.

Once a drug makes it through clinical research, the drug developer must submit a New Drug Application for FDA review in Step 4. FDA thoroughly examines all the data submitted, sometimes over 100,000 pages, related to the research and trials from the previous three steps, before it decides whether to approve the drug or device. The approval process can take up to two-and-a-half years.[7] Even after the new drug is approved, the drug developer must continue to monitor drug efficacy and side reactions in the final step of approval, referred to as Step 5, post-market safety monitoring.

### Applicable regulations, industry standards, and voluntary programs

Other than the rigorous drug approval process, the biopharma industry is regulated much like most other industrial manufacturing facilities. In fact, biopharma research and production facilities are subject to the many of same federal, state, and local environmental, health, and safety regulations as the chemical manufacturing industry. Table 2 summarizes the common regulatory programs that apply to most manufacturing facilities, including biopharma

**Table 2. Common regulatory programs in biopharma manufacturing**

| Regulatory Programs/ Regulated Media | Applicability | Impacts |
|---|---|---|
| Occupational Safety and Health Administration | Industrial activities and construction activities | Lockout/Tagout<br>Confined Space<br>Hazard Communication<br>Deluge showers |
| Hazardous Waste | Generation, storage, handling, and disposal of listed and characteristic wastes | Solvents, unused product, research lab waste, analytical equipment waste, culture stains, equipment maintenance waste |
| Hazardous Materials | Storage of toxic, flammable and listed regulated materials | Solvents (isopropyl alcohol, acetone, methanol, ethyl alcohol), lab reagents, analytical equipment chemicals |
| Industrial Wastewater | Manufacturing and R&D operations | Wastewater collection, treatment and sampling according to categorical standards for pharmaceutical manufacturing operations (40 CFR 439) |
| Fire Code | Storage of flammable materials | Dedicated storage lockers, special storage permits, compliance with state and local building codes |
| Air Emissions | Process and fugitive emissions | Large boilers, steam production, storage and use of solvents, solvent collection and stripping, emergency generators |

research, development, and production facilities.

In addition to the common regulatory programs, certain manufacturers producing consumable goods, including the biopharma sector, are subject to the Good Manufacturing Practice (GMP) regulations promulgated by FDA. These regulations, which have the force of law, require that manufacturers, processors, and packagers of drugs take proactive steps to ensure that their products are safe, pure, and effective. GMP regulations require a quality approach to manufacturing, enabling companies to minimize or eliminate instances of contamination, production mistakes, and chemical errors. This, in turn, protects the consumer from purchasing a product that may not be effective or even worse, contaminated to a point where it has negative effects or is dangerous. Failure of firms to comply with GMP regulations can result in serious consequences, including recall, seizure, fines, and, in certain cases, criminal prosecution.[8]

Regulatory requirements can differ significantly for R&D facilities from those that manufacture products for consumption. Although the chemicals, operations, and equipment used in R&D facilities are similar to the chemicals, operations and equipment used at manufacturing facilities, R&D activities are exempt from most major regulatory programs due to the small volumes of chemicals used and the scale of the operations. Even when exempt from major regulatory programs, R&D facilities still face challenges in complying with environmental, health, and safety regulations due to the number of chemicals used and the processes conducted under fluctuating experimental conditions.

## OVERVIEW OF BIOPHARMA OPERATIONS

Operations in the biopharma industry range from cutting-edge research to high-volume manufacturing. As previously noted, biopharma operations are similar to the chemical manufacturing industry in the types of equipment and processes used. And although the industry is evolving quickly with new discoveries and drug delivery methods, the following sections discuss the five primary categories of manufacturing regulated by EPA under the Pharmaceutical Manufacturing Effluent Guidelines and Standards (40 CFR 439), which include:

1. Fermentation products
2. Extraction products
3. Chemical synthesis products
4. Mixing/compounding and formulation
5. Research

### 1. Fermentation

Fermentation is commonly conducted in batch reactors and used to grow microorganisms that contain a biological or chemical agent that when recovered and isolated can be used as an active pharmaceutical ingredient (API). Fermentation in biopharma is similar to fermentation in the food and beverage industry in which it is conducted within a closed batch reactor under controlled conditions. The process can range from 12 hours to seven days. Depending on the length of fermentation, additional nutrients may need to be added to the fermentation "broth," and some of the broth within the reactor may need to be wasted. When fermentation broth is wasted, filtration devices are often used to keep the active microorganism culture (i.e., product or API) within the reactor. Once fermentation is complete, the product in the broth is typically recovered by solvent extraction, direct precipitation, ion exchange, or adsorption.[9]

Wastes from fermentation processes can be a virtual "biological cocktail" commonly high in organic matter as measured by the waste's biochemical oxygen demand (BOD) and the chemical oxygen demand (COD). Fermentation waste may also contain high levels of macronutrients and micronutrients, such as nitrogen and phosphorus, as well as common proteins, amino acids, and growth accelerators (enzymes) that aid fermentation. Fermentation wastes may be extremely high temperature if steam is used, or contain high levels of disinfectants such as chlorine or peracetic acid. In certain operations extremely strong disinfectants are used that must be segregated and handled as a regulated waste. Solvent extraction techniques involve common solvents such as acetone, methanol, isopropyl alcohol, or ethanol. Solvent recovery equipment is typically used to recover most of the solvent; however, solvents having a high organic load can be discharged to the sewer system during cleaning.

### 2. Biological and natural extraction operations

Many plant and animal cells have naturally occurring pharmaceutical properties that when extracted from the source can be used alone or in combination with other pharmaceutical products. These products have a wide range of pharmaceutical applications, from tranquilizers to insulin to pain-relief and allergy-relief medications. Biological and natural extraction processes are typically conducted in sequential operations where the active ingredient is isolated and portions of the source material that do not contain the active ingredient are removed. As a result, the source material volume gets increasingly smaller as the active ingredient is isolated in small batches. These small batches of product are commonly combined to produce larger batches for ease of processing. The primary wastes associated with biological and natural extraction operations include spent raw materials (e.g., waste plant material, residues, extraction broth), equipment cleaning water and chemicals, and spent solvent used for final extraction. The spent raw material, because it is organic, can be high in total and suspended solids, organics, nutrients, and extraction solvents.

### 3. Chemical synthesis

Most active ingredients in drugs are manufactured by chemical synthesis in batch operations through organic or inorganic reactions.[9] Chemical synthesis is typically conducted in "campaigns" where specific vessels are used for extended periods to manufacture a single product. Campaigns reduce the amount of waste and optimize the production time between cleaning or equipment repairs. Campaign run length can be dictated based on the availability of raw materials, active ingredients, manufacturing space, or warehouse space, or by market demand for the final product. Wastewater from chemical synthesis can have high organic loads from the discharge of spent solvents, filtrates, concentrates, equipment washing, solvent scrubber systems, and the discharge of an off-specification product.

### 4. Mixing, compounding, and formulating

Most active pharmaceutical ingredients must be converted into dosage form (e.g., tablets, pills, creams, oral liquids) using various methods of mixing, compounding, and formulating. Two common drug administration forms include tablets and capsules. Tablets are made by combining the dry active ingredient(s) with a filler (e.g., starch, sugar) and binders (e.g., corn syrup or starch).[9] Some tablets are coated for protection or time release before they are packaged. Tablet coating can be a significant source of air emissions if solvent-based coatings are used and also contribute to high solvent concentrations in the process wastewater if wet scrubber equipment is used for air pollution control. Capsules are made by filling a premade gelatin-like capsule with a powder containing the active ingredient(s) and fillers. Binders are not typically needed for capsules, because the capsule provides a protective and dissolvable barrier. Wastes from mixing, compounding, and formulating are primarily from cleaning operations and can contain cleaning agents, disinfection products, and trace amounts of the API, fillers, and binders.

### 5. R&D operations

Biopharma facilities that focus on preclinical R&D tend to resemble academic research institutions with decentralized and autonomous operations within a single facility. These decentralized operations often conduct a wide variety of experiments using small quantities of numerous chemicals and raw materials. As a result, certain research facilities tend to lack a strong chemical inventory, presenting challenges in characterizing wastewater discharges. When conducting wastewater discharge effluent monitoring, lack of a good chemical inventory can also make it difficult to trace a pollutant with an elevated discharge concentration upstream to the research laboratories.

### Ever-changing landscape

Any of the manufacturing operations described above could be conducted in a wide variety of steps using nearly an infinite number of raw materials and solvents. In addition, the biopharma industry is moving from traditional reusable stainless-steel vessels requiring clean-in-place technologies to single-use disposable systems. Single-use systems have become important in developing and scaling up biotechnology processes as they save space, increase flexibility and, largely, eliminate cleaning costs in development and changeover. However, single-use systems have challenges, including complete integration, scalability, and issues with extractable and leachable components in the single-use materials.[10] Single-use systems typically reduce organic loading to the sewer, because residual organics from the process will be disposed with the single-use system to a landfill as opposed to the drain with cleaning fluids.

## WASTEWATER DISCHARGES FROM BIOPHARMA

The biopharma industry is regulated like most other industrial manufacturing facilities and subject to many of the same federal, state, and local environmental, health, and safety regulations as the chemical manufacturing industry based on the many similarities in manufacturing. However, one major difference is the volume of waste generated compared to the amount of product produced. In many chemical manufacturing processes, final products are manufactured in bulk quantities with low waste-to-product ratios. However, the biopharma industry typically extracts small concentrated volumes of target active ingredients from large volumes of bulk materials, often resulting in high waste-to-product ratios. These high-volume waste streams are often high in organics and result from cleaning and sterilization requirements that call for large amounts of water along with various oxidizing and sterilization agents. Table 3 presents nutrient loads from a typical biotechnology scale-up operation. The common challenges in managing, characterizing, and treating wastewater from various biopharma operations are summarized below.

**Table 3. Nutrient loads from typical biotechnology scale up operation**

| Parameter | Process Discharge (mg/L) |
|---|---|
| BOD | 10,000 – 20,000 |
| COD | 20,000 – 40,000 |
| TKN | 1,000 – 2,000 |
| Phosphorous | 100 – 200 |

### Predicting intended and unintended reactions

**Oxidation Byproducts**. Most laboratories are familiar with the hazardous waste regulations and typically collect small volumes of hazardous wastes, such as solvents and acids, for off-site disposal. However, the discharge of non-hazardous regulated pollutants from one or more operations on the same wastewater collection system or riser can cause a reaction that generates other regulated pollutants. For example, most biopharma operations have strict cleaning and sanitation policies that often call for hot water or steam combined with commercial and industrial cleaning solutions containing oxidizers such as chlorine bleach, hydrogen peroxide, or acetic acid. Because wastewater from biopharma operations is typically high in organics, high quantities of cleaning chemicals containing oxidizers must be used to oxidize organics in the wastewater. The high concentration of organics and large amount of oxidizers can generate regulated pollutants such as chloroform or in certain cases formaldehyde.

**Formaldehyde**. Facilities using highly regulated biological agents such as pathogens, viruses, spores, or other agents are required to conduct extremely aggressive surface cleaning that calls for fumigation. Fumigation is conducted by combining formaldehyde with potassium permanganate, a strong oxidizer, to create a cloud vapor of formaldehyde that can fumigate an entire laboratory or a localized area, such as a fume hood. While fumigation does not directly generate a wastewater discharge, rinse water and cleaning wastewater from subsequent surface cleaning operations may be the source of elevated levels of formaldehyde in effluent discharges. Formalin, a mixture of formaldehyde and water formaldehyde, is often used to preserve organs or tissue used in research. Therefore, laboratories using formalin may experience elevated levels of formaldehyde in their discharge.

**Organic Matter**. Facilities conducting fermentation and natural extraction commonly work with organic materials containing protein structures comprising chains of amino acids. Building a biopharma product often involves breaking apart these protein chains into shorter ones or even into the individual amino acids and then reassembling the protein chains and amino acids into new sequences. From a wastewater perspective, it is important to recognize that those proteins, amino acids, and enzymes wasted to the drain from the process, if not inactivated, may cause unpredictable side reactions in piping systems, equalization tanks, or wastewater reaction vessels. These potential reactions can create or release regulated pollutants, consumption of oxygen, generation of odors, and/or a significant drop in pH because of anaerobic conditions. As presented by Amgen at the NEWEA 2018 annual conference, phenol was detected in the effluent discharge from its facility in Cambridge, Massachusetts. After reviewing chemical purchasing records, it was determined that phenol was not present in any of the chemicals purchased, stored, or used at the facility. Extensive bench-scale testing showed that phenol was being generated because of biological activity within the wastewater collection and treatment system and was directly related to discharges from a high-nutrient-strength batch operation, as shown in Figure 1.

**Nutrients**. Macronutrients and micronutrients are used in fermentation and natural extraction. Macronutrients commonly contain various forms of nitrogen and phosphorus, whereas micronutrients may contain certain regulated metals such as zinc, nickel, and aluminum. While most WWRFs do not limit nitrogen and phosphorus levels in their industrial pretreatment program, some municipalities with reduced nitrogen and phosphorus limits are requiring industrial dischargers to monitor these levels.

### Fluctuating flows

Biopharma wastewater flows tend to be intermittent discharges and depending on the stage and nature of the operations, their volume and concentration can vary widely. Except for large pharma facilities, most biopharma facilities discharge small volumes of waste intermittently throughout a product run or campaign through oversized wastewater collection systems designed using conservative state and local plumbing codes. Intermittent flows containing various biological and chemical constituents discharge to oversized pipes resulting in long retention times that can promote anaerobic biological activity in sewers. Biological activity within the waste collection and treatment system can generate noxious odors that may cause indoor air quality issues leading to employee complaints and, under certain conditions, exposure concerns. In newer facilities, these odor issues can be exacerbated by increasingly tighter and more energy-efficient buildings. As previously noted, biological activity can also release or generate other regulated byproducts.

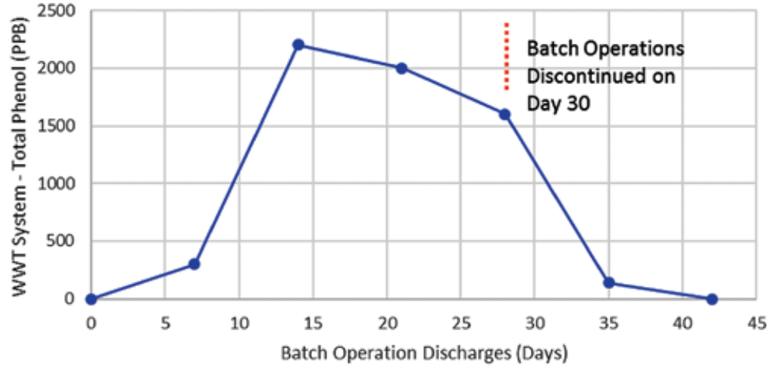



**Figure 1. Phenol generation in wastewater treatment system from batch process operations**

### Access to sampling points within infrastructure

Wet discharges from biopharma operations are often discharged to a sink or a floor drain connected to horizontal manifolds and risers before discharging to the sewer or a facility neutralization system. Waste collection and piping systems in most biopharma facilities are often concealed above ceilings, buried below concrete floors, or framed within vertical walls. In mixed-use facilities with laboratories, manufacturing spaces, and office areas, these pipes may travel over, under, or through occupied spaces. While plumbing codes call for pipe cleanouts on gravity mains, the plumbing code does not require sampling points for wastewater sample collection. Pipes with limited access for sampling make it difficult to trace piping location and to identify where certain pollutants are introduced or where biological activity may be occurring.

### Treatment challenges

Most industrial wastewater treatment systems at small to medium-sized biopharma facilities are limited to equalization and neutralization. In some cases, these wastewater pretreatment systems were designed for previous building tenants or for operations no longer conducted at the facility. For example, a biopharma facility struggled to control odors from its wastewater treatment system. After reviewing current and past operations, it discovered that the facility formerly housed an active vivarium with cage-washing operations that generated high flows. The existing wastewater treatment system was designed to handle these high flows; however, lower flows without the vivarium operations resulted in long retention times promoting biological activity and odor generation.

Many newer biopharma facilities are designed for a single client with specific requirements such as clean rooms, raw material storage, quarantine staging, high-efficiency particulate air filtration, ultrapure water, water for injection, laboratory layout, and process scale-up operations. While architectural and mechanical engineering firms specializing in biopharma research operations typically design these facilities, a commonly overlooked and misunderstood design element is the wastewater pretreatment system. Understandably, wastewater characterization (i.e., quantity and quality) during facility design is often unknown, and there is a tendency to oversize wastewater equalization and neutralization equipment. As discussed, an oversized system with long retention times can lead to unwanted biological activity leading to byproduct generation and odor issues.

Discharges of wet processes are typically sporadic, whereby a small volume of waste with a high concentration of a regulated pollutant could increase the pollutant concentration for a short period. If effluent monitoring occurs while this waste is being discharged, an excursion for that parameter could result, even though the daily, weekly, or monthly average would not exceed permitted limits.

### Coordination between operations and treatment

Laboratory research often is leading-edge and thus not commonly communicated to others to protect intellectual property. Not knowing what is in the pipeline can affect the wastewater treatment system especially if a regulated parameter is discharged that the wastewater pretreatment system is not designed to remove. Companies having strong environmental, health, and safety programs commonly have a chemical inventory documenting the amount and characteristics of raw materials stored onsite. These companies also commonly have a chemical review process in which a designated representative or

group reviews chemicals requested for use before the chemical is allowed to be brought into the facility or laboratory. This review not only helps to manage chemicals being used and discharged, it also leads to more efficient investigations if there is an elevated level of a regulated pollutant in the future.

**Location of treatment equipment**

During facility design, wastewater treatment is often subcontracted to equipment suppliers who typically provide a package treatment system. Too often the wastewater characteristics expected from the facility operations are not considered carefully enough and the equipment tends to be oversized and "shoehorned" into a remote corner in the basement. A wastewater treatment system that is out of sight is out of mind and susceptible to infrequent inspections and inadequate maintenance. A wastewater treatment system in a constricted area or a permit-required confined space can make it difficult to access probes, valves, controls, and equipment for general operation, maintenance, and repairs. These package systems are commonly standalone systems and not integrated into the overall facility computer management systems for monitoring or trending treatment system conditions and critical pollutant levels..

