JOURNAL

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VOLUME 57 NUMBER 3 / ISSN 1077-3002 **FALL 2023**

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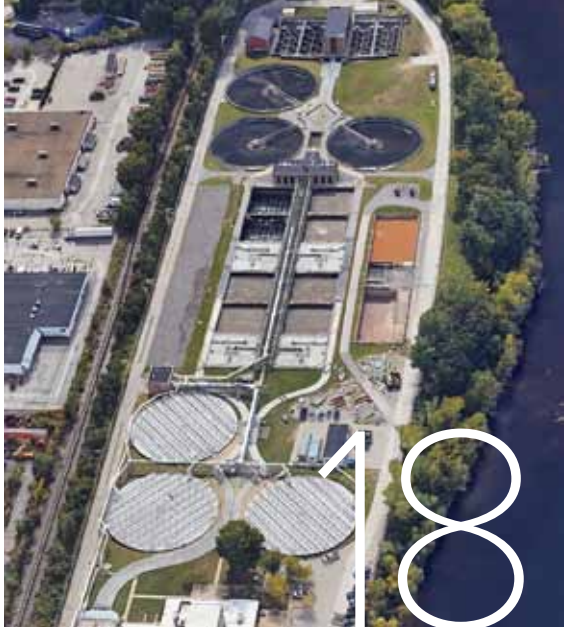

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NEWEA
WORKING FOR WATER QUALITY

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

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

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

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

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

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

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

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2023 RATES ($)

Professional	215
Executive	385
Corporate	446
Regulatory	50
Academic	215
Young Professional	88
PWO	127
Dual	50
Student	27.50

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President's Message

Why follow NEWEA and why read this article? One probable answer is that you read the *Journal* to access articles on current events, technological advancements, and industry trends, and that you participate in NEWEA, as I always have, for the opportunities to attend conferences and other events to share in the cutting-edge and innovative training and networking.

NEWEA was founded on the principles of sharing best practices, technical advances, and camaraderie across the wide range of practices in our industry. But the reason you are reading my message, focused again on One Water, is more elusive. While the message is not "cutting-edge," since more collaboration in our industry has always made sense, my aim is to highlight reasons to continue to beat the drum toward more unity in pursuing abundantly available, clean water.

The more interactions I have with NEWEA committees and staff, the more honored I am to be the NEWEA president. The expertise is stunning from the over 2,100 highly qualified and motivated water and wastewater professionals throughout New England, many of whom volunteer their time, energy, and expertise to preserve, protect, and manage our precious water environment. I re-emphasize the word "volunteer." We all are busy, and the last thing any of us needs is uncompensated additional work. Why do NEWEA members volunteer? Because they know the importance of the mission to protect and advance public health and the environment, both now and for future generations, as have all in the NEWEA membership since 1929. They also volunteer because, although it can be additional work, NEWEA involvement can also be fun—as I will illustrate later.

As discussed in my previous messages, the theme of my presidency emphasizes One Water. The concept is not new, but steady progress takes time and encouragement as we continue toward greater collaboration and integration in the water industries. We continue to trumpet this effort because One Water makes sense logically and economically. The progress seems to accelerate more rapidly in some areas but more slowly in others; still, the occasional "one step back" is often followed by "two steps forward."

In all fields of work, differences among organizations and expectations create challenges to implementing collaborative concepts like One Water across geographical and professional silos. In my own past attempts at fostering collaboration among parallel organizations and individuals (including my earlier frustrated attempts to coordinate state and federal river monitoring in California and my ongoing mixed success at encouraging "One Team" cooperation among competing ski athletes) I have found it most productive to emphasize common goals rather than disparities, and to promote whatever successes have been accomplished. Thus, I will focus here on what is working in advancing the One Water concept and emphasize potential common goals toward future progress.

What works? In my years as chair of NEWEA and GMWEA Government Affairs committees, I have often interacted with legislators. Although the interactions have been informative for the legislators, and though we express our broad concerns, the legislators often seek specific information to understand clear reasons to "vote for bill X" or "support that proposed policy" so they can make an informed decision on how to act in a way that will benefit their constituencies. With this understanding, our collaborative efforts at governmental participation are working, and NEWEA and New England Water Works Association (NEWWA) have agreed to joint meetings in Washington, D.C., during Water Week 2024 with all six New England state congressional delegations.

Among successful One Water committee efforts, the Workforce Development Steering Committee, with Work for Water–New England, is an emerging model. This consortium has met with successful career development organizations from California to Georgia to learn how successful training, recruitment, and workforce development programs are working in other areas. The committee is collaborating with state employment divisions, veterans' organizations, and others, and is using $40,000 of seed money, received from 13 New England water organizations, to hire a consultant and move the effort forward. NEWEA is managing this program that shows how we can do far more by collaborating rather than by competing.

Other blossoming endeavors include the following:

- NEWEA and NEWWA are holding a joint Information Technology & Asset Management Fair on November 8, in Holliston, Massachusetts
- New England Stormwater Collaborative (nestormwater.org), a long-term collaborative success with membership from NEWEA, NEWWA, and the American Public Works Association New England Chapter, has led a successful and popular program for 10 years
- A joint NEWEA and New York Water Environment Association (NYWEA) Risk and Resiliency Conference and Exhibit is scheduled for October 24–25, in Stamford, Connecticut
- The Northeast Residuals and Biosolids Conference and Exhibit, a decades-old collaboration with North East Biosolids and Residuals Association (NEBRA), will be held November 1–2, in Portsmouth, New Hampshire
- Following the 2020 merger between NEWEA and the Northeast Water Innovation Network (NEWIN), the resulting Innovation Council within NEWEA has been championing water industry innovation awareness across the region through further development of the New England water cluster

More examples of One Water success include the success of GMWEA as a joint Clean Water and Drinking Water association since 1994; successful joint events in Maine among the Maine Water Environment Association, Maine Water Utilities Association, the Portland Water District, Maine Rural Water Association, and others; and a newly launched NEWEA Regulators Ad-hoc Committee to foster One Water cooperation among the six states that is being led by John Adie from the New Hampshire Department of Environmental Services.

This year's climatic eruptions remind us that collaborating is logical, especially in response to emergencies, such as devastating storms that appear to be increasing in frequency and intensity. Agencies such as the Water/Wastewater Agency Response Networks (WARNS) are a good example of how One Water can work. In Vermont, we are suffering from devastating summer floods. As of this writing, four of the state's 94 clean water facilities are out of service, and the effects have also been severe among the drinking water systems. Many others have been impacted, including the countless residents with private wells and septic systems in the state. In one critical instance, the Vermont WARN proved effective in a multi-agency effort to help the Ludlow facility secure 300 ft (90 m) of replacement influent pipe that had been swept away by flood waters. Through Vermont WARN and NEWEA connections, the pipe was delivered within two days rather than the much-longer predicted lead time.

The more interactions I have with NEWEA committees and staff, the more honored I am to be the NEWEA president

Solving the Ludlow pipe crisis is one example of the advantages of NEWEA membership, among many others. Other benefits include a wealth of opportunities for sharing best practices, learning of technical advances, and, especially, experiencing camaraderie. Having personally met countless outstanding colleagues through NEWEA, I have continually learned a lot technically, but I have also had a lot of fun and met many lifelong friends who share this field of interest. The joint NYWEA/NEWEA Spring Meeting in June is a great example. The Operations Challenge event displayed top-notch skills, but even more impressive was the outstanding camaraderie among the competing teams. I had not previously met NYWEA President Donna Grudier, but together we worked hard during the conference, as we both made many new contacts and friends among regional vendors, operators, and engineers. Later in the evenings though, when my new friend for life Donna and I greeted everyone together at the Young Professional and other events, we had the most fun, intermingling with that amazing crowd of caring and warm-hearted professionals. My point here is that while NEWEA involvement encourages us to achieve excellence, it also offers myriad opportunities for fun.

Please enjoy reading this issue of the *Journal* from leading experts who make NEWEA a successful organization. I thank you for being a part of the excellence that is NEWEA!

From the Editor

Microbes are the coolest. While the pathogenic species often give them a bad rap, these troublesome* species account for much less than 1 percent of the total number of microbial species on the planet.[1] Meanwhile, the remaining 99 percent are invisibly and silently cycling oxygen into the atmosphere, turning over the soil to help plants grow, digesting the food in our stomachs, and—in the spirit of this edition of the *Journal*—cycling nutrients in our wastewater treatment plants and stormwater structural best management practices (BMPs). So, we can all thank (or curse?) our tiny little helpers when we meet (or just fall short of …?) National Pollutant Discharge Elimination System (NPDES) permit requirements.

Jennifer Lawrence, PhD, PE
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In this edition of the *Journal*, our four feature articles highlight the power of nutrient cycling microbes. The first article, by Bryanna Denis, Jeffrey Pinnette, Frederick McNeill, and Robert Robinson, details Manchester, New Hampshire's comprehensive approach (spanning 12 years and costing $47.4 million dollars) to comply with phosphorus discharge limitations. The endeavor leveraged operators' familiarity with existing operations to successfully navigate the complexities of microbially-driven phosphorus uptake and re-release. The next article, by Christopher Pierce and W. Douglas Hankins, describes Stamford, Connecticut's journey to reduce effluent nitrogen by improving conditions for denitrification, and also minimize chemical and energy costs along the way. The third article, by Larry Morris, Soichiro Yatsugi, and Hiroki Itokawa, takes an innovative look at the combination of activated sludge and membrane bioreactors to maximize nitrogen removal while simultaneously minimizing operating expenses.

Phosphorus- and nitrogen-cycling microbes can be challenging to control at the water reclamation facility, and perhaps even more so in their natural environments. Increased emphasis on programs (including structural BMPs) to reduce non-point source water pollution is critical to the United States' goal of restoring and maintaining the physical, chemical, and biological integrity of its waters. The recent extremes of heat, drought, and increased precipitation in our region are having complex consequences on our environment and the microbes that inhabit it. Warmer temperatures in particular allow many microbes to work at faster rates, sometimes with negative consequences for the growth of algae, etc. But, if we can understand and harvest the power of these microbes in their natural habitats, we can do wonders with our stormwater structural BMPs. Our final article, by Zach Henderson, Kate Edwards, Natalie Pommersheim, Lauren Caputo, and James Houle, builds upon NEWEA's recent Stormwater Control Workshop, and discusses innovative strategies to remove nitrogen from stormwater.

The Public Awareness Committee and Young Professional (YP) spotlights also highlight how all-encompassing nutrient control is for our industry. Flip towards the end of the *Journal* to read about the Public Awareness Committee's wonderful work communicating the importance (and expense!) associated with nutrient control. Check out the YP spotlight as well; YP Thomas Waterfield has been sampling for cyanobacteria in Massachusetts and he shares his his take on nutrient control in New England. Just like Tom, I can attribute at least part of my origin story to a prominent TV figure. Mine was Scully from the "The X-Files." (Hopefully I'm not alone on this one—the Scully effect is a real phenomenon. Women who regularly tuned in to "The X-Files" were 50 percent more likely to have worked in a science, technology, engineering, and math [STEM] field.[2]) Read Tom's piece to learn about his TV influence!

As always, I hope you enjoy this edition of the Journal. And, if you ever want to learn more about how cool microbes are, just ask me next time we cross paths!

*I do want to acknowledge that pathogens are no joke. Worldwide, 16 million people die from infectious disease every year, and many more are living with debilitating viral and bacterial infections.

1. Nat Rev Microbiol 9, 628 (2011). https://doi.org/10.1038/nrmicro2644.
2. The Scully Effect. https://seejane.org/wp-content/uploads/x-files-scully-effect-report-geena-davis-institute.pdf.

Industry News

The Massachusetts Water Resources Authority Deer Island Treatment Plant, Boston Harbor

EPA proposes updated protection for Boston coastal waters in new draft permit

On May 31, 2023, EPA issued an updated draft permit under the Clean Water Act for the Massachusetts Water Resources Authority (MWRA) Deer Island Treatment Plant and several effluent outfalls associated with the system. The draft permit includes provisions to address climate impacts and lingering combined sewer overflows (CSOs).

The proposed permit would significantly update protections for Boston Harbor and Massachusetts Bay by bringing water quality protections in line with other more recent permits, including adding as co-permittees the 43 communities whose wastewater flows to the Deer Island facility for treatment before being discharged into Massachusetts Bay. EPA received public comment on the Draft Permit through July 31, 2023. The Deer Island Treatment Plant provides secondary treatment to wastewater from 43 cities and towns in the greater Boston area.