## CONCLUSION

Biopharma operations present current and future challenges in managing wastewater discharge compliance. One challenge is maintaining compliance with local and state wastewater discharge regulations. To comply with these current standards, a thorough understanding of biopharma operations, process chemistry/biology, waste collection systems, and wastewater treatment equipment is needed. Understanding these aspects can help to prevent noncompliant discharge of pollutants and expedite investigation of an elevated pollutant discharge if one occurs. A future challenge for biopharma wastewater compliance is the eventual addition of nutrient limits such as nitrogen and phosphorus to industrial discharge permits by locally owned municipal wastewater treatment plants. These increased nutrient limits will likely be due to greater enforcement from state and federal regulatory agencies. As this pressure increases, municipalities will be forced to look upstream to industrial dischargers to reduce nutrient loads to the municipal system prior to discharge. When this happens, biopharma facilities with simple neutralization systems may be required to design and construct treatment systems with advanced nutrient removal.

## ABOUT THE AUTHORS


- Wayne E. Bates, PhD, P.E. is a principal engineer leading the industrial client sector at Tighe & Bond. He has 30 years of consulting experience in the industrial and high-tech sectors and specializes in industrial wastewater and corporate sustainability. He holds a Bachelor of Science degree in civil engineering from UMass Dartmouth and doctorate in environmental engineering from Worcester Polytechnic Institute.
- William Potochniak, P.E. is a project manager at Tighe & Bond. He has 20 years' experience in industry and consulting engineering and specializes in industrial wastewater and environmental compliance. He holds a degree in environmental engineering from Roger Williams University.


## REFERENCES

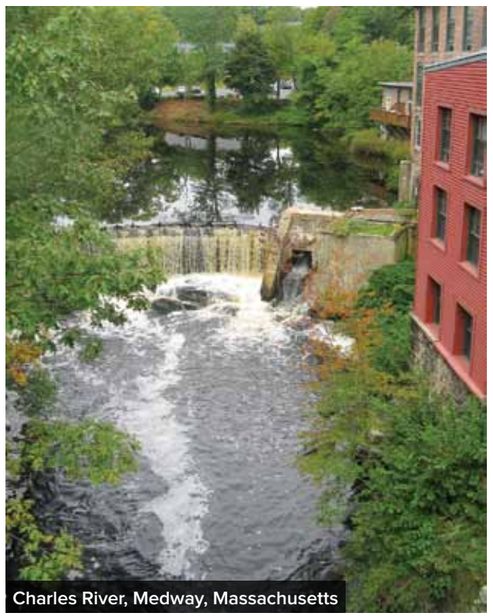

1. Massachusetts Biotechnology Council, "Industry Snapshot 2017," files.massbio.org/file/MassBio-Industry-Snapshot-2017.pdf, downloaded March 1, 2018
2. Medicine Network, "Drug Approvals—From Invention to Market...A 12-Year Trip," medicinenet.com/script/main/art.asp?articlekey=9877, downloaded March 2, 2018
3. *Journal of American Medical Associations on Internal Medicine*, "Study Estimates R&D Spending on Bringing New Cancer Drug to Market," September 11, 2017
4. fda.gov/ForPatients/Approvals/Drugs/default
5. US Food & Drug Administration, "Step 2: Preclinical Research" (fda.gov/ForPatients/Approvals/Drugs/ucm405658), downloaded March 24, 2018
6. Massachusetts Biotechnology Council, "Industry Snapshot 2017," files.massbio.org/file/MassBio-Industry-Snapshot-2017.pdf, downloaded March 1, 2018
7. Drugs.com, "New Drug Approval Process," drugs.com/fda-approval-process, downloaded March 21, 2018
8. International Society of Pharmaceutical Engineers, "What is GMP," https://www.ispe.org/initiatives/regulatory-resources/gmp/what-is-gmp, downloaded March 21, 2018
9. Jones, Donald E., *Pharmaceutical Waste Analysis, Quality Environmental Solutions,* February 1, 2006
10. Rudge, Scott R., "Single-use Systems for Biotechnology Products," *European Pharmaceutical Review*, April 12, 2017

# Planning for phosphorus control in stormwater—let us not reinvent the wheel

ZACH HENDERSON, Woodard & Curran, Andover, Massachusetts

**ABSTRACT** | This summer, the 2016 Massachusetts small municipal separate storm sewer system (MS4) permit goes into effect—setting off a timetable for municipalities in the Charles River watershed to initiate controls for phosphorus in stormwater runoff. The planning, labor, and capital cost estimates to comply with these water quality improvements are steep, but there are cost-effective strategies to control phosphorus in stormwater runoff that have been researched and implemented in other regions that can greatly benefit our planning and policies in New England.

**KEYWORDS** | Stormwater, green infrastructure, Charles River, small municipal separate storm sewer system (MS4), structural controls, non-structural controls, stream bank stabilization, leaf litter collection



Charles River, Medway, Massachusetts

More than 80 percent of the nation's population lives within an area serviced by a municipal separate storm sewer system (MS4). The owners or operators of these "stormwater drainage systems" are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit from EPA (or delegated state authority) to ensure that they are taking the necessary steps to reduce and eliminate stormwater pollution before it discharges into their local water bodies. This is referred to as the MS4 General Permit or MS4 permit. While the MS4 permit program is in different phases of regulation across the country, the core permit requirements are largely the same everywhere. Consistent with national trends in other more traditional NPDES permit programs, the MS4 General Permit is increasingly obligating relevant parties to address discharges into impaired waters through mandatory pollutant load reductions.

In Massachusetts, the communities within the Charles River watershed will soon face their first specific MS4 General Permit required pollutant load reductions. More than 20 years ago, EPA New England launched the Clean Charles initiative to make the Charles River fishable and swimmable again. While the Charles River watershed communities, the Massachusetts Water Resources Authority (MWRA), the Massachusetts Department of Environmental Protection (MassDEP), and other partners have made great progress with Charles River water quality, and specifically bacterial contamination, excess nutrients are perceived to continue to impair water quality. These nutrients are considered largely a result of cultural eutrophication, in which urbanization increases discharge of nutrients into a water body through greater stormwater runoff volumes. These nutrients, phosphorus chief among them, are a major cause of algae blooms, which can release toxins poisonous to humans and fish, and can reduce the available oxygen in the water.

## NPDES MS4 DISCHARGE OBLIGATIONS IN THE CHARLES RIVER

The MS4 General Permit in the Charles River is based on Total Maximum Daily Load (TMDL) calculations approved by EPA for the Upper and Lower Charles River Basin in 2011 and 2007, respectively. The Upper TMDL was calculated using the Hydrologic Simulation Program – Fortran (HSPF) model with 1999 land use as a base scenario and was run and calibrated for the period of 1998 to 2002 to be consistent with the Lower Charles River TMDL. The Upper TMDL model was run for 18 scenarios and was inclusive of non-point and point source stormwater and point source wastewater discharges (at permitted loads and not actual loads).

The Final Upper TMDL has total phosphorus (TP) wastewater treatment facility (WWTF) discharge limits for summer and winter for major and minor WWTFs at 0.1 and 0.3 mg/L with additional point-source (MS4) stormwater phosphorus reduction requirements as well. According to the Upper TMDL, the necessary TP load reduction to meet water quality standards is approximately 13,200 lb (6,000 kg) TP/year from wastewater sources and approximately 33,000 lb (15,000 kg) TP/year from point source stormwater.

This means that communities in the Charles River must reduce TP in stormwater by at least 51 percent and perhaps more considering 1999 land use conditions were used as a baseline. To meet this lofty goal, EPA and MassDEP require aggressive pollutant load reduction targets for phosphorus in regulated stormwater discharges under the 2016 MS4 General Permit. The permit, anticipated to become effective July 1, 2018, will require Charles River watershed municipalities to create a phosphorus control plan (PCP) that identifies and ranks areas and infrastructure suitable for structural stormwater-based phosphorus controls, establishes an O&M program for those structural controls, and identifies non-structural stormwater controls that will support the reduction of phosphorus loading. The permit establishes specific load reduction requirements for each watershed community.

**Table 1. Allowable structural controls included in the Massachusetts MS4 permit**

| Structural BMP (EPA Nomenclature) | BMP Description | Phosphorus Removal* |
|---|---|---|
| Infiltration trench | Subsurface storage and infiltration of stormwater | 18–100% |
| Infiltration basin | Surface storage and infiltration of stormwater | 35–100% |
| Biofiltration practice | Surface or subsurface storage and vertical filtration of stormwater before discharge | 19–89% |
| Gravel wetland system | Storage and horizonal filtration of stormwater before discharge; anaerobic unit processes | 19–66% |
| Porous pavement | Storage and vertical filtration of stormwater through and below pavements | 62–78% |
| Wet pond | Storage and settling of stormwater in permanent pool of water | 14–63% |
| Dry pond | Storage and settling of stormwater in impoundment or excavation | 3–14% |
| Dry water quality swale | Linear storage and settling of stormwater | 2–36% |

* Performance ranges are based on BMP performance curves in Appendix F of the MS4 General Permit. Actual performance may vary greatly by antecedent soil conditions, volume of stormwater retained, treatment train installation, influent water quality, etc. These ranges are offered for simple broad comparison of systems.

Each of the 34 MS4 regulated communities in the Charles River watershed is required to meet individual "load reduction requirements" within the permit term. The communities must reduce loads by 20 percent within eight years of the effective date of the permit and 25 percent within 10 years. The initial 20 percent TP load reduction requirements vary based on watershed area and land use within each community; reductions range from a low of 6.6 lb (3 kg) TP/year in Wayland to a high of 855 lb (388 kg) TP/year in Newton, with an average of 88 to 176 lb (40 to 80 kg) TP/year range for required reductions.

## STORMWATER STRUCTURAL CONTROL OPTIONS AND COST IMPLICATIONS

Although the core MS4 permit requirements are largely the same everywhere, the acceptable control alternatives vary from permit to permit. For the Massachusetts MS4 General Permit, all the best management practices (BMP) guidance, including credit calculations, are embedded by EPA within the permit rather than within separate, non-permit management guidance documents. Through the permit, EPA allows specific structural control

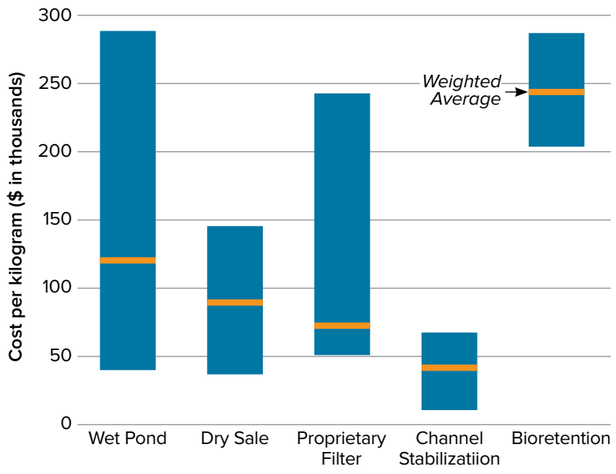



**Figure 1. Cost of TP reduced for different phosphorus control techniques in the East of Hudson watershed**

alternatives and provides the associated load reduction calculations for TP control planning. Table 1 outlines the permit's allowable structural controls.

EPA has established BMP performance curves for each of the practices above with variable levels of TP reduction based on how much stormwater the system stores and treats. Infiltration systems provide the greatest load reduction per unit of volume managed in the system (upward of 60 to 80 percent at ½ in. [1.27 cm] of the water quality volume [WQV]). A load reduction model developed by EPA will be available to assist permittees in determining various stormwater BMP treatment alternatives.

*The Sustainable Stormwater Funding Evaluation for the Upper Charles River Communities of Bellingham, Franklin and Milford, MA 2011* was commissioned by EPA to better understand the likely costs for stormwater-based controls in the Charles River. The average cost for structural stormwater controls, presented by the study, was $42,795 per lb ($94,069 per kg) TP for a variety of stormwater controls under a variety of contributing land uses. The authors also presented two implementation case studies and provided a cost per quantity value of recently (2011) constructed systems, which were $68,539 per lb ($151,102 per kg) TP and $112,915 per lb ($248,934 per kg) TP.

Although these costs may seem high, they appear consistent with actual implementation results from other areas in the Northeast, for example, the East of Hudson Watershed Corporation (EOHWC). The EOHWC recently completed nearly $40 million of stormwater controls for phosphorus in the drinking water supply watersheds of New York City. During its second phase of stormwater retrofit planning, EOHWC examined the costs of its previous projects. Figure 1 summarizes the full costs (in cost per unit of TP removed) realized after the first $40 million of stormwater retrofit program implementation.

The results from the extensive stormwater control implementation in the East of Hudson watershed are consistent with EPA commissioned studies in the Upper Charles. On average, it cost EOHWC about $45,000 per lb ($100,000 per kg) of TP removed through stormwater controls. Plugging these estimates into the TP load reduction goals for each community in the Charles River paints an expensive picture of the cost for structural stormwater controls. To meet the 25 percent reduction target for the average watershed community would cost several million dollars per community if it were to complete an all-structural control implementation program. For some of the communities with larger load reductions, it may require tens of millions of dollars in new stormwater controls to comply with the MS4 General Permit through the first 10 years. While some communities may be able to reduce costs through an alternative to traditional plan-design-bid-build approaches to stormwater retrofit installation, controlling nutrients in stormwater at the landscape scale is challenging.

## COMPLEMENTING STRUCTURAL CONTROLS WITH POLLUTION PREVENTION AND SOURCE CONTROL

Typical for our industry, the initial solutions we have relied on to improve water quality in stormwater discharges are engineered treatment technologies. While there have been impressive advances in structural stormwater control techniques over the past several years, clearly structural controls alone will not address the vast array of stormwater pollutants or water resource impairments across the country.

The National Municipal Stormwater Alliance (NMSA), a non-profit organization devoted to supporting MS4 permittees, recently asked Congress to "create a basis for implementation of source control for stormwater pollution." The organization suggests that it is technically infeasible to remove many pollutants once entrained in stormwater and that keeping them from being introduced into the environment is the only long-term and sustainable solution. NMSA cites the exceptional source control legislation instituted for metals in California and Washington. Through the legislated reduction of copper in automotive brake pads, the regulated stormwater dischargers in California expect to save the state $1 billion at the municipal level for urban copper control programs.

So, in the realm of nutrients in stormwater, which sources can reasonably be controlled? Phosphorus is a chemical element found in numerous compound forms that move in a cycle through rocks, water, soil,





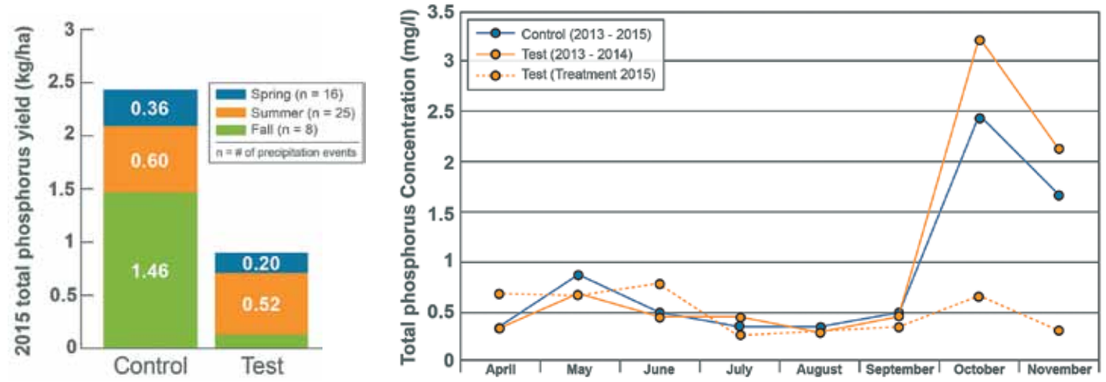



**Figure 2. Findings from USGS study showing the reduction in total phosphorus following a leaf removal program (from "Evaluation of leaf removal as a means to reduce nutrient concentrations and loads in urban stormwater," William Selbig, *Science of the Total Environment*, 2016)**

and sediments and organisms. An essential nutrient for animals and plants, phosphorus is critical in cell development and a key component of molecules that store energy. Naturally occurring phosphate ions and other minerals are released from rocks over time through rain and weathering and are distributed in soils and water and it is passed to animals. Plants take up inorganic phosphate from the soil and pass it to animals who eat the plants. Once in the plant or animal, the phosphate is incorporated into organic molecules such as DNA; when the plant or animal dies, it decays, and the organic phosphate is returned to the soil or, in urban environments, to the pavement.

With this process in mind, which sources of phosphorus can be reasonably controlled in the urban stormwater environment? Eroded sediments are often thought to be the primary source of phosphorus, and erosion control is critical in controlling phosphorus as a pollutant. Chemical fertilizers applied to lawns in the urban landscape can be mobilized via surface runoff and discharged into the environment, but changes to national manufacturing practices are already limiting phosphorus in commercially available, non-agricultural lawn food. This change may have a promising effect on nutrients in the Charles River without any action on the part of municipalities. Newly updated TP export coefficients should be incorporated into future TP load reduction planning presuming that recent removal of TP in fertilizer will have some impact on urban residential TP concentrations in stormwater.

But what about the phosphorus in organic debris? Think about those lovely fall days kicking leaves on the sidewalk.

In 2016, William Selbig of the U.S. Geological Survey (USGS) published an article in which he presents research from Wisconsin showing that nearly 60 percent of the annual phosphorus yield in suburban environments comes from leaf litter in the fall. This would make leaves the primary contributor of phosphorus to stormwater discharged from suburban land uses. Through a paired watershed experiment, it was shown that in one watershed, extensive leaf removal during the fall resulted in load reductions of TP and dissolved phosphorus by 84 and 83 percent, respectively, and total and dissolved nitrogen by 74 and 71 percent at the outlet of the entire drainage discharge area. A few of the study's findings are shown in Figure 2.

Recently, the USGS conducted additional research on more "typical" municipal leaf litter collection programs to determine their impacts on TP reductions. The results indicate that leaf litter collection programs that collect leaves three to four times each fall and then mechanically sweep all roadways within 24 hours of collection saw decreases of 40 percent TP load in the fall.

This research has been well received in the upper Midwest where lake and pond TMDLs have challenged municipal stormwater managers and the permitting authorities. In March 2018, the Wisconsin Department of Natural Resources issued an Interim Municipal Phosphorus Reduction Credit for Leaf Management Programs. This credit program allows for up to 17 percent reduction in annual TP load for the drainage area that receives leaf litter collection consistent with the guidance document. This is an attractive suburban nutrient management complement to other more traditional structural controls.

## HOW DOES THIS COMPARE TO EPA REGION 1?

In addition to the structural controls outlined earlier, EPA Region 1 has described several allowable non-structural controls within the Massachusetts MS4 General Permit: enhanced sweeping, catch basin cleaning, and organic waste and leaf litter collection. Additionally, EPA provides load reduction

Figure 3. Typical suburban Boston neighborhoods where leaf litter cleanup would provide the most benefit

calculations for impervious area disconnection, conversion to pervious area, and soil amendments to enhance urban soil permeability.

While non-structural controls have a place in the new permit, the science behind the permit's TP reduction calculations is already outdated and does not reflect the recent findings discussed. For example, one key difference exists between the Wisconsin and EPA credit calculations for leaf litter collection. The EPA calculation in the Massachusetts MS4 General Permit allows for a 5 percent annual TP load reduction associated with leaf litter cleanup, but the credit calculation is for only an impervious area directly swept. In Wisconsin, the 17 percent load reduction credit is applied to the entire contributing area TP load.

An evaluation of how this difference would affect a typical TP credit calculation follows. Take an example catchment in Lexington, Massachusetts, as shown in Figure 3. This is a 38 ac (15.4 ha) medium density suburban land use area serviced by approximately 3,700 feet (1,128 m) of roadway and the associated stormwater drainage catch basin and pipe system. Approximately 2.2 ac (.9 ha) of impervious area are within the catchment.

Under EPA's calculation described in Appendix F of the MS4 General Permit, a leaf litter collection program would result in 0.22 lb (0.1 kg) of annual TP load reduction. EPA also requires at least once-weekly collection and sweeping compared to only four times in the Wisconsin guidance. Following the Wisconsin credit calculation, the resulting TP load reduction would be 3.17 lb (1.44 kg) of annual TP load reduction, a 15-fold difference from EPA Region 1.

Under the Wisconsin credit calculation, a regulated community with limited areas applicable to this BMP may realize meaningful impacts on its TP load reduction requirements through leaf litter cleanup. Under the EPA Region 1 calculation, the benefit to cost may not motivate a community to implement these programs despite actual benefits of this proven non-structural BMP. This is the classic conundrum of "managing to the model" where actual water quality improvements may not be realized if the model does not demonstrate a nutrient control benefit.

## OTHER OPTIONS NOT IN THE PERMIT

EOHWC's stormwater controls also shed light on the efficacy of other non-traditional nutrient control projects. As noted in Figure 1, one of the most cost-effective TP control projects was streambank or channel stabilization. When TP removal from the channel stabilization methods included in the Year 1 to 5 Plan was compared to regional and national references, New York's load reduction credit was much more conservative than in other regions (namely, the Chesapeake Bay). When developing the second stormwater retrofit plan (Year 6 to 10), the EOHWC negotiated for modified channel stabilization credits based on common credits offered in the Mid-Atlantic states, allowing it to take advantage of projects with a much more attractive cost-benefit ratio. Additionally, streambank and channel stabilization are not only a great opportunity to reduce phosphorus, but these types of projects offer significant safety, infrastructure protection, and stream ecology co-benefits. Unfortunately, streambank or channel stabilization is not an allowable activity within the MS4 General Permit, despite its proven efficacy in other regions.

The challenge for Massachusetts communities is that all of the BMP guidance, including credit calculations, is embedded within the MS4 General Permit rather than within separate, non-permit management guidance documents. This means regulated MS4 dischargers may be locked into management actions as outlined in the permit. Given the likelihood of continued delays in permit issuance and reissuance, regulated dischargers may be managing to 15-year-old or older information.

If new research reveals new information that would improve management, such as the USGS study in Wisconsin, communities should be allowed to adapt programs to incorporate the latest information for improved water quality benefits. A path forward for flexible and adaptive management has always been a challenge for permit writers but becomes more pronounced when traditional five-year permit cycles become 15- or 20-year permit cycles as is the case with the Massachusetts MS4 General Permit.

## ENCOURAGING SCIENTIFICALLY BASED AND FLEXIBLE NUTRIENT CONTROL MANAGEMENT

New England communities will need to continue to reduce nutrient loads in stormwater runoff, and we must base our understanding of the cost-effectiveness and co-benefits of a full range of management alternatives on relevant and recent science. To encourage new science within the NPDES permit environment, EPA, advocacy groups, municipal stormwater managers, and state stormwater program managers should work together to advance guidance documents that are separate from permits so adaptive management can take place. The implications are too expensive to misdirect stormwater management funds and make costly mistakes that have already been addressed elsewhere. Let us not reinvent the wheel.

## ABOUT THE AUTHOR

Zach Henderson is a water resources technical manager with Woodard & Curran dedicated to clean water and assistance to municipalities in development of stormwater programs. Mr. Henderson focuses on planning, compliance, asset management, and stormwater treatment system design across New England.

# Timing is still everything—capital project prioritization

KEVIN CAMPANELLA, P.E., Utility Planning Leader, Burgess & Niple, Inc., Columbus, Ohio

**ABSTRACT** | Prioritization of projects in a capital improvements plan (CIP) is important in squeezing the most out of every dollar, and several utilities have recently explored improvements to their prioritization processes. Most favor multi-criteria analysis, in which projects are assessed and scored, versus such criteria as system reliability, and the financial, social, and environmental issues addressed. In some cases, simple 1–5 scoring systems are used for each category, and the sum of the scores dictates the priority. In other cases, scores range from 1–100 in each category, and each category is weighted. Prioritization using the asset management concepts of risk and triple bottom line valuation has evolved recently to assist utilities in providing customers even more value for their investments.

**KEYWORDS** | Capital plan prioritization, asset management, triple bottom line

In 2016, the American Society of Professional Engineers' publication "Failure to Act: Closing the Infrastructure Investment Gap for America's Economic Future" estimated the 2016–2025 investment gap in the water and wastewater industries at $105 billion. This gap highlights the importance of prioritizing investments to provide the greatest community value. When insufficient funds are available to bridge the gap, every investment matters.

Replacing assets too soon results in not achieving a full useful life from them. Failing to replace them on time could have additional financial consequences, and impacts on customer service and the environment, and potential safety concerns for those performing reactionary repairs. Favoring expansion over aging infrastructure rehabilitation can lead to more reactionary replacements and service interruptions. An imbalance in the other direction can lead to missed opportunity to generate revenue or get ahead of regulatory mandates.

By prioritizing projects that generate the most value, utilities support the overall financial well-being of the communities they serve, provide customers with more reliable service, and protect the environment.

## CAPITAL IMPROVEMENTS PLAN (CIP) PRIORITIZATION FRAMEWORKS

Utilities around the world have used various methods to prioritize projects. While the baseline practices at some utilities combine tacit knowledge of system performance with an understanding of the system's most critical portions, more-advanced utilities have been implementing more quantitative, and presumably less subjective, prioritization frameworks.

One major east coast utility's prioritization framework contains nine criteria, each scored on a 1–5 scale. Scores for each criterion are added to calculate an overall prioritization score. Criteria include asset physical condition, performance, regulatory impacts, reliability, financial considerations, and other categories focused on customer impacts and experiences.

Another major east coast utility's prioritization scoring method rates the project's impacts on only three major criteria, based on asset management's three foundational pillars: service levels, costs, and risk. Each criterion is scored on a 1–5 scale. A formula weights the scores and calculates an overall score, also between 1 and 5. Half of the weighting is assigned to risk, 30 percent to service-level alignment, and 20 percent to other considerations.

A third major east coast utility's prioritization scoring method contains eight criteria, each scored on a 1-to-5 scale. Scores are weighted and then added to calculate an overall prioritization score. Criteria include health and safety, regulatory compliance, risk reduction, financial benefits, capacity, and other community-focused criteria.

The Anchorage (Alaska) Water and Wastewater Utility (AWWU) prioritization scoring method contains 10 criteria, subdivided into the following categories: safe environment, impacts on customer needs, financial, reliability, and (utility) sustainability. Each criterion is weighted as a percentage, with scores for each criterion from 0 to 100. Scores are weighted and added to calculate a total prioritization score, also from 0 to 100.

**Table 1.**
**CIP prioritization categories used by major U.S. wastewater utilities**

| Criteria | A | B | C | D | E |
|---|---|---|---|---|---|
| Risk Reduction/Reliability | ✓ | ✓ | ✓ | ✓ | ✓ |
| Customer Service | ✓ | ✓ | ✓ | | ✓ |
| Regulatory Compliance | | ✓ | ✓ | ✓ | ✓ |
| Capacity | ✓ | | | ✓ | |
| Safety | ✓ | | | ✓ | ✓ |
| Community Impacts/Public Acceptability | ✓ | ✓ | ✓ | ✓ | ✓ |
| O&M Efficiency/Savings | | ✓ | ✓ | | |
| Public Health | ✓ | ✓ | | ✓ | ✓ |
| Environmental Goals Achievement | ✓ | ✓ | ✓ | | ✓ |
| Overall Financial Impacts | | ✓ | | ✓ | ✓ |
| Sustainability | | | ✓ | | |
| Community Economic Development | | ✓ | | | ✓ |
| Coordination with Other Projects | ✓ | | ✓ | ✓ | ✓ |
| Use of Proven Technology or Process | ✓ | | | | ✓ |

## INCORPORATING ASSET MANAGEMENT CONCEPTS INTO CAPITAL PROJECT PRIORITIZATION

In 2017, AWWU sought to improve project prioritization. The drivers for doing so were manifold. First, because the Anchorage metropolitan area represents roughly 40 percent of Alaska's population, the AWWU CIP is heavily scrutinized by the Regulatory Commission of Alaska, which can determine which AWWU projects may be publicly funded. Second, Anchorage's economy and Alaska's in general have not recovered from the Great Recession similarly to many other states, and utility revenue has suffered. Last, leadership did not think past prioritization methods were as effective as possible, leading in many cases to lack of clarity regarding projects to be advanced or deferred.

While a multi-criteria analysis methodology was already in place to prioritize projects, AWWU turned to its Strategic Asset Services Section to update its process using an asset management-based solution. The first step was to ensure the process was founded on risk management. Virtually every project on a utility's CIP in some way addresses the risk of failing to provide adequate service levels to customers, or environmental or financial risks. Risk reduction from a project represents the benefits provided, and AWWU sought to capture that magnitude in its project prioritization. Evaluation criteria were therefore divided into two categories according to the two components of risk: likelihood of failure and consequences of failure.

In addition, the consequence of failure categories in the AWWU prioritization were broken down further to ensure all triple bottom line project impacts were captured. Criteria for social, environmental, and financial consequences were incorporated, recognizing that AWWU's infrastructure affects the community and environment it serves, including its industrial and commercial customers as well as the swell of visitors who pour into Alaska each summer through Anchorage.

**Table 2. AWWU prioritization criteria by risk and triple bottom line (TBL) categories**

| Risk Category | TBL Category | Criteria |
|---|---|---|
| **Consequence of Failure Categories** | Financial | • Direct AWWU financial costs/benefits<br>• Impacts on outside entities<br>• Improving asset knowledge/ data driven decision-making |
| | Social | • Service interruptions<br>• Community disruptions<br>• Stakeholder confidence<br>• Strategic and regional importance |
| | Environmental | • Security and safe work environment<br>• Environment and regulation |
| **Likelihood of Failure** | | • Reliability of assets and services |

For each of the 10 criteria in Table 2, projects are scored from 0 to 100 using discrete increments or "levels" as shown in Table 3.

Once the assessment criteria were finalized, additional objectives included:

- Increased objectivity within the scoring criteria
- Better justification of smaller projects that provide fewer benefits than larger ones
- Improved inclusion of non-water infrastructure projects in the prioritization process, such as information technology (IT) implementations, asset management, master planning, and other planning projects

**Table 3. Scoring for each criteria**

| Level | Score |
|---|---|
| I | 100 |
| II | 50 |
| III | 20 |
| IV | 10 |
| V | 5 |
| n/a | 0 |

**Table 4. Environment and regulation prioritization criteria**

| Level | Score | Former Criterion | Updated Criterion |
|---|---|---|---|
| I | 100 | Compliance order or regulation that requires immediate action | Compliance order or regulation requires action immediately or within the next 6 years. |
| II | 50 | Regulation that requires compliance in near future 1–5 years OR anticipated regulation with major implications for operations | A significant unpermitted environmental discharge, or smaller but more frequent discharges that may lead to significant enforcement action |
| III | 20 | Anticipated regulation (regulation in the current legislative/regulator process) | Minor, infrequent, unpermitted environmental discharge |
| IV | 10 | Potential regulation anticipated in next 5–10 years | Significant permitted discharge that is infrequent and unlikely to result in additional action by a regulatory body |
| V | 5 | Potential regulation anticipated in >10 years | Minor permitted discharge(s) that is/ are unlikely to result in additional action by a regulatory body |

- Functionality to score project alternatives that reduce only part of the potential risk
- More granularity among project scores for clearer distinction of priorities

## MAXIMIZING OBJECTIVITY

In most cases, projects are placed on a CIP prior to preliminary and final design, with many details to be determined. As a result, reasonable judgment regarding ultimate costs and benefits is necessary in prioritization. A well-designed prioritization process can limit the judgment necessary. As an example, earlier AWWU versions allowed users to assign points to a project that addressed a potential regulation anticipated more than 10 years in the future. These options seem reasonable when addressing a project's benefits, but they are speculative and, in some cases, scoring could be applied inconsistently. Given that wastewater regulations are in place to protect the environment, AWWU replaced those speculative criteria with more objective ones focused on known environmental impacts that projects would address.

## JUSTIFICATION OF SMALLER PROJECTS

By their very nature, projects with smaller budgets are less likely to produce the same benefits as those with significantly higher costs. When that is not the case, little thought needs to go into prioritizing the lower-cost projects. In most cases, though, the prioritization scores for smaller projects do not rise to the level of larger ones if prioritization looks only at the benefits. In previous versions of AWWU prioritization, this introduced two issues: artificial inflation of smaller project scores by using speculative scoring criteria, such as the regulatory factors discussed earlier, and the need to subjectively judge which smaller projects should be prioritized despite their lower scores. Both issues were attributed to prioritizing what intuitively seemed like high-value investments not borne out by the scoring process.

The updated version of AWWU prioritization now takes each prioritization score (which measures project benefits) divided by each project's lifecycle cost estimate to produce a benefit-to-cost ratio. By doing so, artificial score inflation is no longer needed, and many small projects rise to the top of prioritization based on their low cost. Examples include a security project, building repairs and office upgrades, and a scum line repair project that had one of the lowest overall project scores but one of the highest benefit-to-cost ratios.

## INCORPORATION OF NON-WATER INFRASTRUCTURE PROJECTS

Another enhancement to the AWWU process was accounting for projects such as master plans, IT projects, condition assessments, asset management plans, and other activities that allow better planning and decision-making without affecting infrastructure. Without such projects, decisions on which assets to repair and replace are less clear, and the implications are significant. For AWWU, buried infrastructure management is critical because the average depth of cover for water and sewer mains exceeds 10 ft (3 m) in most of the system. Pipe excavations are costly, so replacing pipes too soon significantly reduces value by not achieving a full useful life, and not replacing pipes on time can lead to reactionary repair costs 5 to 10 times higher than those experienced in the contiguous United States.

A category was added, "improving asset knowledge," to capture the value of making more informed, data-driven decisions. Projects that generate data to support decision-making are now scored based on the types of decisions made with the data.

## PARTIAL RISK REDUCTION

Almost all prioritization frameworks assume projects will address the full range of risks. However, so-called "80/20 rule" project alternatives address most of the risk in an area for a small fraction of the cost of total risk reduction. The enhanced AWWU process allows users to indicate the risk levels both before and after project completion, with scoring adjusted to reflect the incremental risk reduction.





## MORE GRANULARITY AMONG PROJECT SCORES

Even the most well-designed processes can lead to difficulty in prioritizing the right projects. Most utilities do not have unaddressed "sky is falling" projects, and therefore project prioritization scores tend to cluster in the lower range. For AWWU, prioritization scores could range from 0 to 100, but only 10 percent of the projects scored more than 10 points in previous scoring versions, as shown in Figure 1.

Given that prioritization processes should clarify which projects provide the most value, clustering of projects introduced judgment rather than removed it. Multiplying the resultant scores by an order of magnitude, though simple, led to far better visual interpretation of results and allowed far simpler distinction among projects.

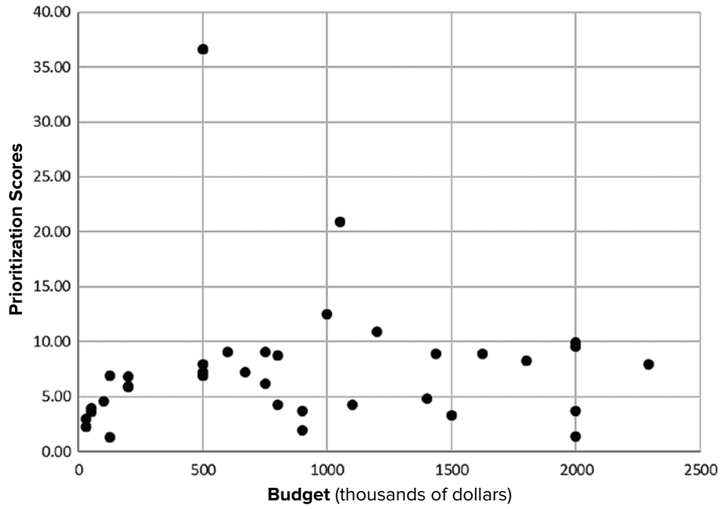



**Figure 1. Prioritization score versus budget (despite a potential project score ranging from 0–100, more than 90 percent of projects scored fewer than 10 points in previous versions of the AWWU prioritization framework)**

## CONCLUSION

AWWU, like many water and wastewater utilities facing tighter budgets, recognized the value of enhancing how it prioritizes investments. By using the principles of risk, triple bottom line valuation, and more data-driven decision-making, AWWU developed a project prioritization framework that better identifies high-value projects more efficiently and objectively. An asset management-based prioritization can be more easily understood and communicated internally and to governing bodies and regulators, facilitating interpretation of results in the context of each utility and its community with the goal of providing the most value to communities being served.

## ABOUT THE AUTHOR.

Kevin Campanella is the utility planning leader for Burgess & Niple, Inc. He has 24 years of experience in assisting clients with planning and management of utility infrastructure systems. He has led asset management initiatives for utilities with 4,400 to 1.1 million customers. For seven years, he was the asset management program director at Columbus Public Utilities (Ohio). Mr. Campanella is the chair of the American Water Works Association (AWWA)-Ohio Section Asset Management Committee and focuses on asset management plans and performance management, CIP prioritization, capital project evaluations, renewal and replacement planning, and maintenance program enhancements. He is a native of Wakefield, Massachusetts, and worked for 10 years at Metcalf & Eddy (AECOM) in Wakefield.