"This proposed clean water permit is an important milestone for updating protections for Boston Harbor and Massachusetts Bay, continuing efforts begun in the 1980s when those waters were heavily polluted," said EPA New England Regional Administrator David W. Cash. "The proposed updated permit reflects a common-sense application of science and policy to ensure that all communities sending wastewater to Deer Island for treatment will be responsible for taking action to correct any problems within their wastewater collection systems. The draft permit also helps to address the environmental impacts facing communities with environmental justice concerns by providing cleaner water and better protected coastal resources for all to enjoy. Finally, the proposed permit addresses the climate crisis by requiring MWRA and member communities to assess the vulnerability of their assets to future severe weather threats."

The draft permit, once finalized, will replace the previous permit in effect since 2000. The proposed updated permit makes important updates in keeping with other National Pollutant Discharge Elimination System (NPDES) permits issued by EPA in New England communities. New provisions in the permit include the following:

- **Co-Permittees**. The 43 communities that contribute wastewater to the treatment system will now be co-permittees along with MWRA. This approach ensures that all communities understand their obligations and are accountable under the Clean Water Act (CWA) for maintaining their wastewater collection systems. Other NPDES permits issued by EPA since 2000 have made contributing communities co-permittees. This is especially important to address the concerns of neighborhoods that have been historically overburdened with environmental contamination due to inadequate maintenance and capacity of their collection systems.
- **Emerging Contaminants**. The permit includes new monitoring and reporting requirements for per-and polyfluoroalkyl substances (PFAS) that will help EPA and other public health organizations understand these chemicals and employ effective strategies to protect public health from potentially hazardous exposure to this chemical family.
- **Climate Change**. The permit includes new provisions to address the threats of climate change by requiring MWRA and the member communities to assess the vulnerability of their assets to future severe weather threats.
- **CSOs**. The permit continues to include provisions to regulate CSOs, including a requirement that any discharges from such overflows must not contribute to the exceedance of water quality standards. The 2023 Draft Permit also incorporates CSO requirements for the four satellite collection systems (Boston, Cambridge, Chelsea, and Somerville) that were previously in separate permits.
- **Former Nearshore Outfalls Closed**. The permit also stipulates that MWRA's five nearshore effluent outfalls will no longer be authorized under the permit as they are no longer a necessary contingency option, due to the proven reliability of MWRA's offshore outfall in Massachusetts Bay.

To better protect environmental and public health, the draft permit also includes updated requirements for effluent limits based on new Massachusetts Water Quality Standards and/or new data; effluent monitoring requirements for Deer Island discharges for a wide range of pollutants; ambient water quality monitoring in Massachusetts and Cape Cod bays; implementation of an industrial pretreatment program to control the discharge of pollution into the MWRA sewer system; and updated operation and maintenance requirements, consistent with state regulations, to ensure that sewer system infrastructure, such as sewer pipes, pump stations, and the treatment facilities are properly operated and maintained, and are resilient. These include contingency measures, such as maintaining alternative power systems in case of power outages, preventing groundwater and rainwater from entering the sewer system, and evaluating and implementing measures to maintain system operation during major storm and flood events. These provisions are also essential to the readiness to address climate impacts on this infrastructure.

The permit is part of a broader effort to address issues that have plagued Boston Harbor and builds upon other recent efforts, including EPA's decision last fall to use its residual designation authority to regulate stormwater. The residual designation addresses non-point sources of nutrients from stormwater, in addition to the current regulation of a point source discharge of millions of gallons of municipal wastewater, further reducing nutrient pollution to the harbor.

Note: All EPA industry news provided by EPA Press Office

Massachusetts Clean Water Trust approves over $35 million in new loans and grants

Source: Office of State Treasurer and Receiver General Deborah B. Goldberg—The Massachusetts Clean Water Trust

The Massachusetts Clean Water Trust's (the Trust) Board of Trustees approved $35,595,331 in new low-interest loans and grants at its meeting on August 2, 2023. The Trust, in collaboration with the Massachusetts Department of Environmental Protection (MassDEP), helps communities build or replace water infrastructure that enhances ground and surface water resources, ensures the safety of drinking water, protects public health, and develops resilient communities. It accomplishes these objectives by providing low-interest loans and grants to cities, towns, and water utilities through Massachusetts State Revolving Funds (SRFs).

Loans released include $22,328,800 for clean water projects in Northampton and Acton; $11,806,279 for drinking water projects in Andover, Boston, and Norwell; $1,454,252 for lead service line planning in Attleboro, Burlington, Concord, Gloucester, Great Barrington, Huntington, Millis, Pembroke, and Upton; and $6,000 for school water improvements in two school districts in Brighton and Brookline.

For more information on these and other loan programs, visit mass.gov/programs. To learn about past meeings or find project descriptions, visit mass.gov/service-details/2023-board-of-trustees-meeting-information.

Aquapalooza forced preemptive closure of Prudence Island shellfishing area

Source: Rhode Island Department of Environmental Management (RIDEM)

On July 27, 2023, RIDEM announced that the risk of accidental and illicit discharge of sewage expected to be associated with the gathering of hundreds of boats off Prudence Island on July 29 was forcing RIDEM to preemptively close 700 acres (283 ha) of shellfish grounds on the north end of the island. The closure was in effect from sunrise on July 29 until sunrise on Aug. 5, and extended from the shoreline and all waters south and west of a line from Providence Point to the northwest extension of Warner Avenue on Prudence Island.

Aquapalooza necessitated a harvest area shellfish closure

The so-called Aquapalooza gathering—an unauthorized, social media-driven event whose organizers remain anonymous, and which was purposely scheduled on the summer's busiest day on Narragansett Bay—necessitated the precautionary closure. The event drew more than 1,000 boats and personal watercraft. With so many boats concentrated in such a small area for hours, federal and state public health guidance required that the shellfish harvest area, which includes all of Potter's Cove, be closed to protect public health.

Although most recreational boaters follow Rhode Island's "No Discharge" law, a high concentration of vessels increases the chances of accidental or illicit discharge of sewage into shellfish waters. The week-long closure provided enough water and time to dilute inadvertently discharged sewage before the area was reopened to shellfishing.

There are 15 pump-out boats and 59 marine pump-out facilities across Narragansett Bay and coastal waters. However, these facilities are not routinely in operation along the undeveloped north shore of Prudence Island. Around 40,000 boats are registered in Rhode Island, and the state welcomes many thousands more visiting boats each year. In 2022, over 600,000 gallons (2,270 m^3) of sewage was pumped out at those facilities and diverted from directly entering Rhode Island's surface waters. Visit RIDEM's website for a map of marine pump-out facilities in Rhode Island.

Closing shellfishing areas when warranted protects public health by ensuring that only quality, safe shellfish is harvested and enters the food system. RIDEM, the Rhode Island Department of Health, and the Rhode Island Coastal Resources Management Council, along with industry partners, collaborate to ensure that shellfish grown and harvested from Rhode Island waters continues to be a quality safe seafood product. This is achieved by diligent monitoring of shellfish harvesting waters. Such monitoring enables a quick response, including shellfish closures, when conditions indicate a change in water quality due to natural events such as algae blooms or unusual events.

For more information on the shellfish harvesting classifications, review the annual notice available at dem.ri.gov/shellfish. An interactive shellfishing map is also available.

For information on emergency and conditional area water quality-related shellfish closures, call RIDEM's 24-hour shell fishing hotline at 401-222-2900, visit dem.ri.gov/shellfish, or sign up for the Office of Water Resources' listserv: RishellfishOWR-subscribe@listserve.ri.gov.

2022 River Report Cards

Source: Julia Hopkins, Charles River Watershed Association

On August 3, 2023, the EPA joined U.S. Senator Ed Markey, Charles River Watershed Association, Mystic River Watershed Association, Neponset River Watershed Association, state and local leaders, and community partners to announce the 2022 Water Quality Report Card grades for the three rivers that flow into Boston Harbor: Neponset, Charles, and Mystic.

The 2022 Report Card grades, which range from A to F, show vast improvements in the recreational health of the Charles, Mystic, and Neponset compared to prior decades, yet illuminate how the weather extremes of drought, heat, and increased precipitation affect river health, safe recreation, and enjoyment of these rivers, when residents rely on them most.

"From historic drought to record-breaking floods, communities across greater Boston are bearing witness to the climate crisis each and every season," said Senator Markey. "I am grateful for the leadership of the EPA and Charles River, Mystic River, and Neponset River watershed associations and their commitment to working alongside state, local, and federal partners to act in the face of this crisis. Together, we have made critical progress by doing our part to remediate environmental injustice and clean up these treasured urban rivers. I look forward to the day when every resident of greater Boston has access to an A+ river or stream in their community."

Background On EPA Report Card Grades

Since 1995, EPA has issued the annual Charles River Report Card to report the recreational health of the river and educate the public on challenges to water quality. Since 2006 and 2021, respectively, EPA has issued Report Card grades for the Mystic River and Neponset River. Beginning in 2021, grades for the Charles, Mystic, and Neponset have been reported together at a joint announcement with state and local partners.

The Report Card grades are based on the percentage of time *E. coli* bacteria concentrations are safe for recreation and weighted according to a three-year average of precipitation data. Additionally, in the Charles River, grades account for the presence of cyanobacteria blooms and CSO discharges—two additional threats to public health. These grades exclusively report recreational health; for a full picture of river health, a myriad of factors must be considered, like nutrient pollution, biodiversity of aquatic life, river flow, temperature, and more.

Community-driven Science

Each year, the Charles River, Mystic River, and Neponset River watershed associations rely on hundreds of community science volunteers to collect samples, which are sent for analysis to MWRA. Those results are reported to EPA and announced as letter grades to help the public better understand the recreational health of the three rivers that flow into Boston Harbor.

"Robust water quality monitoring is at the heart of MassDEP's efforts to maintain and restore Massachusetts waterways. The thousands of water samples taken in these rivers help identify pollution problems, inform cleanup efforts, and plan for the impacts of a changing climate," said MassDEP Commissioner Bonnie Heiple. "We are proud of our partnerships with the watershed associations in the Charles, Mystic, and Neponset rivers, and will continue to collaborate and invest in these important efforts to improve water quality."

"DCR is committed to ensuring all communities across Massachusetts have access to clean water for recreation, and to preserving our important natural resources like our riverways for generations to come," said Massachusetts Department of Conservation and Recreation Commissioner Brian Arrigo. "We look forward to continuing to work with our local, state, federal, and watershed association partners to improve water quality in these three urban rivers in the face of climate change-driven extreme weather, and to remedy longstanding injustices that have prevented lower income neighborhoods and communities of color from accessing our rivers."

Climate Change and Water Quality

Greater Boston and its three rivers are already seeing the effects of climate change. Just the last three years show oscillating weather extremes of drought in 2020, heavy rainfall in 2021, and severe drought again in 2022. Climate impacts—increased precipitation, drought, heat, and stronger storms—threaten to stall the progress made toward swimmable urban rivers.

Additionally, across the three watersheds, stark disparities exist. Low-income and language-isolated neighborhoods, and communities of color face disproportionate exposure to pollution, unequal access to the outdoors and green spaces, and outsized risk from impacts of extreme heat and flooding.

"It's great to be here again to celebrate the improvements we have all made in the water quality of these rivers, but challenges remain," said Fred Laskey, MWRA's executive director. "And the impact of climate change on the rivers is no longer a future threat—it's here now. We must continue to work together to find viable and affordable solutions."

Drought and Increased Precipitation

In 2022, the severe, prolonged drought significantly affected Massachusetts rivers. Such droughts have become a pattern. In 2016, Massachusetts experienced the most significant drought since the 1960s with record low surface and groundwater levels. Then, severe drought happened again in 2020 and 2022. Drought impacts not only water quality for recreation, leading to more concentrated bacterial pollution, but also has devastating consequences for the river ecosystem, wildlife, and all who depend on healthy rivers for drinking water, recreation, and enjoyment.

In the three highly urbanized watersheds, with over 80 percent impervious cover in some communities, the effects of heavier rainfall and extreme weather are enormous, and the consequences are stark, resulting in more stormwater pollution, CSOs, and flooding.