# Increasing sewer system capacity and lifting a sewer connection moratorium through inline storage

KEVIN OLSON, P.E., Senior Project Manager, Wright-Pierce, Andover, Massachusetts
BARRY YACESHYN, P.E., Lead Project Engineer, Wright-Pierce, Andover, Massachusetts

**ABSTRACT** | Most of the wastewater in Westminster, Massachusetts, is discharged to neighboring Fitchburg via the Whitman River Pumping Station (WRPS), force main, and receiving gravity sewer, all of which have been at their hydraulic capacity limit for years. Westminster's Comprehensive Wastewater Management Plan recommended sewer expansion for high-priority "needs areas" of town. Before any sewer expansion or new sewer connections were possible, capacity limitations at the WRPS, force main, and receiving gravity sewer in Fitchburg had to be resolved. Original recommendations to replace these facilities with a new siphon and gravity sewer system at an estimated cost of $5 million were cost-prohibitive. The town had to overcome capacity constraints and lift its sewer connection moratorium, while reducing project cost. An inline storage system was selected as an alternative solution for this challenging wastewater capacity problem.

**KEYWORDS** | Inline storage, box culvert, Comprehensive Wastewater Management Plan (CWMP), wastewater storage, wastewater flow, capacity, pump station, cost-control, Massachusetts Department of Transportation (MassDOT)

## INTRODUCTION

The wastewater collection system in Westminster, Massachusetts, consists of gravity sewers, pumping stations, force mains, low-pressure sewers, and flow metering stations that date to the early 1980s. Wastewater generated in Westminster is collected within one of two service areas and conveyed to the neighboring city of Fitchburg for treatment and effluent disposal in the north branch of the Nashua River. The current inter-municipal agreement (IMA) between the two communities allows Westminster to discharge up to 320,000 gpd (1.2 ML/d) to Fitchburg and is valid until 2020.

Of the two service areas, the largest is the Whitman River Pump Station (WRPS) service area, which produces approximately 99.8 percent of the town's wastewater flow. Wastewater flow from this area enters the WRPS via an 18 in. (45.7 cm) diameter gravity interceptor sewer, where it is pumped through a 6 in. (15.2 cm) force main (2,850 ft [869 m] long) to a flow metering station in Fitchburg near the town line. From the flow metering station, it flows via a gravity sewer to Fitchburg. The current IMA allows up to 250,000 gpd (0.95 ML/d) at the WRPS discharge point. The discharge point for the remaining wastewater flows (up to 70,000 gpd [0.27 ML/d]) is on Fitchburg Road (Route 31).

The collection system has been expanded several times to connect large "needs areas" or add critical assets to the town and the region. One regional asset permitted to connect is the Wachusett Mountain State Reservation, opened in 1982. Wachusett Mountain is a 3,000 ac (1,214 ha) recreational area with alpine and nordic ski trails and facilities. The area also caters to other seasonal recreation that includes summer time hiking, biking, and picnicking. In 1982, Wachusett Mountain constructed the original sewer system from its property to the current connection point along Route 2A in Fitchburg.

Westminster's collection system aims to protect environmental resources and minimize impacts to the Nashua River basin. The town's goal is to preserve its agricultural heritage and open-space assets, and limit sprawled growth, while supporting local economic development. Expansion of the public sewer and water systems to densely developed areas addresses the town's goals to protect water supplies, while reducing pollution of lakes, surface runoff, and groundwater. To address these goals and increase collection system "coverage," the town chose a phased approach that included servicing four areas:

1. Dense residential development
2. Dense development adjacent to critical resource
3. Dense development where on-site wastewater management may have caused water quality impacts
4. Future industrial zoned areas

The most recent system upgrades have included a downtown sewer in the mid-1990s and a major sewer extension to four specific "needs areas" of town in 2004.

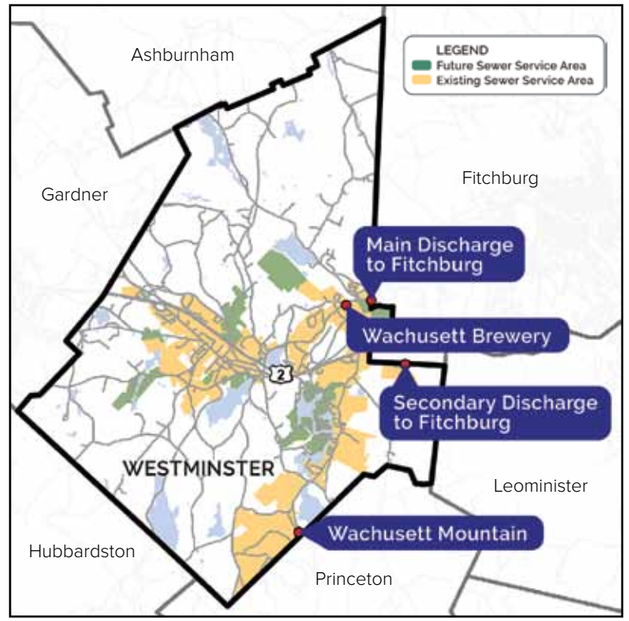



**Figure 1. Westminster's wastewater collection system**

## EXISTING SYSTEM

Westminster's wastewater collection system, owned and operated by the town, consists of approximately 18.9 mi (30.4 km) of gravity sewers ranging in diameter from 8 to 18 in. (20.3 to 45.7 cm). The sewer pipes are largely PVC construction with a small percentage of ductile iron piping. The town operates seven pumping stations with approximately 3.3 mi (5.3 km) of force mains, 2.9 mi (4.7 km) of low-pressure sewers, and 360 sewer manholes. Figure 1 provides an overview of the town's wastewater collection system service area.

The WRPS is a below-grade "tin can" drywell and separate dual 8 ft (2.4 m) diameter wetwell-type pumping station. The site is small in area and constrained by Route 2A (and the bridge over the river) and the Whitman River wetlands. The station includes controls in the below-grade pump chamber and an above-grade control pedestal to house other electrical, and control and instrumentation equipment. An above-ground generator provides standby power service to the station, and a control interlock with a private pumping station is across the river. The original station does not have a force main bypass or pig launch connection.

## PROJECT BACKGROUND

The town's wastewater collection system tributary to Fitchburg via the Route 2A connection (at Montachusett Regional Vocational Technical School [Monty Tech]) is flow capacity limited by the WRPS and the receiving gravity sewer along Route 2A between the Monty Tech flow metering station and Route 2A/31 intersection. The town identified this capacity limitation years ago and implemented a sewer moratorium in 2002.

To address this challenge and other wastewater system issues, the town developed a CWMP. Completed in 2007, the plan recommended expanding the municipal sewer system to five "needs areas" that used individual on-site septic systems for wastewater treatment and disposal. However, before expanding the collection system to these areas, capacity upgrades were necessary to allow the existing system to accommodate additional flow. The recommended upgrades, Phase A, would replace the WRPS, force main, and receiving gravity sewer in Fitchburg.

In 2008, the town began implementing the CWMP recommendations. At the outset of preliminary design, several elements needed to be addressed, including:

- Size, type, location of new pump station
- Peak flows, capacity of new pump station
- How to upgrade the Fitchburg gravity sewer and funding to do so

The first task re-evaluated average and peak flows to the WRPS. There was a question regarding the peak flows estimated via the CWMP (estimated peak flows seemed too low). As the town wanted also to evaluate infiltration/inflow (I/I), wastewater flow metering was performed for this service area.

**Table 1. Wastewater flows**

| Item | Estimated Flows |
|---|---|
| IMA flow | 250,000 gpd (0.95 ML/d) |
| Existing average daily flow | 180,000 gpd (0.68 ML/d) |
| Existing peak daily flow | 1 million gpd (690 gpm) (3.79 ML/d [2,612 L/Min]) |
| WRPS flow capacity | 550 to 600 gpm (2,082 to 2,271 L/min) |
| Receiving sewer capacity | 860,000 gpd (600 gpm) (3.26 ML/d [2,271 L/min]) |

Notes: 1. Whitman River area flows only (does not include Route 31 connection)
2. Average daily flow has increased from CWMP flow (135,000 gpd [0.51 ML/d])

**Table 2. Future wastewater flows (for WRPS area)**

| Item | Flow |
|---|---|
| Existing average daily flow | 135,000 gpd (0.51 ML/d) |
| Estimated future average daily flow | 165,000 gpd (0.62 ML/d) |
| Estimate sewer expansion flows | 200,000 gpd (0.76 ML/d) |
| Phase 1 sewer expansion flow | 42,000 gpd (0.16 ML/d) |
| Phase 2 sewer expansion flow | 30,000 gpd (0.11 ML/d) |
| Phase 3 sewer expansion flow | 25,000 gpd (0.09 ML/d) |
| Phase 4 sewer expansion flow | 15,000 gpd (0.06 ML/d) |
| Phase 5 sewer expansion flow | 88,000 gpd (0.33 ML/d) |
| Estimated average daily flow | 500,000 gpd (1.89 ML/d) |
| Estimated peak daily flow | 2.1 million gpd (7.95 ML/d) |

Note: Flows from CWMP. Estimated average daily flow is currently 180,000 gpd (0.68 ML/d)

Table 1 summarizes wastewater flows for the project. The current average daily flows are approximately 180,000 gpd (0.68 ML/d), and the current peak daily flows are approximately 1 million gpd (3.79 ML/d) or 690 gpm (2,612 L/min), based on flow metering and a late February 2010 wet weather event. The WRPS flow capacity and the receiving gravity sewer capacity is approximately 600 gpm (2,271 L/min). Based on these flows, the capacity constraint becomes clear. Under specific flow conditions, the 18 in. (45.7 cm) diameter gravity sewer between the WRPS and the first upstream service lateral, Wachusett Brewing Company, will surcharge.

Future wastewater flows were then estimated for the existing sewer area and sewer expansion areas. The estimated future peak flows were then calculated using a peaking factor of 4.2 based on wastewater flow metering data. The estimated future peak flow is 2.1 mgd (7.95 ML/d). Table 2 provides additional detail.

The preliminary design phase continued with a second and final evaluation of the recommended Phase A capacity upgrades. After review of the recommended pumping station replacement, other options were also considered, including elimination of the pumping station. This could be accomplished by installing a three-barrel siphon under the Whitman River. This approach was attractive to the town from both a capital and an O&M cost standpoint, but the receiving gravity sewer in Fitchburg would still require replacement. The capital cost estimated for this option was $4 million in 2008 dollars. The 20-year life cycle cost was lower than the CWMP recommendation of installation of a new pumping station and force main. This approach would provide more than enough capacity for current and estimated future flows in Westminster.

The town set out to implement the revised Phase A capacity improvements project, but as it began to discuss appropriation of funding at the annual town meeting, the need for the project was questioned. Did the town have to move forward with a $5 million system upgrade if sewer expansion for the five areas of need was not imminently pending, it was asked. The town put the project on hold to further consider if and when it would move forward with sewer system expansion. It acknowledged the immediate capacity problem that had to be solved, but it was cautious about moving forward with a $5 million upgrade and ramifications to current sewer users. The town had just incurred a significant sewer user rate increase (68 percent) from the city of Fitchburg and was concerned about the cost impacts of this project. Thus, the town considered other, less costly, interim solutions to the siphon project.

## NEW APPROACH

The challenge was to overcome the capacity constraints and allow the town to lift the sewer connection moratorium (and allow partial sewer expansion to occur), while reducing the project cost. The WRPS had reached its capacity, and a sewer connection moratorium had been put in place, severely limiting connections to the sewer.

The WRPS had been upgraded a few times to increase capacity. One upgrade included a wetwell volume increase via installation of an additional wetwell and connecting the new and original wetwells with an 18 in. (45.7 cm) diameter pipe. Since its last upgrade in 2000, the station was plagued by pump clogging problems (caused by non-dispersibles in the sewage).

To overcome the challenge, a solution had to: (1) be affordable; (2) allow the community to lift the moratorium so additional "needs areas" could connect to the sewer system; (3) not require the downgradient sewers in Fitchburg to be replaced; and (4) address the O&M issues created by the non-dispersible products (pump clogging problems).





## ALTERNATIVES CONSIDERED

Several alternatives were considered. Two alternatives proposed discontinuing wastewater discharge to Fitchburg by:

1. Constructing a new wastewater treatment facility with a groundwater discharge in town
2. Discharging some of the wastewater to neighboring towns—Gardner or Ashburnham

Other alternatives proposed continuing discharge to Fitchburg but relocating the primary discharge location to other places that were not capacity limited. Those options included:

3. Discharging directly to Fitchburg's pump station (formerly the Fitchburg West wastewater treatment facility)
4. Re-routing the Whitman River area flow to Route 31 (away from the WRPS and Route 2A gravity sewer)

The town decided to continue discharging its wastewater to Fitchburg, but it wanted to consider and develop less costly solutions that would allow partial sewer expansion (Phases 1, 2, and 5) and not require any improvements to the receiving gravity sewer in Fitchburg. The alternatives included:

a. Modest improvements to the WRPS (no force main or receiving gravity sewer upgrades)
b. Additional storage through an offline or inline system
c. WPRS improvements to handle the non-dispersibles problems (pump clogging) and other systems

The recommended solution was an inline storage system consisting of a box culvert with sufficient storage to accommodate limited additional flow at a much-reduced cost of $2.5 million.

## SOLUTION—AN INLINE STORAGE SYSTEM

The inline storage system would be provided with improvements to the WRPS. The proposed inline storage system/structure was identified as an alternative that would allow limited sewer system expansion/connections, while reducing the need for costly upgrades to the WRPS and force main. It would also avoid the need to upgrade any infrastructure downstream in Fitchburg.

Site constraints and the hydraulic profile dictated the sizing of the new inline storage system. Approximately 850 ft (259 m) was available for the length of the box culvert, and several types, sizes, and shapes were considered. A 4 ft by 8 ft (1.22 m by 2.44m) box culvert, 850 ft (259 m) in length was designed.

**Table 3. Inline storage system design flows**

| Item | ADF | PDF (gpd) | PDF (gpm) |
|---|---|---|---|
| Existing flow | -- | 1 million (3.79 ML/d) | 694 (2,627 L/min) |
| **Sewer expansion area flow:** | | | |
| Phase 1 | 42,000 (0.16 ML/d) | 106,000 (0.40 ML/d) | 74 (280 L/min) |
| Phase 2 | 30,000 (0.11 ML/d) | 74,000 (0.28 ML/d) | 51 (193 L/min) |
| Phase 5 | 88,000 (0.33 ML/d) | 219,000 (0.83 ML/d) | 152 (575 L/min) |
| Subtotal | 160,000 (0.61 ML/d) | 400,000 (1.51 ML/d) | 277 (1,048 L/min) |
| **Total** | **160,000 (0.61 ML/d)** | **1.4 million (5.30 ML/d)** | **971 (3,675 L/min)** |

Note: Existing peak flow based on February 24–25, 2010 storm

The box culvert design included interior concrete filleting to allow for the use of a v-notch channel in the bottom center of the structure. This reduced the effective volume (capacity) of the box culvert by about 10 percent. It provided approximately 185,000 gal (0.7 ML) of inline storage. Design flows for the inline storage system are highlighted in Table 3.

EPA SWMM modeling was then performed to confirm sizing the inline storage system and consider the hydraulic effects for different flow scenarios. Five modeling scenarios were run. Average flows were added to the hydrograph for the entire storm, and peak flows were added to the peak 8 hours of the hydrograph. It was determined that the new box culvert could handle flows 24 percent higher than peak flows. Table 4 (see next page) summarizes the results of the SWMM modeling for the inline storage system.

## INLINE STORAGE FACILITIES AND WRPS UPGRADES

Improvements include 900 lf (274 m) of a 4 ft by 8 ft (1.22 m by 2.44 m) precast concrete box culvert storage system (shown in Figures 2 and 3—see next page) to replace part of the 18 in. (45.7 cm) diameter PVC interceptor immediately upgradient of the WRPS (between the Wachusett Brewing Company and the WRPS). The 18 in. (45.7 cm) diameter pipe had significant infiltration at the pipe joints for the segment proposed to be replaced.

The pump station upgrade included two new vertical, dry-pit submersible centrifugal pumps, new isolation valves, check valves, and piping within the drywell. The pumps have the impellers designed to pass the non-dispersible loads received at the station. New weather-resistant cabinet and controls were located above-grade to eliminate confined space entry to monitor the station and perform daily inspections. A new standby power generator and power service was installed to remedy power supply problems. The HVAC system within the pump station drywell was also upgraded.

**Table 4. Inline storage system design flows**

| Model Run | System Geometry | Flow Conditions | 1 Pump Operating | | | 2 Pumps Operating | | | Peak HGL in Storage Conduit | | Peak Volume Stored (Gal) | Storage Conduit % Full | Flooding to Grade (Yes/No) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pumping Rate (gpm) | Duration (hr) | Total Volume Pumped (MG) | Pumping Rate (gpm) | Duration (hr) | Total Volume Pumped (MG) | U/S | D/S | | | |
| 1 | Existing | Existing | 603 (2,282 L/min) | 53.41 | 1.932 (7.313 ML) | 612 (2,316 L/min) | 3.73 | 0.140 (0.530 ML) | 678.39 (206.77 m) | 668.76 (203.84 m) | 104 (0.0004 ML) | — | No |
| 2 | Existing | Future | 603 (2,282 L/min) | 65.66 | 2.375 (8.990 ML) | 612 (2,316 L/min) | 12.86 | 0.482 (1.824 ML) | 678.45 (206.79 m) | 674.30 (205.53 m) | 10,303 (0.04 ML) | — | Yes |
| 3 | Proposed | Existing | 603 (2,282 L/min) | 52.57 | 1.901 (7.195 ML) | 612 (2,316 L/min) | 4.63 | 0.170 (0.644 ML) | 678.39 (206.77 m) | 668.49 (203.76 m) | 5,190 (0.02 ML) | — | No |
| 4 | Proposed | Future | 603 2,282 L/min) | 53.94 | 1.951 (7.384 ML) | 612 (2,316 L/min) | 27.50 | 1.010 (3.823 ML) | 678.45 (206.79 m) | 671.67 (204.73 m) | 119,390 (0.45 ML) | 64.00 | No |
| 5 | Proposed | Future* (1.24) | 603 2,282 L/min) | 41.80 | 1.512 (5.723 ML) | 612 (2,316 L/min) | 53.33 | 1.958 (7.411 ML) | 678.48 (206.80 m) | 674.11 (205.47 m) | 186,200 (0.7 ML) | 100.00 | No |

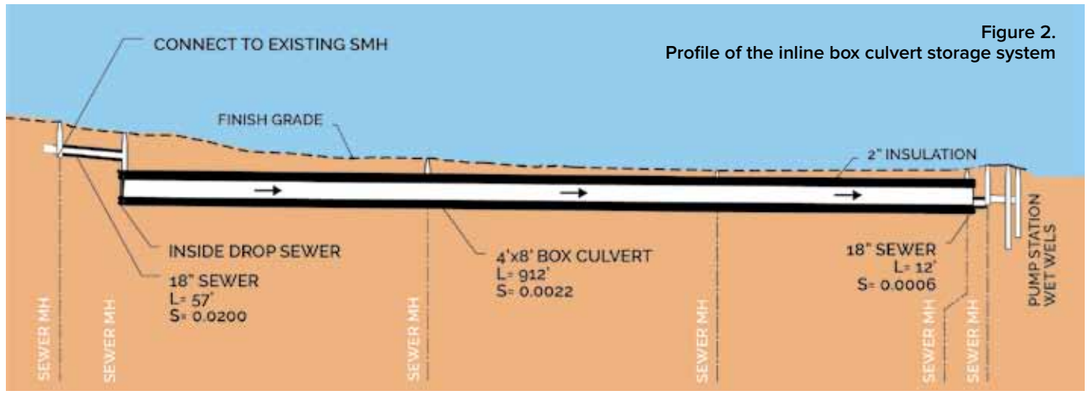



Figure 2.
Profile of the inline box culvert storage system

Figure 3. Cross-section of the concrete box culvert

## Funding

To reduce the cost impact on ratepayers, the town received funding through the U.S. Department of Agriculture's Rural Development Program (USDA). It appropriated $2.5 million for the project, a portion of which was issued as a grant ($471,000) by the agency. The remainder of the USDA funding is a low-interest loan ($2 million).