Stormwater pollution is one of the greatest threats to clean rivers. Rainstorms wash gasoline, trash, oil, pet waste, and more from our roads, parking lots, and roofs straight into storm drains, which carry this polluted runoff straight into rivers, untreated and containing excess nutrients that degrade the river ecosystem and cause rampant invasive species growth, toxic cyanobacteria blooms, and even fish kills. CSOs occur when heavy rain and intense storms cause outdated combined sewer systems in Boston, Chelsea, Somerville, and Cambridge to overflow into local waterways, exposing river users to bacteria, viruses, excess nutrients, pharmaceuticals, trash, and even PFAS.

Charles River Report Card Grades

In the Charles River, grades ranged from A's in the upper and middle watershed, B's in the headwaters and Lower Basin, and a C in the Muddy River, following trends observed across recent years. More urbanized, paved areas consistently see lower grades due to stormwater pollution while greener, more forested areas of the watershed are swimmable most days.

More urbanized, paved areas consistently see lower grades due to stormwater pollution while greener, more forested areas of the watershed are swimmable most days.

While the grades show vast improvements from 1995, progress has stalled. Increased precipitation, drought, and heat from climate change make CSOs, stormwater pollution, low water levels, and toxic cyanobacteria blooms routine, inhibiting safe recreation.

In the summer of 2021, with a record 35 in. (89 cm) of precipitation, 53 known CSO events occurred, and 126 MG (477 ML) of sewage and stormwater were discharged into the Charles River. Additionally, in 2022, severe drought caused several sections of the Charles to run nearly dry, with observed water levels under 0.5 ft (0.15 m) in Bellingham, Medfield, Needham, Newton, and Waltham.

Many areas saw grades decrease slightly in 2022: The upper watershed fell from a B+ in 2021 to a B; the upper middle watershed decreased from an A in 2021 to an A-; and similar trends were seen in the Stop River and Lower Basin. Some improvements were observed, as in the Muddy River which improved from a C- to a C in 2022. However, a C grade is still not acceptable, and the Muddy River remains the most polluted aboveground tributary within the Charles River watershed.

"While we've made such amazing progress since 1995, the work is not done until residents can experience the joy of swimming in cool, clean urban rivers on a hot day," said Emily Norton, executive director of the Charles River Watershed Association. "We have the solutions we need, the strong foundation of decades-long federal, state, and local partnership, and the passion and dedication for cleaner rivers; we just have to get to work, with urgency. We need rapid advancement of nature-based solutions—green infrastructure, land conservation, sewer system infrastructure improvements, and flood storage—especially in environmental justice areas, to build the future our communities deserve."

Mystic River Report Card Grades

In the Mystic River watershed, water quality remains consistent with previous years. Upper Mystic Lake continues to have high swimmability and the mainstem of the Mystic River has good water quality, but a number of tributaries—including Alewife Brook and the Malden River—continue to show poor grades due to evidence of sewage contamination especially, though not exclusively, in wet weather.

Several areas, including the Mystic mainstem and streams, show marginal declines in grades in this year's Report Card. This may reflect the impact of changing precipitation patterns where larger storms are more common, leading to more stormwater pollution.

The continued presence of CSOs in the Alewife, Mystic, and Charles represent an unfinished chapter in the huge success story that is the cleanup of Boston Harbor.

"In wet summers like the one we are currently experiencing, and most dramatically in 2021 when 14 in. (36 cm) of rain fell in July, CSO releases are a commonplace occurrence, routinely exposing river users to bacteria, trash, and more. There is stark evidence these impacts are not felt equally—reports show CSOs are more likely to occur near environmental justice communities, like Alewife Brook," said Patrick Herron, executive director of the Mystic River Watershed Association. "We understand that the elimination of remaining CSOs will be expensive—but we believe investment in public health and safety for all communities is worth it, given these discharges inhibit residents from fully enjoying vital greenspaces and riverways."

Neponset River Report Card Grades

In the Neponset River, as with the Charles and Mystic rivers, the grades are based on the percentage of time *E. coli* bacteria concentrations are safe for recreation, and then weighted based on precipitation data across a three-year average. Grades for the Neponset River are given to 26 segments, including 4 main reaches, 18 tributaries, and several ponds. In addition, *Enterococcus* data collected by MWRA is used to grade the Neponset estuary.

In the Neponset watershed, water quality remains good in the mainstem, receiving A's and B's, with three of four sections improving in 2022. Numerous lakes and ponds receive high marks for swimmability, with the highest grades in Turners Pond, Crackrock Pond, and Willett Pond.

However, many tributaries, especially those flowing through the cities and towns with the highest impervious surface area and populations, have seen water quality worsen in 2022, reflecting the impact of extreme weather such as drought and increased precipitation over the last three years.

"Polluted stormwater runoff from streets continues to be a huge problem, and we are working to educate residents and upgrade stormwater infrastructure systems to reduce pollution and prepare for climate change," said Ian Cooke, executive director of Neponset River Watershed Association. "We need to slow the flow of stormwater, replenish the groundwater, and return clean, filtered water to our rivers."

Manchester's holistic approach to phosphorus compliance

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ABSTRACT | Manchester, New Hampshire's wastewater treatment facility has proceeded with a two-phase approach to meeting an effluent phosphorus discharge limit. The first phase replaced failing aeration equipment with new, more efficient systems, provided greater operational flexibility and redundancy, increased the capacity of its secondary system and overall facility, and added a new process to achieve enhanced biological phosphorus removal (EBPR). The second phase will allow the city to meet the phosphorus limit by implementing separate waste activated sludge thickening followed by immediate dewatering to prevent phosphorus release within return flows. The reconfigured solids handling process will facilitate fermentation within the gravity thickeners to produce volatile fatty acids to further drive the EBPR process.

KEYWORDS | Manchester, enhanced biological phosphorus removal (EBPR), energy savings, thickening centrifuge, cake silo

In 2006 Manchester, New Hampshire, reassessed its wastewater and stormwater infrastructure to determine future goals and objectives. This reassessment was required to address more stringent regulatory requirements, aging and failing infrastructure, and climate change-induced weather events. The reassessment led to four master plan documents focused on the wastewater treatment facility (WWTF), combined sewer overflows (CSOs), pump stations, and collection system. These four documents provided a clear and cohesive vision with a defined roadmap that would lead the city's focus, efforts, and investments in its wastewater infrastructure for the next 20 years.

Two key planning documents were a 2010 WWTF Facility Plan and a Revised Long-Term CSO Control Plan. A driver from the WWTF Facility Plan was an anticipated discharge phosphorus limit in a future National Pollutant Discharge Elimination System (NPDES) permit. Another driver was from the CSO control plan, which identified the need to increase peak wet weather flow capacity at the WWTF to minimize CSO discharges. These two drivers have resulted in a 12-year, $47.4 million investment at Manchester's WWTF, including an aeration system upgrade from 2011 to 2015 and a solids handling train upgrade from 2018 to 2023. This article will review both projects that, together, will achieve Manchester's long-term goals established in the 2006 reassessment.

BACKGROUND

Manchester, New Hampshire, is the largest city in New England north of Boston with 115,000 residents, and its metropolitan area has grown and been revitalized in the past 30 years. The Manchester WWTF was constructed in the 1970s in response to the Clean Water Act and went into operation in 1975 with a capacity of 26 mgd (98 ML/day). The WWTF was upgraded in 1993 and expanded to 34 mgd (129 ML/day). Presently, the WWTF treats flow from the communities of Manchester, Goffstown, Londonderry, and Bedford (total metro population of 172,000) and averages 17 to 26 mgd (64 to 98 ML/day) depending on long-term precipitation. The city's 385 mi (620 km) collection system includes about 55 percent combined sewers, resulting in high wet weather flows.

Before the aeration system upgrade, the WWTF's aeration basins consisted of two parallel trains of six tanks in series. The activated sludge system was aerated via 12 two-speed mechanical surface aerators. Many of the aerators were over 40 years old, unreliable, and consistently in need of maintenance and repair.

The WWTF's peak capacity was 65 mgd (246 ML/day). This flow was processed by directing a peak hourly flow of 35 mgd (132 ML/day) through the secondary system, and the remainder through a secondary bypass system. From 2008 to 2011, the facility provided secondary treatment to 89 percent of the influent flow. The facility previously used one of its four primary effluent channels to direct secondary bypass flow to the bypass structure. During extended high flow events when secondary bypass flows exceeded 35 mgd (132 ML/day), this system's hydraulic limitations caused flow to back up to the primary clarifiers, resulting in flooding of the scum troughs and effluent weirs. This was a key limitation to handling high peak flows.

The aeration system upgrade design began in 2011 and had the following goals:

- Replace the aged and failing aeration system with a new, more energy-efficient system
- Provide greater operational flexibility and redundancy for the activated sludge process
- Increase secondary system and overall plant capacity
- Provide enhanced biological phosphorus removal (EBPR) as a first step toward addressing a phosphorus limit

Process modeling indicated that the EBPR level would not meet the pending effluent phosphorus permit limit under all conditions due to a combination of high phosphorus loads from the return flows and low volatile fatty acids (VFAs) in the secondary influent. The phosphorus loads in the return flows were from the gravity thickeners used to co-thicken primary and secondary solids. Fermentation in the primary clarifiers to increase VFAs was not desired because of the potential solids loss when the secondary bypass would activate. Additional modifications would be needed, including chemical addition and/or eliminating co-thickening of primary and secondary sludges.

The city decided to implement a solids train upgrade that eliminated co-thickening. While additional goals were achieved by the solids train upgrade, the main objective was to improve phosphorus removal to comply with an effluent phosphorus limit. When the design phase of the solids train upgrade began in 2018, a separate waste activated sludge (WAS) thickening operation, using either rotary drum thickeners or gravity belt thickeners, could have been implemented. However, a new generation of thickening centrifuge was included in the alternative evaluation and was the most advantageous based on life cycle costs. The WWTF already had dewatering centrifuges and was comfortable with the operation and maintenance considerations. The solids train upgrade is now in the start-up phase.

Photo 1
Manchester WWTF

AERATION SYSTEM UPGRADE

The $22.4-million aeration system upgrade was completed in 2015. The improvements included a new activated sludge process; aeration tank configuration; aeration system and ancillary equipment; a dedicated secondary bypass structure; a major electrical upgrade including transformers, switchgear, and motor control centers (MCCs); and instrumentation. Photo 1 shows an aerial view of the WWTF after completion of the upgrade. The performance has met and sometimes exceeded expectations. Following is a summary of the aeration system upgrade.

Figure 1A. Old configuration: two trains of six tanks each

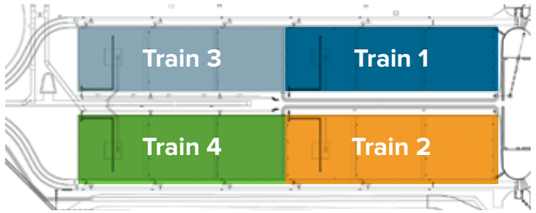

Figure 1B. New configuration: four trains of three tanks each

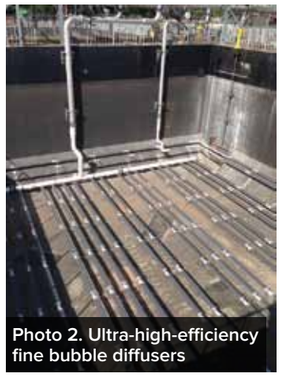

Photo 2. Ultra-high-efficiency fine bubble diffusers

Photo 3. Integrally geared aeration blowers

Increased Operational Flexibilty and Redundancy

Manchester's old aeration process is shown in Figure 1A. Typically, the facility operated with one of the two trains of six tanks in series online. To increase process redundancy and operational flexibility, both trains were divided into two trains to make four trains of three tanks in series as shown in Figure 1B.

The new tank configuration included the following:

- New secondary bypass structure
- Four new Palmer-Bowlus flumes in the aeration influent channels to induce head loss and split flow equally.
- Three tanks in series for each train with one anoxic selector tank and two aerated contact tanks
- Two new aeration effluent troughs
- 13 percent increased working capacity in the aeration basins by raising outlet weirs about 2 ft (0.6 m)
- Automated return activated sludge (RAS) flow-splitting with new pinch valves and splitter manifold that allows RAS from any of the three secondary clarifiers to flow to any aeration train

The new tank configuration increased redundancy by allowing the WWTF to operate with two, three, or four trains online and the flexibility to reduce the volume of offline train tankage to 25 percent of the total.

Ultra-high-efficiency Aeration System

The city selected a fine-bubble diffused aeration system using energy-efficient equipment. The new diffusers are the ultra-high-efficiency, urethane membrane, small panel-type shown in Photo 2 and are fed by the integrally geared, single-stage, centrifugal-type aeration blowers shown in Photo 3. The four 300 hp (224 kW) blowers are housed in a new 4,300 ft² (400 m²) blower building.

Dissolved oxygen (DO) control allows automated aeration adjustments when loadings to the secondary system fluctuate, to prevent under- or over-aerating. The new aeration system was calculated to reduce aeration energy usage by about 48 percent. Figure 2 shows the long-term reduction in electrical power use at the WWTF.

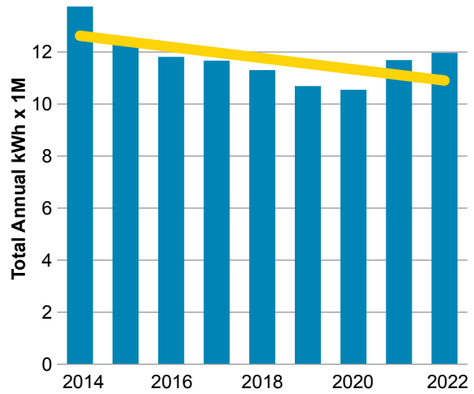

Figure 2. Total annual electric energy use at Manchester WWTF

Upgraded Activated Sludge Process

The old system provided biological treatment via a conventional activated sludge process to remove biochemical oxygen demand (BOD). The new aeration tank includes a three-stage anaerobic selector and a separate RAS denitrifying zone, as shown in Figure 3 (next page). These zones were incorporated into the first tank of each train. The anaerobic selector enhances sludge settleability, which increases secondary clarify capacity and facility EBPR.

The RAS anoxic zone helps drive EBPR by removing nitrates that would otherwise consume the VFAs essential to EBPR. The RAS denitrifying zone (anoxic zone) and each stage of the anaerobic selector are mixed with separate hyperbolic mixers. Oxidation-reduction potential (ORP) monitoring is provided in this zone with feedback to the facility supervisory control and data acquisition system to enable monitoring of RAS conditions.

The upgrade increased peak secondary system capacity to 42 mgd (159 ML/day), allowing 97 percent of influent flow to receive secondary treatment (previously 89 percent). The new secondary bypass

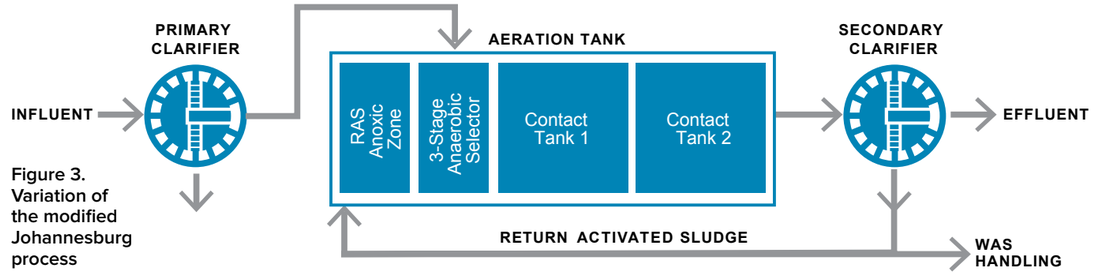

Figure 3. Variation of the modified Johannesburg process

eliminated bottlenecks to higher overall peak flows, and the facility handles peak flows up to 72 mgd (273 ML/day). As shown in Table 1, the facility has a history of excellent treatment performance, with single-digit final effluent results for both total suspended solids (TSS) and carbonaceous BOD (cBOD) before and after the aeration system upgrade.

The updated NPDES permit included a seasonal mass-based limit of 236 lb/day (107 kg/day) for total phosphorus (approximately 0.9 mg/L at permitted flow) in the plant effluent. As noted, process modeling indicated that EBPR alone would not consistently achieve the new seasonal total phosphorus (TP) limit of 236 lb/day (107 kg/day). The BOD:TP ratio in the secondary influent varies, but 15:1 is typical with the current solids handling system. This is lower than the desired range of 30:1 to 40:1 for EBPR to produce the desired effluent levels.

Figure 4 shows the monthly average effluent phosphorus results from April 2020 through May 2023; they are typical of the upgraded system and illustrate that the monthly effluent phosphorus limit is not consistently achieved. This was only the first step, however, in achieving the city's long-term goal of NPDES permit compliance via EBPR. A second project was required to achieve that goal, so in 2018 the city initiated the WWTF solids train upgrade project.

For more information about the aeration system upgrade, see the *NEWEA Journal* Summer 2017 issue article, "Manchester, New Hampshire retools it aeration system for the next generation."

Table 1. Average TSS and cBOD performance (mg/L)

	Before Upgrade 2012		Post Upgrade 2016–2022	
	TSS	cBOD	TSS	cBOD
Raw influent	143	111	185	125
Final effluent	5.2	5.0	8.1	6.1
Percent removal	96.4%	95.5%	95.6%	95.0%

Solids Train Upgrade

The solids train upgrade aimed to reduce the phosphorus in the recycle flows to meet the NPDES effluent phosphorus limit with EBPR process treatment.

Manchester's Phosphorus Cycling

As shown in Figure 5 (next page), primary effluent and denitrified RAS enter the three-stage anaerobic selector that provides conditions for polyphosphate-accumulating organisms (PAOs) to grow, outcompeting other organisms and taking up phosphorus in the aerated zones, thereby accomplishing EBPR. PAOs in the mixed liquor are settled in the secondary clarifiers, with a portion wasted to the gravity

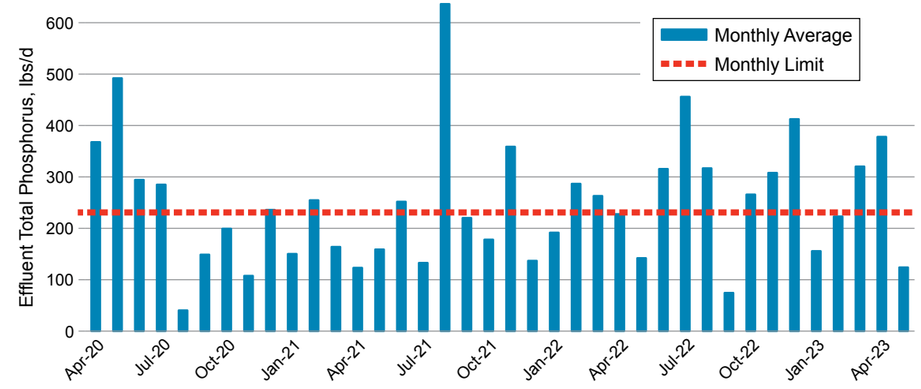

Figure 4. Total Phosphorus monthly average effluent—April 2020 through May 2023

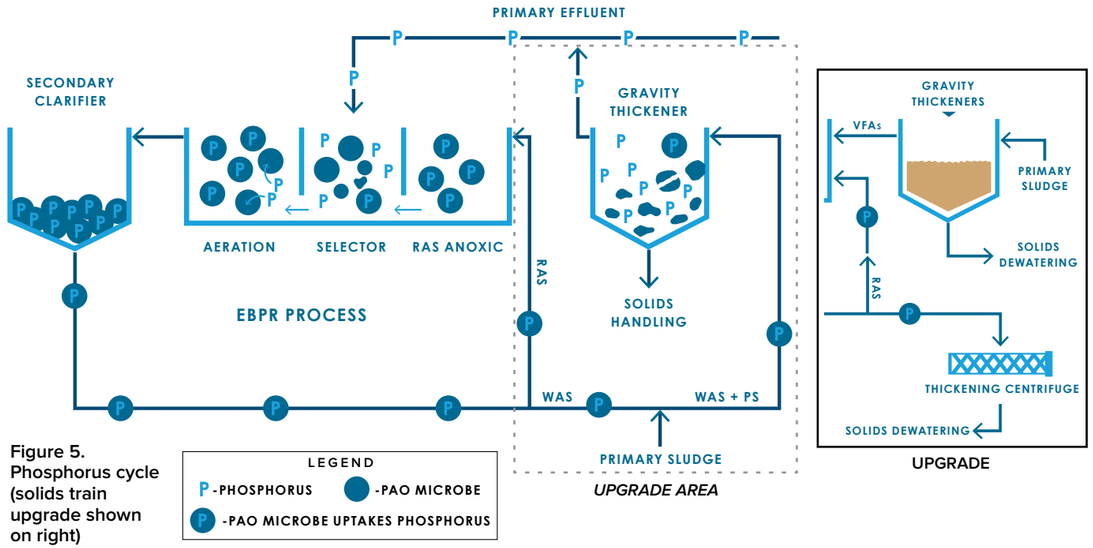

Figure 5. Phosphorus cycle (solids train upgrade shown on right)

thickeners and the rest recycled in the RAS. Primary and secondary sludge have been co-thickened and stored in gravity thickeners prior to dewatering and incineration. Manchester operates its dewatering and incineration process simultaneously, and the gravity thickeners provide sufficient storage to allow for up to three days in between dewatering and incineration runs. The co-thickening in the gravity thickeners results in anaerobic conditions that promote the release of phosphorus stored by the PAOs. This phosphorus cycles back through the gravity thickener overflow to the primary effluent and secondary influent. This capture–waste–release cycle has detrimentally affected the plant's ability to meet its effluent phosphorus limit of 236 lb/day (107 kg/day).

Figure 5 illustrates the revised configuration, currently in start-up mode, as part of the solids train upgrade. WAS will be thickened separately, followed immediately by dewatering and storage in a cake silo. WAS or thickened WAS (TWAS) will not be stored in liquid form to avoid conditions that could result in phosphorus release. Primary solids will continue to be thickened in the gravity thickeners. The ability to operate the gravity thickeners as fermenters to produce VFAs and direct the overflow to either the RAS anoxic zone or the primary effluent and secondary influent will help drive the EBPR process. This design allows for the phosphorus to stay bound in the sludge and in the dewatered cake, significantly lowering the amount of phosphorus in the recycle to the biological process and moving the BOD:TP ratio toward the desired range to meet effluent permit requirements.

Solids Handling Changes

The current solids handling process is illustrated in Figure 6. Primary sludge (PS) and WAS are wasted at constant rates, 24 hours per day, seven days per week (24/7). This combined sludge stream is pumped to the gravity thickeners, constantly building up the thickened sludge blanket level. When sufficient solids are available for an incineration run, co-thickened sludge is drawn from the gravity thickeners and pumped to the dewatering centrifuges (typically using two of the three units). The dewatered cake is conveyed via screws to the incinerator feed pumps, and then to the fluidized-bed incinerator (FBI) or, as a backup, to truck loading. When the blanket level in the gravity thickeners is drawn down completely, both dewatering and incineration are stopped, and co-thickened sludge begins to fill up the gravity thickeners again. This intermittent "batch" methodology allows for the most efficient operation of Manchester's FBI.

The new solids handling process is illustrated in Figure 7. Primary sludge and WAS will continue to be wasted 24/7 as before the upgrade. Instead of co-thickening, PS and WAS will be thickened separately, with PS pumped to the gravity thickeners and WAS directed to new thickening centrifuges. The thickened primary sludge (TPS) and TWAS will then be blended and directed to the dewatering centrifuges. Dewatered cake will be conveyed to a new cake storage silo for up to three days of storage. When sufficient sludge cake is available for an incineration run, it will be discharged from the silo and pumped to the FBI. The operational schedule of the FBI will be similar to the existing schedule, with approximately seven days online and three

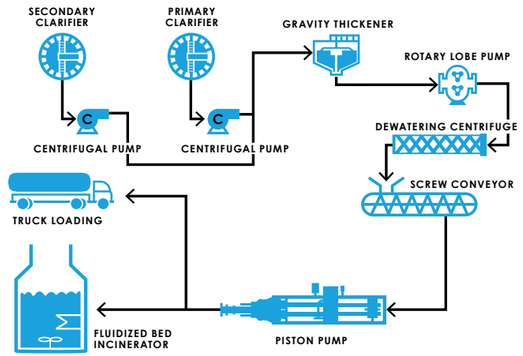

Figure 6. Solids train before upgrade

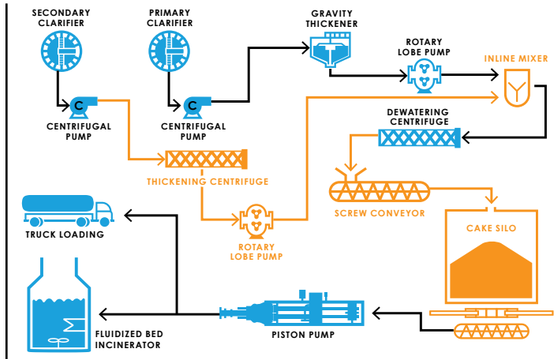

Figure 7. Solids train after upgrade

days offline, while PS and WAS sludge pumping, thickening, blending, and dewatering processes will be operating 24/7. This will prevent the PAOs in the WAS from releasing stored phosphorus, and thus will break the phosphorus cycle described above.