## Project Site

The project area for the inline storage and the WRPS upgrades is adjacent to State Road East (Route 2A). The pump station has security fencing and guard rails to limit access to the pump station, protect the equipment, and prevent vandalism.

Access for the pump station is limited to the shoulder of the two-lane roadway maintained and controlled by Massachusetts Department of Transportation (MassDOT). The edge of road consists of gravel, grass, and several mature deciduous trees. The trees had to be removed to install the box culvert. The parking area is small and adjacent to a highly traveled road requiring parked cars to use





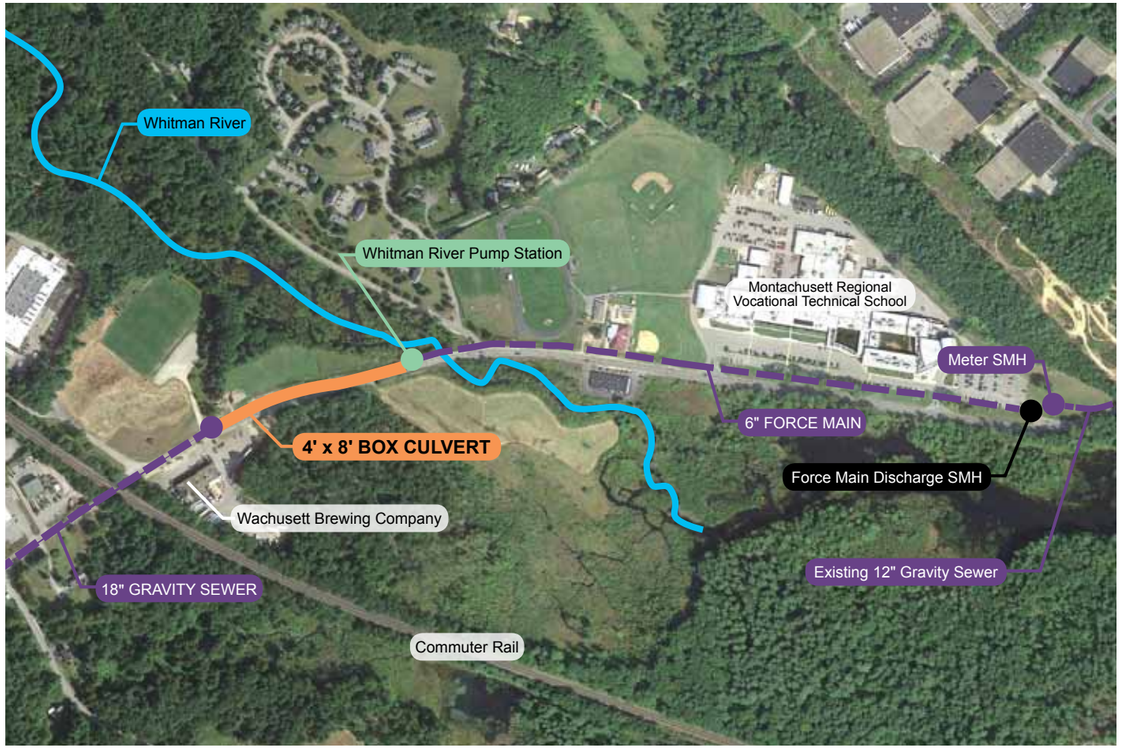



Figure 4. Overview of the project site and surrounding area

hazard or warning lights to notify traffic of activity on or near the shoulder of the road. The pump station itself is slightly farther from the travel lanes, allowing safer access.

The box culvert structure replaced the pipe that ran parallel to the state highway (within the existing field) for approximately 900 ft (274 m) and is connected to a new manhole just upgradient of the WRPS. The centerline of the new structure varied from less than 10 to 20 ft (3.05 to 6.1 m) away from the edge of the paved surface. Part of the culvert is within the wetlands abutting the Whitman River. Figure 4 provides an overview of the project site and surrounding area.

## Schedule

Funding agency and MassDOT deadlines as well as the weather affected the schedule, but another large driver was the general contractor coordination with the box culvert supplier to ensure delivery of the culvert box sections to the site. Coordination with utility companies was also important for utility pole relocation. The construction schedule was planned for 1 year. Owing to the factors above and other factors, the project took an additional 6 months to complete.

## Permitting

The project site was close to wetlands and within a state roadway right-of-way, requiring a Wetlands Protection Act permit from the town's Conservation Commission and an Access Permit from MassDOT, which was concerned with road-base damage and impacts to traffic flow through the site. It was important to ensure that extreme mitigation measures (high-speed barriers, for example) were not necessary during construction. If required, project cost would have increased significantly. Wetlands Protection Act permitting included the filing of a Notice-of-Intent (NOI), which resulted in an Order-of-Conditions (OOC) from the Conservation Commission.

One permitting issue that arose was trench support. MassDOT initially required driven sheeting for the entire length of the culvert to protect the trench wall from sloughing and undermining the section of state road. This effort would have been costly and time-consuming. Construction test pits indicated a dense gravel/cobble layer at the pipe invert so that it would have been difficult to drive sheeting. The contractor proposed and petitioned MassDOT to forgo the sheeting in lieu of standard trench box support, and this was approved. This reduced costs (approximately $100,000) for the

Figure 5. Trench box support in use during construction

town. Figure 5 shows the trench box support in use during construction.

### Design and Construction Challenges

The box culvert was aligned to remain outside the wetland buffer zone while minimizing impacts to the MassDOT traveled way. The alignment limited excavation to the edge of the MassDOT right-of-way and kept the new box culvert within town property, hence requiring no permanent or temporary access easements.

Another challenge included the co-owned Verizon and National Grid utility (telephone and electric) pole and guy wire support. This utility pole required replacement and a new service drop as part of the WRPS upgrades. Coordination between the two utilities and scheduling this work was a significant challenge for the general contractor and affected the schedule for upgrading the WRPS.

Since the large storage volume of the box culvert will increase detention times and low-flow velocities, a v-channel was included at the bottom of the culvert. This increases velocity and reduces solids deposition in the culvert. Even with the v-bottom channel included, sedimentation within the box culvert is still a possibility, and has been observed since the box culvert went into operation. To further facilitate flushing (manually), the box culvert includes four access manholes. Additionally, two new water system hydrants were installed adjacent to the new box culvert to allow town staff to wash or "jet" the box culvert, as needed.

During the construction phase, there were a few "lessons learned." One included testing of the precast concrete box culvert sections. A special testing device was specified for the specific size and type of box culvert to be installed. This equipment was custom-made and expensive. Application of this equipment in the field was difficult, as the unit would not "seat" well in the precast concrete sections. After numerous attempts with the testing-equipment vendor, it was concluded that this testing was not effective, and another means to seal the culvert section joints was necessary. To adequately seal each complete joint, a cementitious water plug was used both internal and external to the box culvert sections.

Careful field quality control of each box culvert section was also required during construction. One section of culvert was sent back to the vendor due to poor workmanship.

### Construction Cost

The total bid to construct the box culvert and pumping station was just under $2 million. The inline storage cost was $1.15 million and the WRPS upgrade cost was $600,000. Other ancillary project costs were $206,000. Owing in large part to a change in approach to the sheeting/shoring for the box culvert (as described above), there was a net credit of $104,000. The resulting total construction cost was $1.85 million, which was within the town's budget for construction of the project.

## CONCLUSIONS

The town completed construction of the inline storage system (box culvert) in the summer of 2017. Completion and startup of the upgraded WRPS was in December 2017.

Although the town took a different approach to solving a wastewater capacity problem, it has successfully increased its flow capacity by providing additional storage upstream of its WRPS. The town lifted its long-time sewer moratorium in December 2017. Concurrent with the installation of the new box culvert, the town significantly upgraded the WRPS. Doing so, the town installed new dry-pit submersible-type pumps with solids handling impellers to address pump clogging problems (due to non-dispersible materials). The town also improved operations and safety conditions at the WRPS by installing new controls above grade (original controls were in the below-grade pump chamber).

Implementation of this "interim" solution saved the town approximately $2.8 million in capital cost (siphon and downstream piping replacement project cost estimate is $5 million). Although the additional wastewater storage has been used only once (during bypassing of the WRPS, the temporary pump system failed, partially filling the new inline storage system), the town believes this project will allow limited additional wastewater flow into this system. Time will tell whether this project results in a short-term (interim) "fix" or a longer-term solution.

## ABOUT THE AUTHORS


- Kevin Olson, P.E., is a senior project manager at Wright-Pierce. He has a Bachelor of Science degree from Southeastern Massachusetts University and a Master of Science degree in civil engineering from the University of Massachusetts Lowell. For 32 years he has focused on wastewater collection systems, pumping systems, and treatment facility planning, design, and construction. He is a member and former chair of the NEWEA Collection System Committee.
- Barry Yaceshyn, P.E., is a lead project engineer at Wright-Pierce. He has a Bachelor of Science degree in civil engineering from Northeastern University. He has more than 20 years of consulting engineering experience on water, wastewater, stormwater, and other civil-type projects for municipalities and private entities.


## REFERENCES


1. SEA Consultants, Inc. (2006), "Comprehensive Wastewater Management Plan for Town of Westminster, Massachusetts," Cambridge, Massachusetts
2. Wright-Pierce (2018), "Westminster's Approach to Increasing Sewer System Capacity and Cost-Effectively Lifting its Sewer Connection Moratorium; Inline Storage!" Presentation at NEWEA Annual Conference, Boston, MA in January 2018, Andover, Massachusetts
3. United States Department of Agriculture (2015), "Approval for USDA Rural Development grant and loan funding for the project," Amherst, Massachusetts
4. Wright-Pierce (2011), "Town of Westminster, MA Whitman River Pump Station—Inline Storage SWMM Model Summary," Andover, Massachusetts
5. Wright-Pierce (2011), "Town of Westminster, MA Whitman River Pump Station System—Evaluation of Potential Interim Improvements," Andover, Massachusetts

# Help Shape the Water Quality Industry

Volunteering on a NEWEA committee is a great opportunity for you to build leadership skills, gain industry recognition, and help shape the water quality field

Consider what you're good at or jump into a new area and start building your skills. Worried about over-committing? Based on a recent survey, members spent on average two hours a month on their NEWEA volunteer work!

Choose from one of more than 44 active committees—from technology and process, communications and outreach, meeting and event planning, or leadership and ad hoc. For more information please visit newea.org.

## NEWEA Committees

**COLLECTION SYSTEMS/ WATER RESOURCES**
Director: John Digiacomo
- Collection Systems Certification
- Collection Systems
- CSO/Wet Weather Issues
- Industrial Wastewater
- Stormwater
- Sustainability
- Water Reuse
- Watershed Management

**TREATMENT, SYSTEM OPERATIONS, AND MANAGEMENT**
Director: Marylee Santoro
- Asset Management
- Energy
- Laboratory Practices
- Microconstituents
- Operations Challenge
- Plant Operations
- Residuals Management
- Small Community
- Utility Management

**MEETING MANAGEMENT**
Director: Elena Proakis Ellis
- Conference Arrangements
- Exhibits
- Program
- Registration

**COMMUNICATION**
Director: Meg Tabacsko
- Journal
- Newsletter
- Public Awareness
- Website

**MANAGEMENT REVIEW**
Past President: James Barsanti
- Assessment and Development
- Awards
- Bylaws
- Committee Member Appreciation
- Nominating
- Sponsor

**OUTREACH**
Director: Justin Skelly
- Government Affairs
- Humanitarian Assistance and Grants
- Membership
- Public Education
- Safety
- Scholarships
- Student Activities
- Water for People
- Young Professionals

**AD-HOC**
Vice President: Jennifer Kelly Lachmayr
- Veterans Workforce Development

NEWEA
WORKING FOR WATER QUALITY

# National Water Policy Fly-in

by Bob Fischer, NEWEA Government Affairs Committee Chair, Green Mountain Water Environment Association Government Affairs Committee Chair, City of South Burlington, Vermont Water Quality Superintendent

The National Water Policy Fly-in, April 17–18, 2018, was the anchor event of Water Week (waterweek.us). NEWEA has held DC congressional events for nearly 40 years, and has coordinated more closely with WEF and other associations over the past 15 years, as the event has developed into a national "Water Week Fly-in," kicked off by NEWEA's Congressional Briefing event. This year, the NEWEA Congressional Clean Water Briefing Lunch took place at the Capitol Visitor Center and featured speakers including Janine Burke-Wells, NEWEA president, Shiloh LaFreniere, town manager of Jay, Maine, New Hampshire Senators Jeanne Shaheen and Maggie Hassan, Massachusetts Representative Jim McGovern, Raffael Stein, director of the EPA Water Infrastructure Division, Claudio Ternieden from WEF, and Kristina Surfus from the National Association of Clean Water Agencies (NACWA). The National Water Policy Fly-in is sponsored by WEF, NACWA, WateReuse, and the Water Research Foundation (WRF). Held during Water Week, it is co-sponsored by many water sector groups including the American Water Works Association (AWWA), the American Council of Engineering Companies (ACEC), and the American Society of Civil Engineers (ASCE).

Attendees provide information to their Congressional delegations so they can make informed decisions. The NEWEA Government Affairs Committee produced "Talking Points," as in previous years, but this year it combined them with a list from the New England Water Works Association (NEWWA) to produce a joint document. This is the first time we have presented joint NEWEA/NEWWA talking points. In addition, the NEWEA and NEWWA attendees collaborated on the office meetings with the legislators and their staffs, a departure from the tradition of holding separate meetings. During the meetings, we also discussed the "Water Week 2018 One Pager" flyer that was produced jointly by several Water Week sponsoring groups. The flyer pointed out a funding gap and asked for:

1. Doubling of the State Revolving Funds (SRF)
2. Reauthorization and increased Water Infrastructure Finance and Innovation Act (WIFIA) funding
3. Increased funding for the National Priorities Water Research Grant Program to $20 million
4. Increased funding for USDA's Rural Water/ Wastewater Loan and Grant Program to $650 million for grants and $2 billion for loans
5. Increased funding for the Bureau of Reclamation's Water Recycling program to $60 million

"Talking Points" emphasized several issues, including the following:

**Affordability**

As infrastructure costs continue to shift from federal and state sources to the local level, rising water fees affect low- and fixed-income constituents the most. Water rates have increased 41 percent nationwide since 2010, and it's estimated that within five years, 41 million households may struggle to afford rates. As the costs in the core service areas continue to increase, more incentive exists to build outside these areas, causing numerous environmental issues such as forest fragmentation, failing septic tanks, and increased road and driveway building that create stormwater issues.

Meanwhile, our water, wastewater, and stormwater systems are old and in critical need of repairs, upgrades, and replacements. The American Society of Civil Engineers gives these systems a "D" grade. Costs to improve and maintain these systems continue to increase, but federal spending on these systems has decreased from $17 billion in 1977 (2014-dollar equivalent, 63 percent of total investment) to $4.4 billion in 2014 (9 percent of total investment), and this is for the initial capital investment only. As these systems expand and become technologically more complex, nationwide the operating and maintenance (O&M) costs have risen faster than these capital investments. Also, rates over 2.5 percent of median household income can affect a utility's borrowing ability.

On April 17–18, during National Water Week, NEWEA hosted the 2018 New England Congressional Briefing in Washington, DC in coordination with NEWWA. This event brings together New England's congressional senators and representatives and our members to discuss water quality challenges and solutions. More than 50 NEWEA and NEWWA members representing New England water professionals from all six states expressed the association's viewpoints on a range of water issues.

**Emerging contaminants**

Our understanding of various microconstituents and how they interact with the environment continues to increase. As with all contaminants, however, they are best dealt with by eliminating the source and then by advanced wastewater treatment facilities where technologies are always improving. On-site systems are not as robust and may be costlier to adapt.

**Biosolids**

Biosolids are valuable reuse products that can be used in soil reclamation and are "carbon sinks." Compared to using them locally, trucking these products long distances to landfills can increase greenhouse gas emissions, increase gas emissions from the landfills themselves, and take up valuable landfill space.

**Aging workforce**

As the average age of water utility workers is over 50 years, the workforce needs to be developed. We promoted the Water Warriors campaign along with federal efforts to establish a water workforce development program.

**Funding**

This is always our biggest request. Although not funded at last year's requested levels (fiscal year 2018 Clean Water SRF $2.8 billion request funded at less than $1.7 billion and fiscal year 2018 Drinking Water SRF $1.8 billion request funded at less than $1.2 billion), the recently passed fiscal year 2018 Omnibus Spending Package is the first annual SRF increase since fiscal year 2010. The increase of $600 million for the SRF—split equally between Drinking Water and Clean Water—is the most significant new money for these programs in years, and the proposed $63 million for WIFIA is a significant increase in funding (exceeding our request of $45 million last year). This was a pleasant development, and we thoroughly thanked our Congressional delegation for supporting this increase. No one has pushed harder for this than our delegation in the Northeast, where much of the oldest infrastructure is located and utilities face growing expenses for hardening vulnerable facilities against the impacts of rising sea levels and more severe weather.