The main operational difference is that the upgrade decouples dewatering from incineration. When an incineration run commences, the silo sludge level will be drawn down at a faster rate than it is filling, until empty. After incineration, the silo will fill again over several days until the next incinerator run.

This operational change will also provide a more consistent feed to dewatering for more stable operation. With co-thickening, the thickened sludge is drawn down in the gravity thickeners over several days. At the start of each dewatering and incineration run, the higher thickened sludge blanket level yields a higher thickened sludge solids content, which gradually gets thinner as the blanket is drawn down. The resulting inconsistent feed to the dewatering process requires constant monitoring and tweaking of centrifuge operational parameters and polymer input. The new 24/7 operation will maintain a consistent blanket level in the gravity thickeners to provide a consistent TPS stream. Likewise, consistent TWAS solids content is anticipated from the 24/7 WAS thickening operation.

Solids capture is also anticipated to improve both thickening and dewatering compared to the co-thickening operation. Another benefit is to allow the gravity thickener to operate as a fermenter for VFAs and, as noted, to direct the VFA-laden gravity thickener overflow to the RAS anoxic zone or the secondary influent to optimize EBPR.

Thickening Centrifuge

After evaluating WAS thickening technologies that included a life cycle cost analysis as well as lab and pilot testing, the city sole-sourced a thickening centrifuge, as shown in Photo 4. While many WWTFs have used modified dewatering centrifuges at reduced flow rates for thickening, the chosen centrifuges are tailored for sludge thickening. The main differences for this type of thickening centrifuge are as follows:

- No cone, and increased cylinder length to allow for higher solids throughout
- Hydraulic solids baffle disc at the front end to separate solids from water
- Air injection to decrease the specific gravity of the solids

Photo 4. Thickening centrifuges in WAS thickening room

The thickening centrifuges are expected to use much less polymer than more conventional sludge thickening equipment like rotary drum or gravity belt thickeners, albeit with higher energy usage. Even considering the higher energy cost, however, the polymer cost savings resulted in the thickening centrifuge delivering the lowest life cycle cost. The reason is that the secondary system has a dilute mixed liquor, resulting in a WAS concentration of about 0.45 percent, which would require high polymer dosages for gravity belt and rotary drum thickeners. Maintenance of the thickening centrifuge is familiar to plant staff because it is similar to that of Manchester's dewatering centrifuges that have operated since the 2005 dewatering upgrade.

Table 2. Pilot testing data—dewatering centrifuge

Sample	Sludge Flow [gpm]	Polymer Type	Poly Use [lb/dry ton]	Bowl Speed	Solids Loading [lb/hr]	Cake Solids [TS]	Solids Recovery	Specific Power [kW/gpm]
19C	155	K144L	2.5	70%	396	4.4%	95.8%	0.081
22B	203	K144L	2.0	60%	497	3.9%	96.0%	0.055
22C	203	K144L	2.5	70%	468	4.0%	96.1%	0.074
22E	203	K144L	2.1	80%	480	4.2%	97.4%	0.098
22I	203	K279FLX	1.9	70%	478	3.8%	97.4%	0.072
23A	154	Mannich	3.5	70%	317	3.8%	95.2%	0.073
23D	153	Mannich	0.9	80%	365	4.0%	95.2%	0.105
23E	153	Mannich	1.5	80%	364	4.0%	97.2%	0.102

To confirm the thickening centrifuge manufacturer's performance claims, pilot testing was performed in Manchester in November 2018 to confirm polymer dosage and energy usage. Table 2 shows the highest solids capture results for the testing with polymer. From the pilot testing, staff established the following specified equipment performance:

- WAS feed at maximum monthly condition of 400 gpm (1,514 Lpm) at a concentration of 0.45 percent for total solids throughput of 850 lb/hr (386 kg/hr)
- TWAS output of 4.0 percent
- Polymer usage of 0 to 3 lb/ton dry solids (0 to 1.4 kg/tonne solids)
- 90 percent capture with no polymer and 95 percent capture with polymer

Under typical operating conditions, one thickening centrifuge will operate 24/7 and the TWAS will be fed to a single dewatering centrifuge. Each thickening centrifuge will discharge to a new rotary lobe TWAS pump with integral screw auger feed and a 450 gal (1,700 L) hopper to allow consistent feed to dewatering.

Thickened Sludge Blending

Inline mixers blend the TPS and TWAS streams for each of the three parallel sludge feed lines to dewatering. The mixers are shown in Photo 5 and feature an integral mixing chamber that uses an impeller to blend the sludge streams. This allows mixing to occur under the pressure from the TPS and TWAS pumps without an additional pumping step. Inline mixing minimizes the TWAS storage time and potential for phosphorus release. Gravity thickeners were renovated in 2020 and new thickened sludge (now TPS) pumps were supplied in a separate project.

Photo 5. Sludge mixers provide inline blending of TPS and TWAS

Solids Analyzers

Seven solids analyzing sensors provide real-time solids data for operational control. These analyzers will allow operations staff to monitor solids content of WAS feed, TWAS feed, and TPS feed. The TWAS and TPS sensors along with flow data can also calculate the solids concentration to dewatering for control of polymer dose and other operating parameters. Initially the sensors will be used for monitoring only, but they could also be used for process automation. Manchester pilot-tested solids sensors to find the most consistent and reliable instruments; a solids analyzer installation is shown in Photo 6.

Photo 6. Solids sensors provide real-time solids content of sludge feed lines

Cake Storage System

The new 225 yd³ (172 m³) cake storage silo has a 22 ft (6.7 m) diameter, 26 ft (7.9 m) high silo tank on supports, for an overall 46 ft (14 m) height; the silo will store dewatered cake for up to three days to allow the FBI to be fed at higher solids loading rates, improving operating efficiency over if they were fed continuously from the thickening process. The cake silo equipment includes the steel silo, a sliding-frame floor powered with hydraulic cylinders, and shafted extraction and transfer conveyors to transport stored cake to the facility's dewatered cake piston pump. The project included new screw conveyors to carry dewatered thickened sludge from the centrifuges to the new cake silo. Figure 8 shows the cake silo spanning all four levels of the Operation Building; the sliding frame live floor is depicted in Figure 9.

After evaluating alternatives, a sole-sourced manufacturer supplied the complete cake storage package. Manchester has used two hydraulic piston pumps from the same manufacturer to feed dewatered sludge cake to the FBI or sludge loading area since the 1990s. That experience was integral in choosing this same manufacturer's products for control of the cake silo discharge to the incinerator feed pumps.

The project renovated the former multiple hearth incinerator areas. The cake silo was located in the footprint of the eastern unit, and the silo diameter was sized to match the structural opening in the floors. The western incinerator opening was infilled

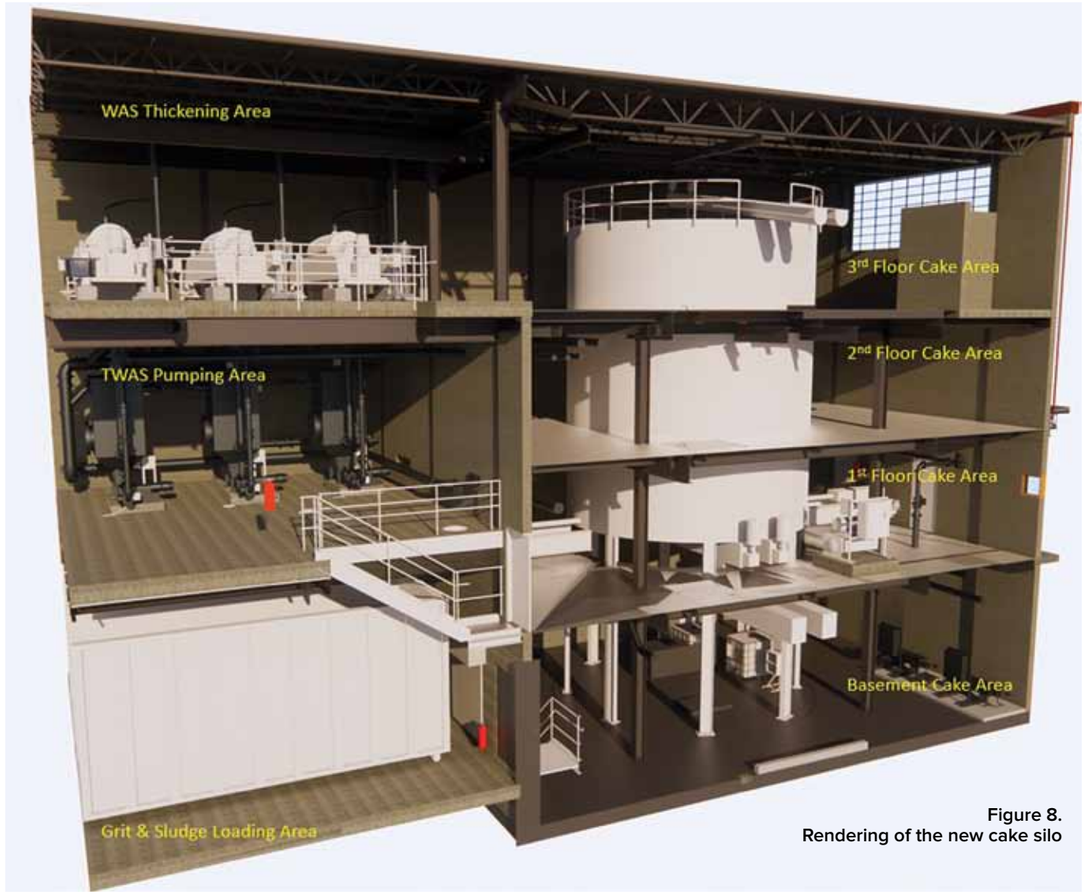

Figure 8.
Rendering of the new cake silo

to provide room for the new emulsion polymer facilities on the first floor, the inline mixer area on the second floor, and two trains of cake conveyors on the third floor. There were also two floors above the sludge loading area that were converted into the WAS thickening and TWAS pumping spaces.

Construction Progress Update

The solids train upgrade was bid in the fall of 2020 and awarded in January 2021 with a bid price of $20 million. As with many pandemic construction projects, the schedule has been a challenge due to supply chain issues and other factors. As of July 2023, the project is in the start-up phase of individual systems with full system start-up anticipated this fall.

Figure 9. Cake silo sliding frame live floor

CONCLUSION

The upgrade of Manchester WWTF's secondary system process and aeration system that was completed in 2015 increased secondary capacity and improved process efficiency, operating flexibility, and reliability. The new secondary process, with a RAS anoxic zone and anaerobic selector, has also promoted EBPR, but it was only the first step to meet permit compliance. The city has subsequently embarked on the second phase to reduce the amount of returned phosphorus by upgrading the solids handling train. This $20-million project is anticipated to come online this fall and will feature the following:

- New separate WAS thickening with purpose-designed centrifuges to eliminate the current co-thickening in the gravity thickener, reducing phosphorus levels in the thickening return flows, improving solids capture, and achieving more consistent dewatering feed characteristics. The thickening centrifuges for WAS thickening also promise lower polymer usage than other thickening methods for optimal solids capture.
- Immediate TWAS centrifuge dewatering to avoid storage under anaerobic conditions that promote phosphorus release from the PAOs. The TWAS will be blended in line with TPS and fed to the dewatering centrifuges.
- A 225 yd^3 (172 m^3) cake silo to allow up to three days of storage between incinerator runs and provide storage during periods when the FBI is down for maintenance, requiring truck hauling for off-site disposal.
- The ability to operate gravity thickeners in fermentation mode to produce VFAs to feed to the RAS anoxic zone or selector inlet will further help to drive the EBPR process.

In 2006, Manchester reassessed its wastewater and stormwater environmental infrastructure needs to determine future goals and objectives. Through two master plans it invested in its environmental infrastructure efficiently and effectively. This resulted in two major WWTF projects totaling $47.4 million to meet its long-term goals of biological phosphorus removal and increased peak wet weather flow capacity at the WWTF to minimize CSO discharges.

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- AECOM, (2010) Facility Plan Report for City of Manchester New Hampshire—Environmental Protection Division.
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Secondary treatment modifications improve efficiency and lower costs

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ABSTRACT | The Stamford, Connecticut Water Pollution Control Facility was upgraded for biological nitrogen removal in 2004, achieving low effluent nitrogen concentrations, but at a cost. The antiquated aeration control system resulted in over-aeration, especially at night during low-flow hours. The aeration blowers were not upgraded in 2004 because they had been recently installed. Between 550 and 650 gpd (2,082 to 2,460 L/day) of methanol was added to provide supplemental carbon to compensate for high dissolved oxygen (DO) concentrations at the end of the oxic zones. To address these issues while maintaining high levels of nitrogen removal, modifications were made that included new aeration blowers, a DO control system, and supplemental mixing to expand the anoxic zone. These modifications achieved a 30 percent to 40 percent reduction in methanol usage and a 10 percent to 15 percent reduction in energy costs.

KEYWORDS | Nitrogen removal, DO control, supplemental carbon, energy efficiency, cost savings, wastewater process simulation software modeling

The Total Maximum Daily Load (TMDL) for nitrogen in Long Island Sound, jointly submitted by Connecticut and New York, was approved by EPA in April 2001. Phase III of the TMDL implementation requires a 58.5 percent reduction in nitrogen discharges to Long Island Sound over a 15-year period. Connecticut's approach to implementing this phase included developing a General Permit for Nitrogen Discharges for the state's publicly owned treatment works (POTWs). The General Permit allows for each plant either to achieve a specific numerical mass discharge limit for nitrogen on an annual average basis or to purchase nitrogen credits from other POTWs that reduce their effluent nitrogen below the General Permit limits. This allows for the construction of nitrogen removal facilities at POTWs with a greater impact on Long Island Sound, while those with lower impacts to Long Island Sound can purchase nitrogen credits to comply with the General Permit instead of conducting costly upgrades.

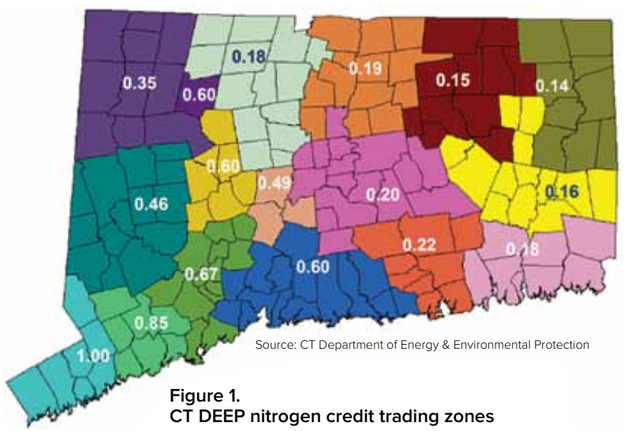

Figure 1.
CT DEEP nitrogen credit trading zones

To identify the impact of each POTW's nitrogen discharge on Long Island Sound, the Connecticut Department of Energy and Environmental Protection (CT DEEP) established nitrogen Trading Zones, establishing a nitrogen equivalency factor for each facility (Figure 1). The equivalency factor indicates the relative impact of 1 lb (0.45 kg) of nitrogen discharged from a particular POTW on Long Island Sound. The impact of nitrogen discharged from a POTW is attenuated based on the distance from the outfall pipe to where the flow enters Long Island Sound. In addition, nitrogen discharges from POTWs farther east were determined to have lower impact than those at the western end of Long Island Sound where hypoxic conditions were typically worse. Based on this, POTWs in northeastern Connecticut were assigned an equivalency factor of 0.14 while POTWs in southwestern Connecticut have an equivalency factor of 1.0.

Figure 2.
Stamford WPCF 2004 upgrade/ expanded facilities

The Stamford Water Pollution Control Facility (WPCF) is in southwestern Connecticut and discharges to an area of Long Island Sound that has historically high hypoxia levels. In 2002, the WPCF discharged an average of approximately 1,600 lb/d (726 kg/d) of total nitrogen. The goal for all POTWs in the state was to achieve an annual average discharge of 9,149 lb/d (4,150 kg/d) by the end of the 15-year period. Prior to the 2004 upgrades, the WPCF discharged approximately 17 percent of the TMDL for the entire state. Therefore, implementing nitrogen reduction improvements at the WPCF was a priority for both the city and CT DEEP.

NITROGEN REMOVAL UPGRADE IN 2004

The WPCF was upgraded to include secondary treatment in the mid-1970s. The secondary treatment facilities consisted of two aeration tanks, each with four separate zones with mechanical surface aerators. Three secondary clarifiers followed the aeration tanks. In the mid-1990s, the mechanical surface aerators were replaced with fine bubble diffused aeration. Five 350 hp (261 kW) multi-stage centrifugal blowers were provided for aeration. The dissolved oxygen (DO) levels in the activated sludge were controlled using modulating inlet butterfly valves on each blower.

In 2004, the Stamford Water Pollution Control Authority (WPCA) significantly upgraded the WPCF to achieve low levels of effluent total nitrogen at a design average flow rate of 24 mgd (90,850 m^3/d). The WPCF's available aeration volume nearly tripled, and the activated sludge system was modified to operate as a four-stage biological nitrogen removal process. To accommodate higher design mixed liquor suspended solids (MLSS) concentrations, a fourth secondary clarifier was added along with a methanol storage and feed system for supplemental carbon addition. However, because the multi-stage centrifugal blowers were installed only 10 years earlier, they were reused as part of the upgrade.

The upgraded facilities came online in 2004 and achieved high nitrogen removal performance. The CT DEEP General Permit for Nitrogen Discharges required Stamford to achieve an annual average effluent total nitrogen discharge of 926 lb/d (420 kg/d) by 2014. By 2007, the WPCF was achieving effluent total nitrogen of less than 800 lb/d (363 kg/d). Since 2015, the WPCF has averaged approximately 275 lb/d (125 kg/d).

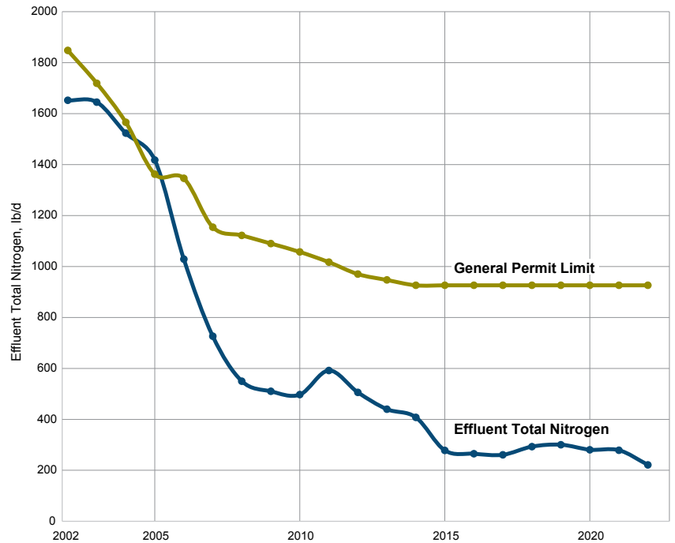

Figure 3. Nitrogen removal performance following 2004 upgrade

The WPCF has an assigned equivalency factor of 1.0. Therefore, for each pound below annual average effluent total nitrogen discharge of 926 lb/d (420 kg/d), Stamford creates 1 lb/d (0.45 kg/d) of nitrogen credits. Since 2015, the WPCF has created an annual average nitrogen credit surplus of approximately 650 lb/d (295 kg/d) that is then sold to other POTWs unable to meet their General Permit limits. From 2006 to 2017, the WPCA received an average of $900,000 per year in income from selling nitrogen credits. This revenue helped offset a portion of the debt from the 2004 upgrades. However, as other POTWs throughout the state completed their own nitrogen removal upgrades, the demand for credits diminished with a subsequent reduction in the unit cost per nitrogen credit set by CT DEEP. In 2021, the WPCA received $256,000 in nitrogen credit income, and in 2022, only $128,000 in nitrogen credit income was received.

SECONDARY TREATMENT IMPROVEMENTS

Although the WPCF was achieving effective total nitrogen removal performance, the WPCA recognized several operational issues with the current process. The expanded aeration tanks include large oxic zones, with each zone divided into six separate stages with submerged baffle walls between each stage. The average flows into the WPCF were approximately 16 mgd (60,570 m^3/d), two-thirds of the facility's design capacity. At these lower flows, the large oxic zones became mixing-limited. WPCF staff could not turn the air flow rate down below the minimum level at which the MLSS would begin to settle. At night, during lower flow and loading conditions, the oxic zones had significant excess DO.

The aeration tanks were divided into two trains, with each train having a separate aeration header with 24 separate drop legs, two into each of the six oxic stages for each aeration train. Each drop leg included a manual butterfly valve to adjust air flow to that zone. Although the air headers to each train could be interconnected, balancing the air between trains was difficult. Therefore, the air header to each train was isolated, with a separate blower discharging to each train. Owing to the air header configuration and the lack of automated control valves on the drop legs, at least two blowers were required to be in service. At night, during lower flow and loading conditions, this also contributed to excess DO.

Because of these operational issues, the WPCA evaluated alternatives and upgrades to address the issues and improve the WPCF's efficiency without sacrificing nitrogen removal performance. The WPCA's goals for the project included the following:

- Replacing aging multi-stage centrifugal blowers with new energy-efficient blower technology
- Using a computer model to evaluate the ability of the nitrogen removal process to treat current and future design year flows and loadings and determine the oxygen demand under these conditions, including diurnal variations in air flow requirements
- Improving the control of DO concentrations in the oxic zones to desired setpoints without over-aerating
- Lowering methanol consumption and power costs

A commercial process simulation software model was used to evaluate the WPCF. Three significant findings were identified based on modeling the process. The first was that high DO concentrations in the oxic zones required adding large quantities of methanol upstream of the post-anoxic zones to achieve the required nitrogen removal. A large portion of the methanol dose was required to drive down the DO to maintain anoxic conditions further downstream. The second finding was that the model showed the excessive DO concentrations occurring in the second and third oxic zones in each train at the minimum air flow rate of the current aeration system. This indicated that these zones are mixing limited and that the total aeration volume is too large for the current flow and loading conditions. The high DO levels were returned to the pre-anoxic zones with the internal nitrate recycle, reducing the nitrogen removal in these zones. The model's third finding identified that the pre-anoxic zones were too small to fully use the raw influent carbon for nitrogen removal. The hydraulic residence time in the pre-anoxic zones was less than two hours under design flow conditions versus the three to six hours recommended in NEIWPCC's "TR-16 Guides for the Design of Wastewater Treatment Works."

Based on these three findings and the WPCA's goals for the project, the software model evaluated three alternatives:

- Alternative No. 1 included modeling the system with an improved DO control process to maintain the desired setpoint in each oxic zone.
- Alternative No. 2 included modeling an expanded pre-anoxic zone along with an improved DO control process.
- Alternative No. 3 was the same as Alternative No. 2, but also divided the two aeration trains into four trains for evaluation. Because the WPCF received only about two-thirds of its design flow, operating three of the four trains under existing conditions was possible.

Alternative No. 1

By improving DO control in each stage of the large oxic zones, the model predicted a 15 percent to 20 percent reduction in air flow requirements. However, because the oxic zones are oversized for current flow rates, the tanks would be mixing-limited at times. This resulted in high DO levels at night entering the post-anoxic zones and being recycled to the pre-anoxic zones. Owing to these high DO conditions, the model predicted only a minimal reduction in methanol use.

Alternative No. 2

The same DO control improvements were assumed as in Alternative No. 1. The first stage of each oxic zone was modeled as an additional pre-anoxic zone volume. The goal of this alternative was to increase the pre-anoxic zone volume to improve denitrification and minimize the oxic zone surface area to reduce the minimum air flow requirements for mixing. Under this configuration, the model predicted a 30 percent to 40 percent reduction in air flow requirements and a 75 percent to 80 percent reduction in methanol usage. Because the minimum air flow required for mixing was reduced, the high DO conditions at night and during low loadings were not predicted. Therefore, the additional methanol required to drive down the DO levels and allow for denitrification was not needed. With the reduction in methanol addition, the model also predicted a 10 percent to 15 percent reduction in waste sludge.