We also thanked our delegation for providing EPA funding at the current fiscal year 2017 level (the Administration called for a decrease of 30 percent). We emphasized that actually spending these allocated funds is imperative. Similarly, we thanked them for keeping new bonds tax-exempt despite talk from the Administration of removing this status. Tax-exempt municipal bonds play a vital role in financing clean water infrastructure and in maintaining affordable rates. Municipal bonds fund more than 80 percent of water infrastructure investments. Along with this "good news" we also raised concerns including U.S. Department of Agriculture's (USDA's) $3 billion backlog in its rural water and wastewater loan and grant program—urging Congress to increase funding to $650 million for grants and $2 billion for loans—as well as the need to support the conservation provisions in the House Farm Bill that improves source water protection.

As in previous years, we told our delegation that money invested in infrastructure is not just money spent on necessary projects: Every $1 invested in water or wastewater infrastructure increases long-term gross domestic product by $6.35; for every $1 in SRF spending ($0.23 is the federal contribution), the U.S. Department of Treasury receives $0.93 in federal tax revenues; and for every $1 million in SRF spending, $2.95 million is added to the local economy and 16.5 jobs are created with an average annual salary of $60,000.

When we returned from Washington, D.C., we drafted a thank you letter to the legislators that contained links to the information that we dispersed.

This year's developments should fully explain why we make this trip each year. Although I never have the impression that what we say during these meetings is not listened to, sometimes it seems we are "preaching to the choir" as our Northeast delegation is usually supportive of infrastructure spending. There seems to be a growing awareness among D.C. lawmakers about the importance of clean water, and the information and support we provide our delegation has helped them to bring this about.

# NEBRA Highlights

**In March, NEBRA hosted EPA biosolids program officials from Washington, D.C., for a day of tours of some of New England's finest, diverse biosolids management programs. Stops included:**

- **Greater Lawrence Sanitary District's anaerobic digestion, energy production, and biosolids pelletizing facility**
- **Merrimack, New Hampshire biosolids composting operation (photo)**
- **Manchester, New Hampshire's dewatering and incineration system**
- **Concord, New Hampshire's lime-stablization, Class A, land application program**

## Local Challenges to Biosolids Management in the Northeast

The Northeast is home to hundreds of successful wastewater solids management programs. Occasionally, however, we are reminded that public understanding and acceptance of solids management solutions are always tenuous. Recently, several towns and counties have voiced concerns over biosolids management as a result of malodors and mistrust of outside wastes and facilities to manage the biosolids. Instances of public concern are described below.


**Gilmanton, New Hampshire** voters have banned local biosolids use. This may apply, however, only to future new uses. After considering a local ban several times before, voters passed a ban on biosolids land application at their town meeting in March. The town narrowly defeated a similar ban in 2016. Several farms in town have used biosolids for years, some for more than two decades. Therefore, when the ban was adopted, the question of grandfathered use was raised, and a lawyer for the New Hampshire Municipal Association said, "A farming operation that is already using biosolids in conformance with New Hampshire Department of Environmental Services regulations (Env-Wq 800; Env-Wq 1600) and best management practices could continue that use as a non-conforming use."

This winter and spring, perhaps the most prominent and lasting biosolids media story focused on a trainload of **New York City wastewater solids** stranded in a town in Alabama, having been rejected by the landfill for which it was destined. New York City digests its solids, and they are safe for use on land or for landfill disposal. But malodors can be an issue. The situation in Alabama was resolved by early April, with all the material removed and the odors mitigated. Media coverage continued into late May.

A proposed **biosolids processing facility** in rural New York State faced local public opposition in 2017 and early 2018. This Lystek organics processing facility was proposed for the Glen Canal View Business Park in Glen, New York, northwest of Albany. The town planning board denied Lystek's local permit, although Lystek said that its application was not complete and therefore that the denial was inappropriate. Over several months, Lystek conducted public outreach and engagement, as it did when siting a similar facility in Ontario several years ago. In late April, it was discovered that a local ordinance from 20 years ago could preclude the proposed facility (although that ordinance may not be legally defensible). Lystek withdrew its application, saying it prefers to "help communities that really need, and want, our help." Subsequently, a local member of the New York Assembly introduced a bill creating a moratorium on such facilities. Whether the bill will gain traction remains to be seen.

**Slate Belt energy project** proponents In northeastern Pennsylvania, continue to work with the local communities to address concerns. This biosolids drying facility, proposed by Synagro, Waste Management, and a local economic development group, would use waste heat from a landfill gas electricity generator to dry wastewater solids from around the region. Local discussion, planning, and revisions have been ongoing for a year and a half. An April meeting provided further exchange of information, and opposition has lessened because of changes made in response to voiced concerns. These include:

- Moving the proposed facility location within the local and state solid waste facility (landfill) boundary, so that a local permit for a non-conforming use is not needed
- Any wastewater discharge will be eliminated, as condensate from the drying process will be transported back to wastewater treatment facilities that are providing solids to the operation

Also, Synagro and Waste Management are pursuing all five state permits now before they have obtained local approval, to demonstrate their commitment to the community.

Given the potential for wastewater solids management programs to be misunderstood, best practices and community outreach are more important than ever.

## Biosolids groups urge robust science and thoughtful regulatory approaches to PFAS

In mid-April, biosolids groups from across the United States submitted a letter to Dave Ross, EPA assistant administrator for the Office of Water, urging the agency to include wastewater and biosolids management professionals and their perspectives to address polyfluorinated and perfluorinated alkyl substances (PFAS) in the environment.

PFAS are a group of chemicals, widely used for 50 years in consumer products, fire-fighting foams, and manufacturing. More than two decades of research has found significant health impacts, mostly with the two most common and persistent PFAS: perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). Starting in the early 2000s, EPA facilitated a voluntary phase-out of these two chemicals, and, already, their concentrations are lower in humans.

Nonetheless, health concerns and public scrutiny are increasing, and regulatory agencies are stepping in to protect drinking water, which is considered one of the primary modes of human exposure. The most serious PFAS contamination has been found at and from industrial and fire-fighting sites. While wastewater and biosolids are mentioned as other sources of PFAS in reviews of the topic (for example, see the new Interstate Technology and Regulatory Council [ITRC] fact sheets at pfas-1.itrcweb.org/fact-sheets), some research finds lower impacts from biosolids sites, even after years of biosolids applications.

Biosolids practitioners are urging state agencies and EPA to consider these findings and work with wastewater and biosolids organizations to address legitimate PFAS concerns related to biosolids.

The biosolids group letter to EPA and NEBRA's perspective fact sheet on PFAS and biosolids are available at the NEBRA website.

## EPA Posts 2017 Biosolids Data Online

*EPA press release*—EPA's Enforcement and Compliance History (ECHO) website, which provides integrated compliance and enforcement data for over 800,000 regulated facilities, now includes the 2017 biosolids annual program report data submitted electronically through the NPDES Electronic Reporting Tool (NeT).

The ECHO Biosolids Facility Search is available to the public and centralizes biosolids-specific permit, inspection, violation, enforcement, and penalty-related data to users for search, sort, and download at echo.epa.gov.

Recent updates to the Biosolids Facility Search include the ability to search on 2016 and/or 2017 biosolids program report data as well as on an additional Biosolids Handler, Preparer, or Applier option to accommodate the update to the 2017 reporting form. The Facility Search Results provide the ability to view:

- Year(s) that a biosolid annual program report was submitted (default table view)
- Date the annual report was submitted
- Number of violations reported on the biosolids annual program report
- Management practice types with violations
- Short description of violations

*NEBRA recommends that all those who report on biosolids to EPA review their online data for accuracy.*

## Join NEBRA in Halifax


NEBRA's Annual Conference is in Halifax, Nova Scotia, a beautiful, historic, and gracious small port city. The conference's two days of technical sessions and the day-long tour will feature the Halifax biosolids recycling program, along with regional and national success stories, challenges, and the latest biosolids and residuals developments around Canada and the northeastern United States. The conference is international, and American participants will see a discount on registration due to the current exchange rate.

If interested in carpooling from New England, contact NEBRA. For more about the technical program and the conference, visit cbrc2018.org.

Ned Beecher, Executive Director
Tamworth, N.H.
603-323-7654 | info@nebiosolids.org

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

nebra
North East Biosolids & Residuals Association

# Spotlight: **Jennifer Kelly Lachmayr**

Jennifer Kelly Lachmayr is well known in the New England water environment community for getting things done. Ms. Lachmayr is a mechanical engineering graduate from Cornell University, a registered professional engineer in most New England states, and a board-certified environmental engineer. She has served in many capacities for both NEWEA and WEF, and is currently NEWEA vice president (and thus will be president in 2020). We spoke with her about her experiences and lessons learned along the way.

**Journal** Coming out of a prestigious school with a mechanical engineering degree might suggest a different career path. What events got you into the clean water/drinking water field?

**Ms. Lachmayr** When I was in college my mentors and advisors were all mechanical engineers. So when I asked about the different careers in mechanical versus civil they felt strongly that I should pursue mechanical as I could always drop back to a 'simple engineering' career. Anyhow, I worked for the number one employer on Long Island (in New York), Grumman Aerospace Corporation, for two summers and one summer at a repair facility in Houston, Texas. By the time I finished, I knew that I did not want to work for a defense contractor-type company and sought a more 'environmental'-type career. My first job out of college was for Hydro Group in its environmental products division. It was a great job as we piloted and then manufactured and installed air stripping towers for all customer types including municipalities.

**Ms. Lachmayr with her husband Alex proudly showing their success at a favorite hobby**

■ *You have been a consulting engineer for over 30 years. What changes in the field and the people in and out of the profession have you seen over your career?*
□ Goodness, so many changes! Technology is a change that continues at a rapid pace but this also affords us to do a lot more and provide great flexibility with our careers. For us consulting engineers this means we can work from anywhere! It also allows for better communication with clients, stakeholders, etc., to promote greater understanding on issues and projects, and thus provide for more thorough or at least more discussed solutions. I think it's wonderful that we all embrace, encourage, and support a work life balance. I'm so glad for all the newer generations that there are so many more options to have a wonderful career and a family life. In the old days, when our children were young, people gave my husband a hard time about working part-time so that he could be a more hands-on dad. It was also frustrating to see men and women performing the same jobs and not receiving the same pay. I'm glad these topics are open for discussion and that opinions have changed and people are more supportive.

■ *What makes you get up each morning and gets you excited about the work you do?*
□ I love being outdoors and especially on the water, and I love people. I am happiest being part of a team working to a solution that involves water.

■ *You have been in this field long enough to remember a time when there were fewer women involved. What thoughts do you have on the changing demographics of the workforce in environmental work?*
□ Yes, when I graduated college there were 136 people in my graduating class. Six of us were women. I think the changing demographics are a good thing for the industry. We need more people in all areas of our profession. The average age of treatment plant operators is 55. We need to continue initiatives to encourage diversity in all aspects of the environmental workforce. Diversity provides for more creative solutions, which keep us energized, happy, and successful. At NEWEA we have many different programs to encourage diversity in our profession. Veterans, YP (Young Professionals), STEM (science, technology, engineering, and mathematics), college chapters, Ops Challenge, etc., to name a few.

■ *What do you see as the challenges facing the clean water profession over the next few years?*
□ Funding and workforce issues are two big challenges. I feel we need to change how we go about seeking funding for our projects. We need to band together with all aspects of our industry to bring a unified voice on the importance of funding infrastructure projects. We need to continue the efforts of being technical resources for our local and state politicians.

■ *From the days of the Clean Water Act and the horrendous pollution that existed in the 1950s and 1960s we have made great progress. How can we keep this progress from being taken for granted?*
□ We must continue to work smarter in all aspects to maintain the infrastructure that supports all our water systems. We have limited funds, time, and people. We all need to work together to best utilize our resources, maximize the lifespan of infrastructure, and provide the best water quality and quantity for future generations. Specifically, we need to think holistically about the water cycle and work to get everyone on the same page so that all resources can provide maximum benefit. We need to continue to educate and promote awareness about our industry, the infrastructure that supports us, and the benefits to all.

■ *What are you most proud of in your professional career?*
□ I am proud to be considered a leader for my company and for our profession. I take this very seriously and always live by the golden rule and work hard to support the underdogs and encourage positive change in our profession and industry. I try to be a good mentor and lead by example with quality work products provided in a timely manner and following through on any commitments I make.

■ *Why does it make sense to be involved in a state water pollution control association or NEWEA?*
□ Both NEWEA and the state associations (I am a member of many of the New England state associations) are great resources to professionals in our field. Originally, I joined for access to technical resources, but as I have been more involved, the networking benefits and the camaraderie that you develop over time are invaluable.

■ *We understand that you are an avid fisherman and diver? How did you get into that?*
□ I have been on boats all my life. I started out sailing. I have five brothers and was often fishing off our sailboat to relieve the boredom of long trips. It wasn't until I started fishing with my husband that I really got into fishing. Then we started with blues and striped bass. Now I have progressed to tuna. But I really enjoy many species. Diving is a natural addition to fun in the water. I first was certified with my son's Boy Scout troop. Today we enjoy diving for scallops and lobster in New England and to see the beautiful fish, coral, and sea life when visiting warmer oceans.

■ *What advice would you give to a student about ready to graduate from high school today? Would you recommend a career in the environmental field? Plant operations in particular?*
□ Absolutely I would recommend that young people consider careers in the environmental field. The jobs that are available generally offer secure, long-term employment with good benefits, and that goes for people looking to change careers a bit later in life as well. For high school students, it depends largely if the student is college bound or not. Of course, college can be expensive, and for those who do not want to pursue a four-year degree in science or engineering (which are great options) students may want to look at the new programs being developed at community colleges in Northern Maine and in Rhode Island. That said, a motivated and hard-working high school graduate can often find employment at a local wastewater treatment plant or public works department that can develop into a rewarding life long career.

■ *Congratulations on your selection as NEWEA vice president. What plans do you have for NEWEA when you are president in 2020?*
□ I hope to be able to expand our presence, allies, partners, and funding so we can take on and tackle even more important initiatives that are important to our membership. Some specific work items I embrace are:

- Some of the specific goals that are outlined in the strategic plan for increasing public awareness/education including to
  - Improve/advance public awareness/education through media outreach
  - Improve/advance public awareness/education through lobby/legislative advocacy
  - Improve/advance public awareness/education by collaboration with other water-based industries
- Continue to empower all the active leaders of NEWEA to be the best they can be and provide support and encouragement
- Work to support the NEWEA staff and hire a new communications specialist, then to work with the specialist to have it become a self-sustaining position.

# WEF Delegate Report

***Representing New England's perspective on a national scale***

Since WEFTEC 2017, NEWEA's WEF delegation has continued to promote New England's needs and issues, which dovetail well with WEF's goals and objectives nationally. Your delegates have ensured that New England's perspective remains relevant on a national scale.

NEWEA's WEF delegates continue to participate in their assigned WEF workgroups for 2018. Noted below are the workgroups and their respective NEWEA representatives.

NEWEA's senior delegate, Susan Sullivan, executive director of the New England Interstate Water Pollution Control Commission (NEIWPCC), and Howard Carter, past speaker of the WEF house of delegates (HOD) and director of the Water Resource Recovery Department for Saco, Maine, continue to participate in the WEF Steering Committee.

The Steering Committee is optimizing HOD activities, elevating the importance and service of the delegate position, and maximizing communication potential and pathways. Based on these discussions, HOD policies and procedures will likely undergo minor updates for approval at WEFTEC 2018; a dashboard-type system is being tested for possible replacement of separate agendas, minutes, and quarterly reports for various WEF committees and workgroups; and a mentoring program will ensure effective transitions and on-boarding for new delegates.

Ms. Sullivan also participates on the Membership Relations Workgroup. This workgroup helps to implement and communicate WEF membership dues strategy by educating the delegates on the strategy, providing organizational feedback to the WEF board of trustees (BOT) and WEF staff, and developing educational materials on strategy and process for member associations (MAs) such as NEWEA.

The Membership Relations Workgroup has three sub-groups to advance their annual activities, goals, and deliverables. One sub-group works closely with WEF staff to evaluate and communicate information about the WEFTEC Membership Initiative, which brought in 351 new WEF members in the past year. The other two sub-groups work with WEF staff and the WEF treasurer on messaging and tools for delegates and MAs to communicate the recently developed Membership Dues Strategy. Tools will include talking points for delegates to communicate the strategy to MA leadership as well as templates for communicating an increase in dues to the MA Leadership and all members if WEF dues change in the future.

The WEFTEC Membership Initiative remains a concern for NEWEA. When NEWEA or another MA provides this service to new attendees to the annual NEWEA meeting (or other MA equivalent), these individuals have a free one-year membership in both NEWEA (or another MA) and WEF. NEWEA (or another MA) has to pay the difference to WEF for their membership. When WEF provides a "free" one-year membership to new attendees to WEFTEC, they receive a free membership in their local MA. However, WEF does not reimburse the MA for the yearly MA membership. This could create a hardship for MAs. The NEWEA delegates and other HOD members are working on this issue.

Ms. Sullivan also chairs the legislative subcommittee for WEF's Government Affairs Committee. This WEF group coordinated efforts with the National Association of Clean Water Agencies (NACWA), WateReuse, and the Water Research Foundation (WRF) on the 2018 Water Week and National Water Policy Fly-in, which took place in mid-April. These groups also coordinated with your NEWEA leadership and the leaders of the affiliated state wastewater/water quality associations from the six New England states on the Fly-in. Thank you to all who participated.

Fred McNeill, chief engineer of the Environmental Protection Division for the city of Manchester, New Hampshire, serves on the WEF Operator Advisory Panel and Operator Initiatives Workgroup, which truly represent the great work that can be accomplished when volunteers from throughout the WEF organization come together! With representation and guidance from the board, WEF staff, committee leadership council, and operator advisory panel (OAP), this group supports an operator census nationwide, identifying and developing tools and resources to advance operator programs, and partnering with the OAP to deliver operator content at each of the four WEFMAX meetings this spring. Other tasks by this workgroup include promoting the role of water professionals in the community, supporting Operations Challenge as a vehicle for new operator involvement with WEF, and defining long-term member association operator training strategies. Work is conducted by monthly conference calls, defined deliverables, and strong group leadership.

Matt Formica, past NEWEA president and senior project manager at AECOM, has been participating on the Student Chapters Workgroup and the HOD Nominating Committee. He will also be participating on the WEF nominating subcommittee.

The Student Chapters Workgroup has worked closely with the Students and Young Professionals Committee (SYPC) to further HOD and MA work related to student chapters across the United States. This workgroup is quickly realizing the numerous complexities with student chapter requirements and needs, not only within WEF but within each university. After much discussion, internally and with SYPC, this group has realized that taking a step back to better understand and define the universe of active WEF student chapters will enhance its ability to identify student chapter needs, and provide the necessary tools and resources later in the year.



# Student Design Competition

NEWEA's annual Student Design Competition (SDC) organized by the Student Activities Committee was recently completed. This competition promotes real-world design experience for students interested in pursuing an education and/or career in water engineering and sciences. The competition tasked teams of student members within NEWEA to design a project that they have worked on together. Student teams were invited to submit written reports and present their findings in front of judges during the SDC reception and presentation on May 1 at Northeastern University (NU) in Boston. The lone competing team was from NU.

The team presented a sustainable residential development project in Gloucester, Massachusetts. Judges evaluated the project's technical aspects, the appearance and structure of the written submittal, and the content organization and effectiveness of the presentation. Following the evaluation, the NU team was selected to represent NEWEA at the annual WEFTEC conference.

The team proposed a design for a sustainable living community to be home to 300 residents on a 16 acre (6.5 ha) plot of land in Gloucester and Rockport, Massachusetts. The design focused on environmental sustainability and economic efficiency through onsite energy generation and innovative water management. The team designed for onsite solar energy generation, low-impact development technologies for stormwater management (including tree boxes and vegetated swales), a constructed wetland system for greywater treatment and reuse, and connections to municipal utilities including water and sewer. The final community design focused on renewable energy generation and cost-effective, sustainable on-site water use.

Competition judges were: Jerry Hopcroft (SAC and Wentworth Institute of Technology), Ben Stoddard (Kleinfelder), Carina Hart (JK Muir), and Tracy Chouinard (Brown & Caldwell).

The winning team will receive a $600 prize and allowance of up to $2,500 to travel to WEFTEC 2018 in New Orleans where the team will present its project at the WEF SDC.

**The NU team with Professor Mark Patterson: (L to R) Sabrina Castaneda, Joanna Sullivan, Prof. Patterson, Anna Mallonée, Meghan Lyons**


**Rendering of the NU team's project—**
***Sustainable development in Gloucester, Massachusetts***

# Specialty Conference, & Networking Proceedings

Young Professionals tour the odor control unit at the Dover, New Hampshire facility during the February Poo & Brew event

## YOUNG PROFESSIONALS NETWORKING EVENTS

NEWEA's Young Professionals (YPs) Committee hosts a popular multi-discipline networking event aptly named Poo & Brew. This event features a tour of a local wastewater treatment facility followed by networking at a brewery. These events are open to organization members and non-members consisting of professionals in the early stages of their water industry careers.

Sponsored by: AECOM; Aqua Solutions; ARCADIS; Brown and Caldwell; CDM Smith; Dewberry; Flow Assessment Services; FlowTech; Hazen and Sawyer; Lystek International, Inc.; Tata & Howard; Ted Berry Company; The MAHER Corporation; Tighe & Bond; Weston & Sampson

### POO & BREW #11

This event highlighted the Leavitt E. Magrath Wastewater Treatment Plant (WWTP) in Hampton, New Hampshire, followed by a networking event held at Smuttynose Brewing Company. Over 40 attendees participated in the event held on Thursday, November 2, 2017. Cohosted with New Hampshire Water Pollution Control Association (NHWPCA)

### POO & BREW #12

A tour of the Dover, New Hampshire Wastewater Treatment Facility was featured, followed by networking at 7th Settlement Brewery in Dover, New Hampshire. Over 35 attendees participated in the event held on Thursday, February 15, 2018. Cohosted with NHWPCA

### TOUR & POUR

NEWEA YPs joined forces with Licensed Site Professional (LSP) Association's Emerging Professionals to host a Tour & Pour. This event featured a facility tour at Globalcycle, Inc. in East Taunton, Massachusetts, followed by networking at Shovel Town Brewery in North Easton, Massachusetts. Over 40 attendees participated in the event held on Thursday, April 5, 2018. Cohosted by the LSP Association

## ASSET MANAGEMENT AND ENERGY SPECIALTY CONFERENCE

The New England Water Environment Association's Asset Management and Energy Committees held a joint Specialty Conference & Tour on April 11 & 12, 2018 at Anheuser Busch in Merrimack, New Hampshire. The workshop had 60 participants.

The technical presentations commenced on Wednesday, April 11, 2018, with NEWEA President-Elect Ray Vermette and NEWEA Asset Management Committee Chair John Rogers providing the Welcome and Opening Remarks to meeting attendees.

In addition to the meeting, a networking reception and tours were held on Wednesday, April 11.

### TECHNICAL PRESENTATIONS

**Wednesday, April 11, 2018**

- Panel Discussion: Show Us the Money! Funding Options for Asset Management and Energy Efficiency Projects - John Skelly, ME DEP; Luis Adorno, NH DES; Michael Murphy, MassCEC; CT DEEP; MADEP/CWT; and RI Commerce was presented by Dan Roop, Tighe & Bond


Touring the Dover facility—part of the February Poo & Brew event

Keynote: Why Execution Fails and What to Do About It
• John Fortin, CH2M (now Jacobs)

Pennichuck Water—Asset Management Success Story With a Link to How Energy Use Ties into Their AM Program
• John Boisvert, Pennichuck Water

### TECHNICAL PRESENTATIONS

**Thursday, April 12, 2018**

Anheuser-Busch BERS: Recovering Energy from Brewery Effluent
• Bill Dineen, Anheuser Busch

Are You Actually Using Your Data? Going from Collection to Action to Solve Real World Problems
• Susan Guswa, Woodard & Curran

Cost Effectively Maintaining and Rehabilitating an 80-MGD Pump Station for Energy Efficiency—There is a Lot You Can Do Without Replacing Your Assets
• Frederick Mueller, Tighe & Bond

Envisioning Smarter infrastructure investments—How Sustainability Tools Can Help Utilities Manage Assets and Operations Responsibly
• Courtney Eaton, Woodard & Curran

Real Life is Too Complicated for Simple Payback—Don't Ever Use it Again
• Dennis Clough, ESG

Maximizing Resource Recovery Through Solids and Energy Flow Modelling
• Catherine Moskos, ARCADIS

New Hampshire's Unique Approach To Wastewater Energy Efficiency
• Sharon Nall, NHDES
• Mark Toussaint, Eversource

NHDES Funding Options for Asset Management
• Sharon Rivard, NHDES
• Luis Adorno, NHDES

### SPONSORS

AECOM
Aqua Solutions
ARCADIS
Brown and Caldwell
CDM Smith
CH2M is now Jacobs
David F. Sullivan & Associates
Fuss & O'Neill
Green Mountain Pipeline Services
Hazen and Sawyer
Hoyle, Tanner & Associates, Inc.
Kleinfelder
SUEZ
Tata & Howard
The MAHER Corporation
Tighe & Bond
Weston & Sampson
Wright-Pierce

## STORMWATER CONFERENCE, EXHIBIT & TOUR

The New England Water Environment Association's Stormwater Committee in conjunction with the New England Environmental Finance Center (NEEFC) held a joint specialty conference and workshop on May 7–8 at the Sheraton Portsmouth Hotel in Portsmouth, New Hampshire. Over 110 attendees and 12 exhibitors participated in the specialty conference.

**The specialty conference** on May 7 focused on projects, strategies, and case studies by public and private entities preparing to effectively manage storm-water and build resilient networks in an uncertain climate with significant physical and financial constraints. **A workshop** was offered on May 8 that looked at financial strategies, tools, and funding opportunities for stormwater utilities.


Tracy Wood of New Hampshire Department of Environmental Services (NHDES) makes a point at the Energy Efficiency and Asset Management conference in Merrimack, New Hampshire

The technical presentations commenced on Monday, May 7, with NEWEA Vice President Jennifer Kelly Lachmayr and Stormwater Committee Chair Angela Blanchette providing the Welcome and Opening Remarks to meeting attendees.

### KEYNOTE PRESENTATION

Building Stormwater-Resilient Communities: Encouraging Community Involvement to Soak Up the Rain
• Cindy Brown, US EPA Region 1
• Lisa Loosigian, NH DES

Attendees also had the opportunity to participate in a Green Infrastructure tour in the afternoon.


Attendees share ideas during a break at the Energy Efficiency and Asset Management conference

### CONCURRENT TECHNICAL SESSIONS

***Cities and States Path Towards Resiliency Case Studies***
Moderator:
• Ginny Roach, CDM Smith

Miami Beach Case Study—Advancing Strategy of Green & Grey Infrastructure Towards Advancing Coastal Resilience
• Bernadette Callahan, Stantec

Rhode Island's Resiliency Efforts
• Jan Greenwood, Woodard & Curran
• Shaun O'Rourke, State of RI

Restoring Boston's Bays and Streams
• Julie Wood, Charles River Watershed Association

Integrated Coastal and Stormwater Flood Resiliency for Rebuild by Design Hudson River Project in Hoboken, NJ
• Rahul Parab, Dewberry

***Infrastructure Engineering and Design with Resiliency in Mind***
Moderator:
• David Bedoya, Stantec

Post-Storm Infrastructure Improvements and Stream Restoration: Three Case Studies
• Thomas Graupensperger, Dewberry

Design and Construction of Resilient Stormwater BMPs to Address Climate Change and Improve Water Quality
• Nick Cristofori, Comprehensive Environmental Inc.

Designing for the Impact of Future Climate Conditions
• Mark Costa, VHB

Sharing a Drainage System to Build Stormwater Resilience
• Dr. Yovanni Catano, Stantec
• Richard Raiche, City of Somerville, MA

***Opportunities/Strategies to Help Build a Sustainable and Resilient Future***
Moderator:
• Zach Henderson, Woodard & Curran

Resilient Ecosystems: Quantifying the Co-benefits of Green Infrastructure
• Dr. Indrani Ghosh, Kleinfelder
• Kathy Watkins, City of Cambridge, MA

Increasing Resilience through Intelligent Water Mgmt
• Scott Simpson, Optii
• Tatjana Toeldte, Optii

A Resiliency State of Mind: Living with the Bay Resiliency Strategy
• Jason Hellendrung, Tetra Tech
• Jake Oldenburger, Tetra Tech

The Energy Efficiency and Asset Management conference in Merrimack, New Hampshire was well-attended




Stormwater Committee Vice-chair Kate Edwards and Chair Angela Blanchette pose at the Stormwater Resilience conference in Portsmouth, New Hampshire

Private Development—Public Benefit: Tuscan Village Floodplain Improvements in Salem, New Hampshire
- Joseph Persechino, Tighe & Bond
- David Azinheira, Tighe & Bond

***Stormwater Resiliency Funding via Strategic Regulation and Management***
Moderators:
- Natalie Pommersheim, Env. Partners
- Eric Kelley, Env. Partners

Implementation of Flow Restoration Plans to Address Stormwater Impaired Streams
- Thomas DiPietro, City of South Burlington, VT
- David Wheeler, City of South Burlington, VT

Resilient Bylaws & Ordinances
- Jennifer Kelly Lachmayr, Arcadis
- Kathryn Edwards, Arcadis

Piece by Piece: Funding Targeted Resiliency Projects Through a Phased Approach
- Paul Jacques, Woodard & Curran
- Braydon Marot, Town of Weymouth, MA

Using Asset Management to Maintain a Resilient Stormwater System
- Annie Bastoni and Kelly Siry, VHB

### WORKSHOP

Moderators:
- Martha Sheils, New England Environmental Finance Center
- Jack Kartez, New England Environmental Finance Center

### KEYNOTE

- Jim Gebhardt, Director of Water Infrastructure and Resiliency Finance Center, USEPA

Moving from Contemplation to Implementation of your Stormwater Manwagement Plan
- Ed Suslovic, New England Environmental Finance Center

Harnessing Technical Assistance and Tools to Access and Plan for Stormwater Funding
- Bill Boulanger, Dover, NH
- James Houle, UNH Stormwater Center

Panel Discussion: State Source of Funding
- Jeffrey R. Diehl, Rhode Island Infrastructure Bank; Ted Diers, NHDES; Terisa Thomas, VTDES

Jamie Houle of the University of New Hampshire (UNH) Stormwater Center presents at the Stormwater Resilience conference in Portsmouth

### EXHIBITORS

ACF Environmental
Advanced Drainage Systems, Inc.
Best Management Products
Burt Process Equipment
Flow Assessment Services LLC
ILC Dover
New England Environmental Equipment
StormTrap
Ti-Sales Inc./Neptune Technologies
VHB
Vortex Companies
Wright-Pierce

### SPONSORS

AECOM
ARCADIS
Brown and Caldwell
CDM Smith
CH2M is now Jacobs
Dewberry
Environmental Partners Group
EST Associates
Flow Assessment Services LLC
Fuss & O'Neill
Hazen and Sawyer
Hoyle, Tanner & Associates, Inc
Kleinfelder
Nitsch Engineering
Stantec
Tata & Howard
Ted Berry Company
Tetra Tech
Tighe & Bond
VHB
Weston & Sampson
Woodard & Curran
Wright-Pierce



# Upcoming Events


### AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

**NHWPCA OCEAN NETWORKING TRIP**
**July 13, 2018**
leaving from Seabrook, NH

**NACWA UTILITY LEADERSHIP CONFERENCE & MEETING**
**July 23, 2018**
Boston Marriott Copley Place Hotel, Boston, MA

**NHWPCA ANNUAL GOLF TOURNAMENT**
**August 2, 2017**
Beaver Meadow Golf Course, Concord, NH

**GEORGE DOW MEMORIAL GOLF TOURNAMENT**
**August 17, 2018**
Cedar Knoll Country Club, Hinesburg, VT

**RI NWPCA FALL TRADE SHOW & CLAMBAKE**
**September 7, 2018**
Twelve Acres Banquet Facilty, Smithfield, RI

**MWPCA TRADE FAIR**
**September 12, 2018**
Wachusett Mountain, Princeton, MA

**NHWPCA FALL MEETING**
**September 14, 2018**
Hall Street WWTF, Concord, NH

**NEWWA ANNUAL CONFERENCE**
**September 16–19, 2018**
Stowe Mountain Lodge, Stowe, VT

**MEWEA FALL CONFERENCE & GOLF TOURNAMENT**
**September 19–21, 2018**
Sunday River, Newry, ME

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

**COMMITTEE MEMBER APPRECIATION EVENT**
**July 26 2018**
Kimball Farms, Westford, MA

**WATER REUSE CONFERENCE**
**August 10, 2018**
UCONN, Storrs, CT

**TEACHER TRAINING**
**August 14, 2018**
MWRA

**COLLECTION SYSTEMS CONFERENCE & EXHIBIT**
**September 10, 2018**
Boxboro Regency Inn, Boxborough, MA

**WEFTEC**
**September 28 – October 3, 2018**
New Orleans, LA

**NORTH EAST RESIDUALS & BIOSOLIDS CONFERENCE**
**October 2018**
TBD

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

# New England Water Environment Association, Inc.

## Statement of activities
## For the years ended September 30, 2017 and 2016

| **Changes in unrestricted net assets:** | **2017** | **2016** |
|---|---|---|
| Revenues and gains: | | |
| Registration Fees | $ 451,858 | $ 570,419 |
| Exhibitor Fees | 266,000 | 245,415 |
| Membership Dues | 51,030 | 42,174 |
| Pass Through Dues | 63,068 | 55,839 |
| Advertising and Subscriptions | 118,138 | 84,441 |
| Sponsorships | 73,782 | 72,059 |
| Certification Fees | 17,900 | 9,765 |
| Investment Income | 61,134 | - |
| Other Income | 30,841 | 16,788 |
| **Total unrestricted revenues and gains** | **1,133,751** | **1,096,900** |
| **Total unrestricted revenues, gains and other support** | **1,133,751** | **1,096,900** |
| **Expenses:** | | |
| Program services | 739,129 | 857,800 |
| Management and general | 252,997 | 264,722 |
| Pass Through Dues | 35,343 | 30,023 |
| **Total expenses** | **1,027,469** | **1,152,545** |
| | - | - |
| (Decrease) Increase in unrestricted net assets | 106,283 | (55,645) |
| **Changes in permanently restricted net assets:** | | |
| Endowment income | - | 29,082 |
| Scholarship Expense | - | 9,000 |
| Increase (decrease) in temporarily restricted net assets | - | 20,082 |
| **(Decrease) Increase in net assets** | **106,283** | **(35,563)** |
| **Net assets, beginning of year** | **628,892** | **664,455** |
| **Net assets, end of year** | **$ 735,175** | **$ 628,892** |





# New Members December 2017–May 2018

James P. Malley, Jr,
University of New Hampshire
Durham, NH (ACAD)

CDW Consultants Inc.
Natick, MA (COR)

Dave Mooney
Ecoremedy, LLC
Pittsburgh, PA (DUAL)

Robert Arnoni
Ecoremedy, LLC
Pittsburgh, PA (DUAL)

Mark Brown
Canandaigua, NY (DUAL)

Matthew Berube
Town of Exeter DPW
Exeter, NH (PRO)

Joseph McGinn
Weston & Sampson
Engineers Inc.
Worcester, MA (PRO)

Anthony R Poole
Warwick Sewer Authority
Warwick, RI (PRO)

Noah Stone
Orange, MA (PRO)

Dana Webber
Weston & Sampson
Engineers Inc.
Portsmouth, NH (PRO)

Timothy Balathunis
E Ink
Chicopee, MA (PRO)

Charles Chuck Dam
City of Salem
Salem, MA (PRO)

Carrera Dean
Peabody, MA (PRO)

Steven Hession
E Ink
Tewksbury, MA (PRO)

Bob Nobile
Medora Corp - Solarbee
Norwalk, CT (PRO)

Mandy Olver
Olver Associates Inc.
Winterport, ME (PRO)

Tyson Ross
West Roxbury, MA (PRO)

Xiaodong Tian
Hazen and Sawyer
Boston, MA (PRO)

Insley Haciski
Onset Computer
Bourne, MA (PRO)

Nancy Hammett
Watertown, MA (PRO)

Richard Beauregard
E Ink
Billerica, MA (PWO)

Michael Muscatell
Deering, NH (PWO)

Michael Serra
Norwich Public Utilities
Norwich, CT (PWO)

Todd Wolowicz
MDC Water Bureau
West Hartford, CT (PWO)

Justin Barnett
York Sewer District
York Beach, ME (PWO)

Kevin Eaton
York Beach, ME (PWO)

Matthew Lamson
City of Montpelier Wastewater
Montpelier, VT (PWO)