Alternative No. 3

The process configuration modeled for Alternative No. 3 is similar to Alternative No. 2. This alternative assumed that an improved DO control system was installed and that the first stage of each oxic zone was converted to be part of the pre-anoxic zone. This alternative modeled dividing the two aeration trains into four aeration trains. With the current influent flows being approximately two-thirds of the design flow, this alternative would allow three of the four trains to be operated as needed. By reducing the overall oxic zone volume by one-third and operating only 75 percent of the remaining available volume, additional efficiencies were expected. However, the model predicted only minor reductions in air flow requirements, methanol usage, and waste sludge compared to Alternative No. 2. In addition, the existing baffle wall in the aeration tanks was not designed to allow for operation with one side of the tank full and the other empty. Therefore, these baffle walls would have to be demolished and rebuilt to withstand the four-train operation.

A life cycle cost assessment of the three alternatives was developed. Although Alternative No. 1 had low capital costs compared to the others, it had a much higher annual cost for methanol and power consumption. Alternative No. 3 had a similar annual cost to Alternative No. 2, but added $2 million in capital costs for the baffle wall construction. Alternative No. 2 had the lowest relative present worth cost and was selected by the WPCA.

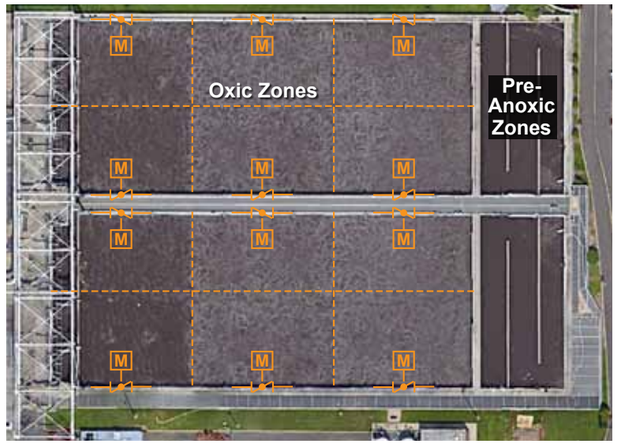

Figure 4. Alternative No. 1 aeration tank modifications

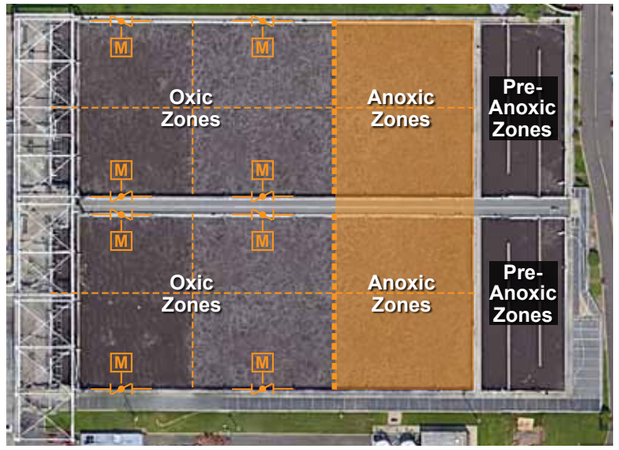

Figure 5. Alternative No. 2 aeration tank modifications

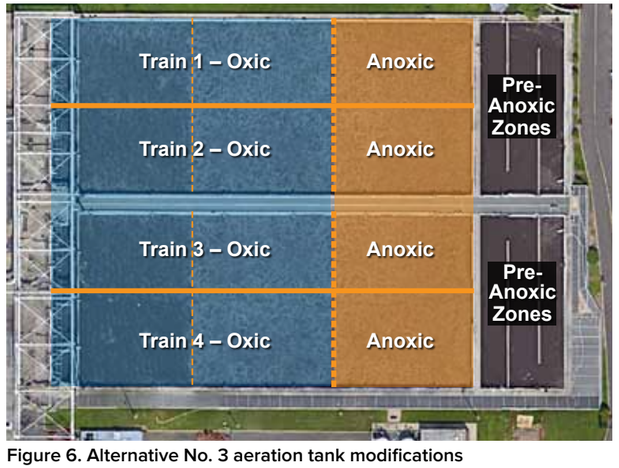

Figure 6. Alternative No. 3 aeration tank modifications


New single-stage blowers


Expanded aeration tank anoxic zone following upgrade

Energy-efficient Aeration Blowers

An initial screening assessment of alternative blower technologies was conducted. Based on this assessment, three alternatives were further evaluated: multi-stage centrifugal blowers with VFD control, positive displacement screw compressor blowers with VFD control, and integrally geared single-stage centrifugal blowers with dual vane control. The evaluation indicated that the original five 350 hp (261 kW) multi-stage centrifugal blowers could be replaced with four smaller blowers between 250 hp (187 kW) and 300 hp (224 kW). While the integrally geared centrifugal blowers had a higher capital cost and higher annual maintenance costs than the other two alternatives, the overall efficiency of the blower was greater, resulting in a 6 percent to 8 percent lower net present worth value. In addition, three 400 hp (298 kW) units could be provided and still meet the necessary turndown requirements of the process. This would require less space for the blowers and free up space for storage and maintenance.

Dissolved Oxygen Control System

As noted, the aeration tanks' oxic zones were divided into six stages, each stage having two drop legs to two separate diffuser grids. In addition, each of the re-aeration zones at the end of the aeration trains had an individual drop leg with a manual butterfly valve for DO control. There were 26 drop legs/diffuser grids across the aeration tanks. To improve the WPCF staff's ability to control DO concentrations across the oxic zones and to allow for the operation of a single blower, the original DO control scheme underwent several modifications. These included individual DO sensors, air flow meters, and actuated control valves for each stage in the oxic zones and the re-aeration zone. Instead of actuated valves on each drop leg, an actuated valve was provided for each pair of drop legs to minimize costs. Rather than 26 separate air flow meters and actuated valves, only 14 were required, including one in the expanded pre-anoxic zone. This allows the pre-anoxic zone to operate as a swing zone, converting back to an oxic stage under the original design flow conditions, if necessary. These valves operate in a most-open-valve control scenario, while a pressure sensor on the air header controls the output of the blowers and provides the minimum discharge pressure necessary to operate the system, helping to minimize costs.

Swing Zone Mixing

Several alternatives were evaluated for mixing the swing zones without having to remove or modify the diffuser grids. These included floating mechanical mixers, vertical hyperbolic mixers, submersible mixers, and large bubble mixing systems. As the design progressed, an additional alternative, using a large-diameter slow-speed submersible mixer with integral VFD, was included. Based on testing that had shown significant power cost savings at another POTW nearby, the large-diameter slow-speed submersible mixers were selected by the WPCA for this project.

RESULTS

The WPCA proceeded with design and construction to expand the pre-anoxic zones, and install three 400 hp (298 kW) integrally geared single-stage centrifugal blowers and a new DO control system. The modified aeration tanks came online in late 2020, and the aeration blowers and DO control system were completed in 2022. Since the upgrades came online, the Stamford WPCF has maintained its high nitrogen removal performance. The WPCF is averaging less than 275 lb/d (125 kg/d) of total nitrogen and is continuing to generate approximately 650 lb/d (295 kg/d) in nitrogen credits. This is achieved by consistently discharging total nitrogen concentrations of less than 2.5 mg/L.

While maintaining high nitrogen removal, the WPCF has also greatly reduced its methanol consumption. Historically, the WPCF used approximately 600 gpd (2,271 L/d) of methanol. Following these recent upgrades, methanol consumption has been reduced to approximately 300 gpd (1,136 L/d), saving around $170,000 annually.

Power cost savings are more difficult to assess due to the variation in plant flow rates and influent loading conditions. To approximate the power cost savings with the recent improvements, the kilowatt-hours per year used to treat 1.0 mgd (3,785 m^3/d) were calculated based on annual power consumption and annual average daily flow rates. Between 2015 and 2021, the annual power usage was 800,000 to 970,000 kW-hr/yr/mgd (211 to 256 kW-hr/yr/m^3/d) with an average of 865,000 kW-hr/yr/mgd (229 kW-hr/yr/m^3/d). In 2022, this dropped to 707,000 kW-hr/yr/mgd (187 kW-hr/yr/m^3/d). Based on this reduction, current flows, and current unit costs for power, an annual savings of $370,000 may be attributable to the energy-efficient blowers, mixers, and DO control system improvements. In addition, the WPCA received an energy-efficiency rebate grant from its local power utility of approximately $360,000 for these aeration improvements.

The project cost approximately $8.9 million, was awarded a $360,000 grant, and saves about $540,000 per year. These annual savings are likely to increase in the future commensurate with anticipated increases in unit prices for methanol and electricity.

While the Stamford WPCA was operating a well-run plant that produced excellent effluent quality with low effluent total nitrogen, staff recognized opportunities to reduce costs and improve process efficiency. By investing in these improvements, the WPCA has reduced the WPCF's annual operating costs, methanol consumption, and power consumption without sacrificing effluent quality.

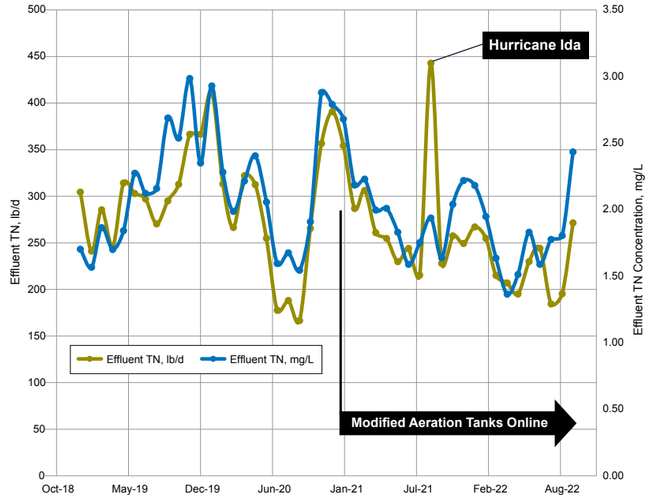

Figure 7. Nitrogen removal performance following 2021 upgrade

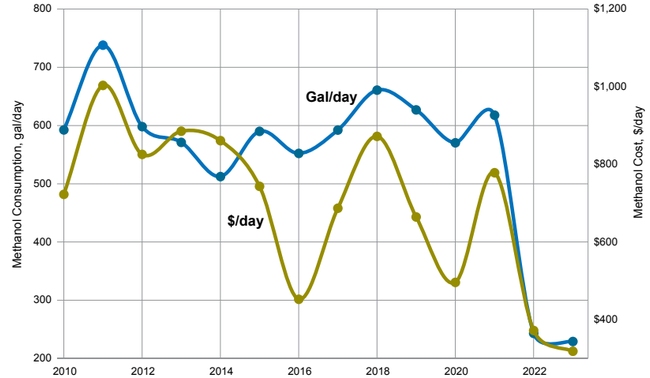

Figure 8. Methanol consumption before and after 2021 upgrade

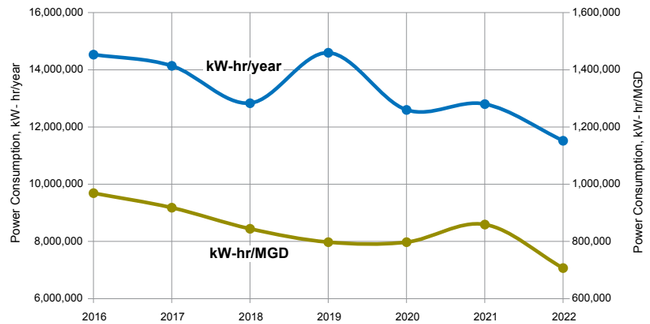

Figure 9. Power consumption before and after 2021 upgrade

ACKNOWLEDGMENTS

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LOOP-MBR: a cost-, energy-, and space-saving cyclical step-feed MBR process with a uniquely high denitrification rate

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ABSTRACT | Membrane bioreactor (MBR) wastewater treatment is an intensified process that combines activated sludge treatment with membrane filtration to produce an effluent devoid of suspended solids and turbidity. MBRs can be paired with a cyclic, step-feed denitrification process to manage stringent nutrient discharge limits. With this configuration, denitrification rates can be increased by setting higher recirculation rates; however, considering restrictions for required devices and power consumption, the maximum denitrification rate is typically 80 percent. To this end, a new, step-feed-type process has been developed to increase total nitrogen removal to approximately 90 percent in MBR filtrate without post-denitrification: the LOOP-MBR (the low operating expense [OPEX] and optimized MBR).