Matthew Lewis
Shrewsbury, MA (PWO)

Marissa Montemagni
Springfield Water & Sewer
Commission
Springfield, MA (PWO)

Keith Ouellette
Springfield Water & Sewer
Commission
Springfield, MA (PWO)

Joseph Rock
Edgartown Wastewater Plant
Edgartown, MA (PWO)

James Sullivan
Springfield Water & Sewer
Commission
Springfield, MA (PWO)

Chris Welch
Town of Uxbridge
Uxbridge, MA (PWO)

Christian Boisvert
Acton, MA (STU)

Ashleigh Gilchrist
Durham, NH (STU)

Ryan Ordung
Willimantic, CT (STU)

Akarapan Rojjanapinun
Tyngsboro, MA (STU)

Carrera Dean
Peabody, MA (STU)

Hichem Hadjeres
Kingston, RI (STU)

Katelyn E. Hellrigei
Ridgefield, CT (STU)

Masoud Mahdisoltani
Boston, MA (STU)

Patrick L. Skawiot
Hartford, CT (STU)

Jacob Cantor
Hazen & Sawyer
Boston, MA (YP)

Maya Clifford
Maine Water
Rockport, ME (YP)

Jonnas Jacques
Cambridge, MA (YP)

Julianne Page
Woodard & Curran
Portland, ME (YP)

Eudora Zhang
Boston, MA (YP)

Lauren Bergman
Westwood, MA (YP)

Jacob S.  Faulise
E.I.T Boundaries LLC
Griswold, CT (YP)

Sean Hutchins
Londonderry, NH (YP)

Kellie Messer
North Andover, MA (YP)

Dan Rowell
Rockport, MA (YP)

John Dimodica
Noresco
Boston, MA (COR)

David Allerton
Town of Milton
Milton, VT (PRO)

Carleton Berk
Environmental Energy Capital
Nashua, NH (PRO)

Laura Blake
Hydroanalysis Inc
Acton, MA (PRO)

John Bobrek
Bobrek Engineering & Construction
Danvers, MA (PRO)

Paula Boyle
Hoyle, Tanner & Associates
Manchester, NH (PRO)

Brian Canterbury
AECOM
Rocky Hill, CT (PRO)

Lucas Chapman
Flow Assessment Services LLC
Auburn, NH (PRO)

Roodly Dorleans
Boston Water & Sewer Commission
Roxbury, MA (PRO)

Jeremy Drinkwine
SJE Rhombus
Detroit Lakes, MN (PRO)

Patrick Ellis
Casella Organics
Concord, NH (PRO)

Brendan Ennis
CDM Smith
Providence, RI (PRO)

Marc Gabriel
Nitsch Engineering Inc
Boston, MA (PRO)

Paul Gallego
Headworks International Inc
Houston, TX (PRO)

Paul Glatkowski
Environmental Energy Capital
Nashua, NH (PRO)

Jeremy Hall
Massachusetts Water
Resources Authority
Chelsea, MA (PRO)

Greg Harmon
Harmon & Co Inc
Poland, ME (PRO)

Ingrid Jacobs
Environmental Partners Group Inc
Middletown, CT (PRO)

Vijay Shankar Jeyakrishnan
Ted Berry Company Inc
Livermore, ME (PRO)

Gary Kellaher
Town of Rutland
Rutland, MA (PRO)

Jim Kelly
Industolutions
Madbury, NH (PRO)

Stephen King
Town of Danvers
Danvers, MA (PRO)

Patrick McCafferty
CDM Smith
Boston, MA (PRO)

Tim McCandless
Synagro Ne
Waterbury, CT (PRO)

Todd Moline
Stantec
Providence, RI (PRO)

Leah Normand
Krohne
Peabody, MA (PRO)

Stuart Osborn
Springfield Water &
Sewer Commission
Springfield, MA (PRO)

Michael Pelletier
Arcadis
Wakefield, MA (PRO)

Daniel Perreault
Springfield Water &
Sewer Commission
Springfield, MA (PRO)

Michael Plummer
Massachusetts Water
Resources Authority
Chelsea, MA (PRO)

Ken Pousland
Upper Blackstone Water
Pollution Abatement District
Millbury, MA (PRO)

Glenn Ratcliffe
Bellingham, MA (PRO)

Laurel Schaider
Silent Spring Institute
Newton, MA (PRO)

Terri St. Vincent
Westfall Manufacturing Co.
Bristol, RI (PRO)

William Taylor
Saratoga Springs, NY (PRO)

Luiz Teixeira
Puc-rio (Pontifical Catholic University)
Rio de Janeiro, Rj, Brazil (PRO)

Deborah Trumbull
Small Water Systems Services
Littleton, MA (PRO)

Mark Wetzel
Town of Ayer
Ayer, MA (PRO)

Kin Wong
Weston & Sampson Engineers Inc
Peabody, MA (PRO)

Fang Yu
Massachusetts Water
Resources Authority
Boston, MA (PRO)

Tony Zerilli
Weston & Sampson Engineers Inc
Peabody, MA (PRO)

Sandip Agarwal
Vuronyx Technologies
Woburn, MA (PRO)

Renee Baxter
Massachusetts Water
Resources Authority
Chelsea, MA (PRO)

Michael Denichilo
Mott Macdonald
West Springfield, MA (PRO)

Paul Ferland
City of Fall River
Fall River, MA (PRO)

Jessica Gooch
City of Portland
Portland, ME (PRO)

Patricia Mallett
Massachusetts Water
Resources Authority
Chelsea, MA (PRO)

Mark McCormick
Madison, CT (PRO)

Paul Russell
Granville, MA (PRO)

Lauren Caputo
Vanasse Hangen Brustlin Inc
Watertown, MA (PRO)

# New Members (continued)

Faye Demoura
Wright-Pierce
Andover, MA (PRO)

Derek Schwab
Norwich, CT (PRO)

John Alexander
Town of Hinesburg
Hinesburg, VT (PWO)

Matthew Bernardini
Veolia Water North America
Georgetown, CT (PWO)

Daniel Bicknell
Freeport Sewer District
Freeport, ME (PWO)

William Branton
Scituate, MA (PWO)

Bryan Copeland
Town of Ayer
Ayer, MA (PWO)

Tim Davidson
Town of Northborough
Northborough, MA (PWO)

Robert Delgado
Falmouth, MA (PWO)

Terrence Donoghue
Winsted, CT (PWO)

Ardis Gary
Town of Nantucket Dept
of Public Works
Nantucket, MA (PWO)

Scott Kraihanzel
Sandwich, MA (PWO)

Daniel Nason
Town of Sudbury
Sudbury, MA (PWO)

Stephen Simeone
City of Concord NH WWTF
Goffstown, NH (PWO)

Joanne Wu
Massachusetts Water
Resources Authority
Winthrop, MA (PWO)

Dan DesJeans
City of Chicopee
Chicopee, MA (PWO)

Arthur Garrison
Town of Milton
Milton, VT (PWO)

Christopher Owsiak
City of Chicopee
Chicopee, MA (PWO)

Brian Peltier
City of Chicopee
Chicopee, MA (PWO)

Allan Sbrega
City of Chicopee
Chicopee, MA (PWO)

Cole Scott
City of Chicopee
Chicopee, MA (PWO)

Karl Averill
Bedford, NH (STU)

Salimar Cordero
Bayamon, PR (STU)

Nicholas Girard
Norwood, MA (STU)

Mitchell Hubbard
Westfield, MA (STU)

Abigail Ismail
Engineers Without Borders-USA
Worcester, MA (STU)

Sally Kramer
New York, NY (STU)

Angelica Medina
Salisbury, MA (STU)

Julia Miller
Kingston, RI (STU)

Pascual Perazzo
Boston, MA (STU)

Megan Sidur
Ware, MA (STU)

Jonathan Gendron
South Grafton, MA (STU)

Aarthi Mohan
Amherst, MA (STU)

Madelyn Morse
Rocky Hill, CT (STU)

Ross O'Neil
Westmoreland, NH (STU)

Stephanie Salerno
Worcester, MA (STU)

P. Griffin Beaudoin
Town of Barnstable
Hyannis, MA (YP)

Shelby Carver
Kennebunk Sewer District
Kennebunk, ME (YP)

Ryan Flood
Tewksbury, MA (YP)

Chloe Greenberg
Dedham, MA (YP)

Matthew Houghton
Weston & Sampson
Engineers Inc
Peabody, MA (YP)

Jonathan Kaiser
Infiltrator Water Technologies
Old Saybrook, CT (YP)

Beth Kaniuka
Weston & Sampson
Engineers Inc
Peabody, MA (YP)

Colleen O'Brien
Gloucester, MA (YP)

Chelsea Roberge
Mont Vernon, NH (YP)

Scott Simpson
Somerville, MA (YP)

Parnian Baniahmad
West Somerville, MA (YP)

Danielle DiRuzza
Massachusetts Water
Resources Authority
Chelsea, MA (YP)

Elyse Dumas
Brookline, MA (YP)

Jason Kaufman
Town of Greenwich
Greenwich, CT (YP)

Kristin Dippold
Northampton, MA (YP)

Amanda Rowe
City of Dover
Dover, NH (YP)

Varun Srinivasan
Natick, MA (YP)



# Thank you

**TO ALL OUR 2018 ANNUAL SPONSOR PROGRAM PARTICIPANTS:**

**Platinum**
ARCADIS

**Gold**
AECOM
Aqua Solutions
Brown and Caldwell
CDM Smith
Dewberry
EST Associates
Flow Assessment Services
Green Mountain Pipeline Services
Lystek International, Inc.
SUEZ
The MAHER Corporation
Weston & Sampson

**Silver**
Environmental Partners Group
Fuss & O'Neill
Hazen and Sawyer
Hoyle, Tanner & Associates, Inc.
NEFCO
Synagro Northeast
Tata & Howard
Ted Berry Company
Tetra Tech
Tighe & Bond
Woodard & Curran
Wright-Pierce

**Bronze**
ADS Environmental Services
AllMax Software, Inc.
David F. Sullivan & Associates
Duke's Root Control
GHD
Hayes Pump
Kleinfelder
Nitsch Engineering
Stantec

**Build relationships with water industry leaders *and* make a positive impact on the water environment**

## Join NEWEA's 2019 Annual Sponsor Program

**NEWEA offers companies the opportunity to promote their products and services throughout the year by participating in multiple sponsorship activities. Annual Sponsorships include:**

- NEWEA Annual Conference
- NEWEA Spring Meeting & Golf Tournament
- NEWEA Golf Classic
- A web presence on NEWEA.org's sponsorship program page
- The option to customize sponsorship levels by selecting to participate in up to eight additional unique NEWEA events plus additional activities

**Sponsorship Benefits:**

- Increased corporate visibility and marketing opportunities before a wide audience of water industry professionals
- Relationship-building access to key influencers involved in advancing water industry services, technology, and policy
- Recognition as an environmental leader among peers and customers

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

NEWEA
WORKING FOR WATER QUALITY

# Advertiser Index





## NEWEA/WEF* Membership Application 2018

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

### Personal Information (please print clearly)

Last name | M.I. | First Name | (jr. sr. etc)

Business Name (if applicable)

Street or P.O. Box ( ☐ Business Address ☐ Home Address )

City, State, Zip, Country

Home Phone Number | Mobile Phone Number | Business Phone number

Email Address

☐ Check here if renewing, please provide current member I.D.

***NEWEA is a member association of WEF (Water Environment Federation). By joining NEWEA, you also become a member of WEF.**

### 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

*Signature (required for all new memberships)* | *Date*

### Sponsorship Information

WEF Sponsor name (optional) | Sponsor I.D. Number | ACQ. Code for WEF use only | WEF 18

### Membership Categories (select one only)

| | | Member Benefit Subscription | Dues |
|---|---|---|---|
| ☐ **Professional Package** | Individuals involved in or interested in water quality | ■ *WE&T* (including *Operations Forum*)<br>■ *WEF Highlights Online* | $185 |
| ☐ **Young Professional Package** | New members or formerly student members with 5 or less years of experience in the industry and less than 35 years of age. This package is available for 3 years. Date of birth (mm/yy) _____ | ■ *WE&T* (including *Operations Forum*)<br>■ *WEF Highlights Online* | $69 |
| ☐ **Professional Wastewater Operations (PWO) Package** | Individuals in the day-to-day operation of wastewater collection, treatment or laboratory facility, or for facilities with a daily flow of < 1 mgd or 40 L/sec. License # _____ | ■ WE&T (including *Operations Forum*)<br>■ *WEF Highlights Online* | $109 |
| ☐ **Academic Package** | Instructors/Professors interested in subjects related to water quality. | ■ *WE&T* (including *Operations Forum*)<br>■ *WEF Highlights Online*<br>■ *Water Environment Research* (Online) | $181 |
| ☐ **Student Package** | Students enrolled for a minimum of six credit hours in an accredited college or university. Must provide written documentation on school letterhead verifying status, signed by an advisor or faculty member. | ■ *WE&T* (including *Operations Forum*)<br>■ *WEF Highlights Online*<br>■ *Water Environment Research* (Online) | $10 |
| ☐ **Executive Package** | Upper level managers interested in an expanded suite of WEF products/services. | ■ *WE&T* (including *Operations Forum*)<br>■ *WEF Highlights Online* ■ *World Water*<br>■ *Water Environment Research* (Online)<br>■ *Water Environment Regulation Watch* | $353 |
| ☐ **Dual** | If you are already a member of WEF and wish to join NEWEA | | $40 |
| ☐ **Corporate Membership** (member benefits for one person) | Companies engaged in the design, construction, operation or management of water quality systems. Designate one membership contact. | ■ *WE&T* (including *Operations Forum*)<br>■ *Water Environment Research* (Print)<br>■ *Water Environment Regulation Watch*<br>■ *WEF Highlights Online* | $411 |
| ☐ **New England Regulatory Membership** | This membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, CT Department of Energy and Environmental Protection, ME Department of Environmental Protection, MA Department of Environmental Protection, NH Department of Environmental Services, VT Department of Environmental Conservation, and RI Department of Environmental Management | | $50 |

**WEF Utility Partnership Program (UPP):** NEWEA participates in the WEF Utility Partnership Program (UPP) that supports utilities to join WEF and NEWEA while creating a comprehensive membership package for designated employees. As a UPP Utilities can consolidate all members within their organization onto one account and have the flexibility to tailor the appropriate value packages based on the designated employees' needs. Contact WEF for questions & enrollment (703-684-2400 x7750).

### Payment

☐ **Check or money order enclosed**
Made payable to NEWEA
10 Tower Office Park, Suite 601
Woburn, MA 01801
For more information: 781.939.0908
Fax 781.939.0907 NEWEA.org

**Charge**
☐ Visa
☐ American Express
☐ Master Card
☐ Discover

Card # | Security/CVC

Signature | Exp. Date

Daytime Phone

**Billing Address** (☐ check here if same as above) | Street/PO Box | City, State, Zip

*Depending upon your membership level, $10 of your dues is allocated towards a subscription to the NEWEA Journal.*

# NEWEA/WEF* Membership Application 2018

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

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**
Engineering and Design Staff

**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)

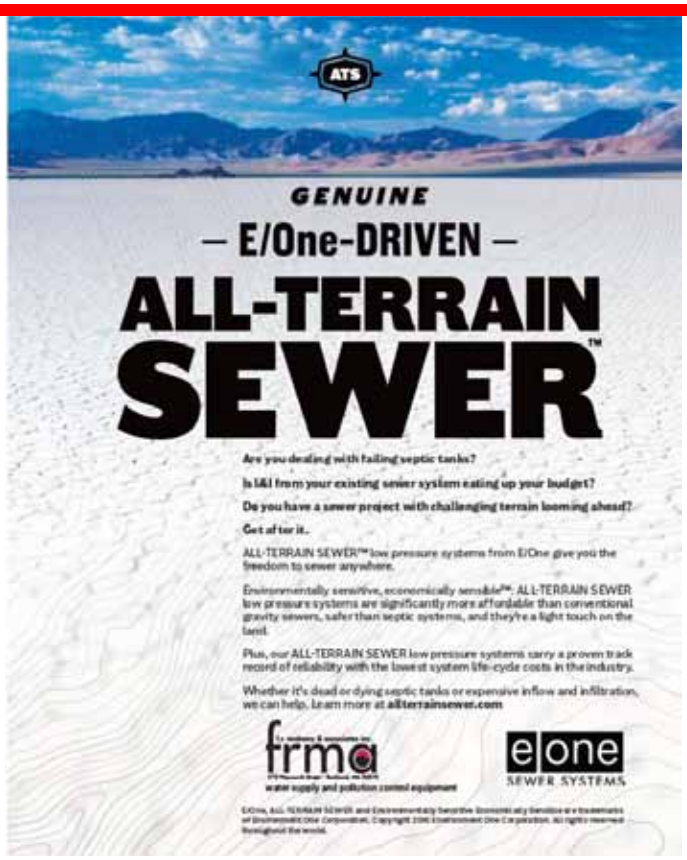
**Gender?** _____
**1** Female **2** Male

**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.

***NEWEA is a member association of WEF (Water Environment Federation). By joining NEWEA, you also become a member of WEF.**




frma www.amphidrome.com

Advanced Treatment Solutions

## Low TN Limit Imposes Technical Challenge on MA On-Site Wastewater Solution

Mashpee , Massachusetts

Stantec Engineers designed an Amphidrome® system with stringent TN limits for Epoch Assisted Living

< 2 mg/L TN has been attained since the fall of 2015.

### 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 |


People are choosing the TITAN® channel grinder because of its effective, streamlined design.
To learn more about this and all our unique grinding, screening, septage receiving and washing technologies, contact us today.

1-800-932-0599
www.franklinmiller.com

Franklin Miller Since 1918
Celebrating 100 Years!


WATER TECHNOLOGIES

Providence, RI helps protect the water quality in the Narragansett Bay using the AnoxKaldnes™ IFAS process, designed to remove more than 2.5 tons of nitrogen per day.

- Retrofit meets seasonal TN of <5 mg/L
- No additional tankage required
- 77 MGD four stage IFAS process

usmunicipal@veolia.com
www.veoliawatertech.com

Resourcing the world

VEOLIA

Represented in New England by:

*Please visit our WEB SITE!*
**www.frmahony.com**

f.r. mahony & associates inc.
frma
273 Weymouth Street • Rockland MA 02370

**Contact ED QUANN c.781.820.6268**
edquann@frmahony.com
t.781.982.9300 f.781.982.1056

*Call or email for more information.*

Stantec

# Our engineers solve today's problems and maintain a sharp eye toward the future

Design with community in mind
stantec.com/water