KEYWORDS | Membrane bioreactor, step-feed, nutrient removal, denitrification

The activated sludge process, with its variations such as step-feeding (Figure 1), is well-known for its capacity to completely oxidize ammonium (NH_4+) and significantly reduce the amount of total nitrogen (TN) by way of denitrification. The complete removal of TN via activated sludge treatment processes, however, falls short due to a limit in technology (Guoqiang, 2017, Oleszkiewicz and Barnard, 2006).

The theoretical TN removal efficiencies for nitrification/denitrification reactions can be obtained from the following equation:

$$1 - [1/(1+n^*R)]$$

R = recycle rate (x*Q) – where Q represents reactor influent forward flow
n = number of anoxic/oxic steps

Equation 1.
N-Removal for nitrification/denitrification reactions

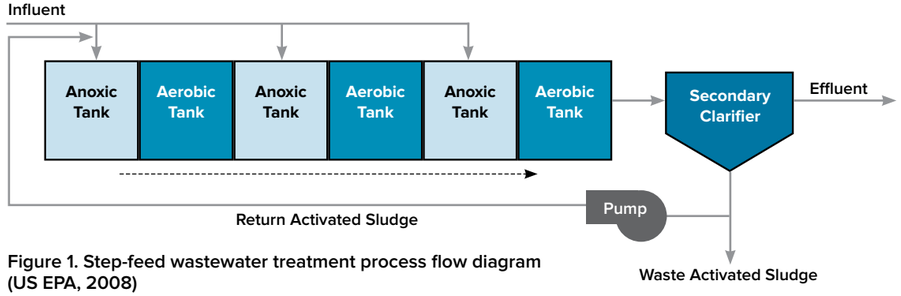

Figure 1. Step-feed wastewater treatment process flow diagram (US EPA, 2008)

When R = 3Q, and *n* = 1, the N-removal is 75 percent; however, if *n* = 4 (as in the Low Operating expense and Optimized Membrane Bioreactor [LOOP-MBR] process), the calculated N-removal for nitrification/denitrification reactions is 92 percent. Table 1 presents a range of theoretical TN removal efficiencies under various operating conditions.

The LOOP-MBR process includes four anoxic/oxic tanks in series; each oxic tank contains a submerged membrane unit (SMU) with a fine bubble diffuser. 0.25*Q (25 percent of flow) or 0.25Q influent feed flows into each of the four anoxic tanks with 0.25Q membrane bioreactor (MBR) filtrate flowing from each oxic tank (totalling 1*Q feed and filtrate flows). Mixed liquor recycle occurs from the final aeration tank to the first anoxic tank at a rate of 3*Q, which yields a total recycle rate of 12*Q. With the combination of a high overall recirculation rate and low influent flow, a plant can be operated at relatively low power compared to conventional MBR systems. Additional energy reduction can be achieved by a reduced air flow from the fine bubble diffused aeration system.

The Japan Sewage Works Association and its industry partner conducted a pilot study for more than two years to verify the performance of the LOOP-MBR system. The pilot plant contained four anoxic/oxic (AO) steps in series, where the influent flow and recirculation flow were 0.25Q and 3Q, respectively. Each oxic tank is an MBR tank with an SMU equipped with a fine bubble diffused aeration system. The mixed liquor suspended solids (MLSS) target values in the oxic and anoxic tanks were 10,000 mg/L and 9,200 mg/L, respectively. The mixed liquor recirculation rate was 3Q, with a total recirculation rate of 12Q. After modifying the system during the first-year test period, a total denitrification rate of 92 percent was achieved for the second-year operation.

The following section discusses the pilot study, in which over 90 percent nitrogen removal was achieved without post-denitrification or additional carbon source addition.

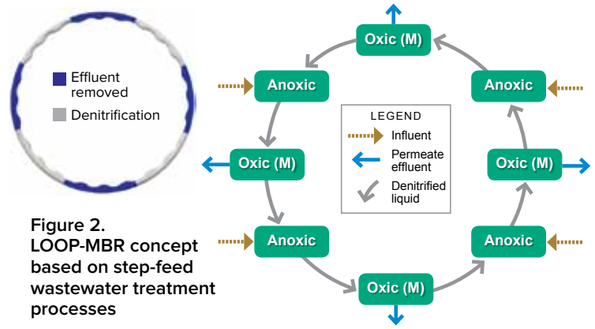

Figure 2.
LOOP-MBR concept based on step-feed wastewater treatment processes

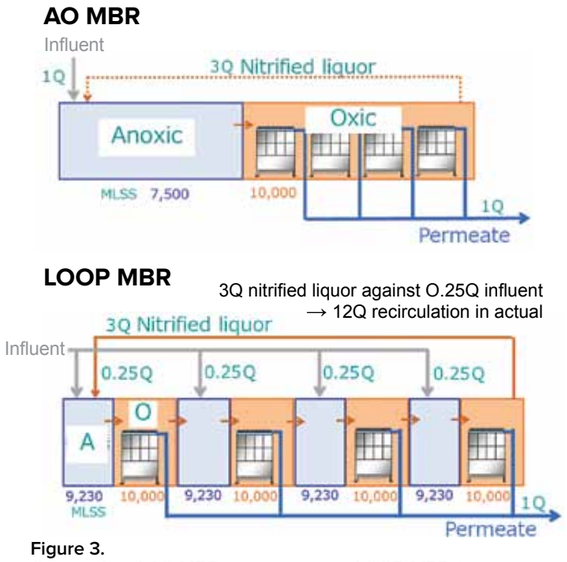

Figure 3.
Conventional AO MBR process versus LOOP MBR (step-feed process}

Table 1. Theoretical nitrogen removal with respect to RAS ratio and number of steps

Step No.	RAS Ratio	Inf. T-N [mg/L]	Removal [%]	Effluent T-N [mg/L]
1	2Q	35	73	9.3
2	2Q	35	84	5.6
4	2Q	35	91	3.1
4	3Q	35	94	2.2

EXPERIMENTAL DESIGN AND PROTOCOL

A LOOP-MBR pilot plant was constructed to test the LOOP-MBR theory and whether a higher denitrification rate was possible, relative to the conventional anoxic/oxic (AO) MBR. Table 2 (next page) presents the main design parameters of the pilot plant.

Clarifier primary effluent served as influent for the pilot. Table 3 (next page) lists the LOOP-MBR influent (primary effluent) and MBR effluent quality targets.

The focus of this pilot study was the treatment process itself, independent of the performance of the SMU. The SMU contains 10 flat plate membranes with 8.0 m^2 (86.1 ft^2) of membrane surface area, total. Figure 4 (next page) shows the LF10 and 510 membranes.

Table 2. Design specifications of the LOOP-MBR pilot plant

Parameter	LOOP MBR
Capacity	4,000 gal/d (15,000 L/d)
Feed wastewater	Primary effluent
Membrane module	LF10 (4 units)
Flux	11 gal/ft^2/d (450 L/m^2/d)
MLSS (MBR tank)	9,000 mg/L
Total hydraulic retention time	5.8 h
Recirculation rate	3Q
Influent flow	0.25Q x 4
Total recirculation rate	12Q

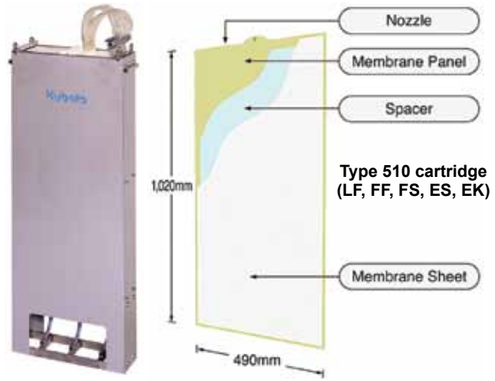

Figure 4. LF10 SMU (left) and Type 510 membrane plate—the LF10 SMU contains 10 Type 510 membranes for a total of 8.0 m^2 of surface area

Table 3. Influent (primary) and target effluent quality

Items	Primary Effluent [mg/L]	MBR Effluent Target [mg/L]
BOD	156	3
Soluble BOD	120	—
SS	64	1
TN	32	3
NO_3-N	—	2 (2 year avg.)

The pilot plant was run from June 2019 through July 2021. The purpose was to determine whether the LOOP-MBR pilot could achieve treated water with a TN < 3 mg/L (equivalent to 91 percent removal with 35 mg/L influent TN) or achieve a TN removal rate ≥ 90 percent.

Denitrification rate and other parameters were based on the analysis of composite samples.

RESULTS

Pilot Challenges

During the first four months, deterioration of the treated water quality due to the shortage of dissolved oxygen (DO) in the aerobic tank was hardly detected. It was presumed that this was due to the influent water TN values being much lower than the design. However, the average TN concentration of the influent (primary effluent) water began to increase after November, and the average value of influent TN exceeded the design value. Furthermore, in this treatment plant, the TN concentration tended to peak at the time of the peak influent flow. Additionally, because sludge was manually removed from the system only twice a week, the MLSS concentration tended to be higher than the target value, and therefore the DO levels of the aerobic tank were lower due to the decrease in the α value. For these reasons, nitrification was lost, likely attributable to the shortage of DO during periods of high flow.

To combat the low DO levels, additional auxiliary diffusers were installed in around November–December. The low DO issue was largely resolved, but the denitrification performance began to decrease when the influent flow decreased. The suspected cause was that the DO in the aerobic tank spiked, and the denitrification reaction was inhibited by the flow of nitrifying liquid (high in DO) into the anoxic tank side.

Based on MBR operation experience, it was assumed an increase in the aerobic tank's DO value from a low influent strength was a common event and the effect on the denitrification reaction in the anoxic tank would be less than anticipated. However, because the nitrifying circulation amount of this process was 4 to 6 times greater than that of a conventional MBR, the effect rose to a level that could not be ignored. To solve this problem, DO control was essential. In April 2020, the system was reconfigured, and in 2021, strict DO control was achieved by routinely conducting a partial blast of the membrane during low load conditions. Following these improvements, the denitrification reaction was relatively stabilized. The three temporal regimes of DO control can be seen in Figures 5–8 (next page), separated by the vertical dashed lines.

Basic MBR Performance

Primary effluent contained about 110 mg/L biochemical oxygen demand (BOD) and 35 mg/L TN, which is slightly carbon limited.

It was confirmed that the absolute value and BOD:N ratio of the analytical result of BOD and SS tended to be higher after March 2021 than in the summer and autumn of 2020. The absolute values of BOD and SS increased significantly, and the influent load likely changed.

Nitrogen Removal Performance

The concentrations of effluent TN and NH_4-N tended to increase after the start of load fluctuation operation (sampled on July 9, 2019). Although BOD:N ratios > 3 increased after December 2019, removal rates did not improve significantly.

With the start of increased aeration from December 2019, NH_4-N treatment improved, but the value of influent NH_4-N decreased. The presumed reason was that the DO value in the aerobic tank became excessive due to the installation of the auxiliary diffuser, and the denitrification reaction in the anoxic tank was inhibited. The TN removal rate was significantly improved with the modification to enable DO control operation in late April 2020.

From June to July 2020, the TN concentration of the effluent elevated during rain events. In particular, the effluent TN concentration increased as the TN concentration of the influent decreased. It is suspected that DO in the influent also negatively affected the denitrification reaction. The DO value of the influent remained high at approximately 1.5–2 mg/L since monitoring began in September 2020, and DO can rise during rainfall. Thus, the system influent's effect on nitrogen removal was inferred not to be negligible, but the effect was not evaluated in this study.

The frequency of complete nitrification failure was higher in the summer of 2020 when adequate air was supplied to the system compared to 2019 when the system had inadequate aeration. As described above, erroneous detection by the DO meter, which controls the auxiliary aeration amount, was considered one of the causes. However, since the amount of membrane cleaning aeration air before November 2020 was equal to that before the start of auxiliary aeration, the change in quality of the inflow water was also considered. In addition, the nitrification failure on November 19 was suspected to have reduced the membrane cleaning aeration air volume.

From December 2020 to February 2021, poor nitrification occurred frequently. It is presumed that this was caused by the DO of each tank becoming unequal when a portion of the membrane scouring aeration was discharged; an excessive rise of DO in the aerobic (membrane) tanks occurred in November, 2020, and sufficient DO was not provided in any aerobic tank other than the aerobic tank where the DO meter for DO control was installed. After March, the occurrence of poor nitrification decreased because of the adjustment of air discharge volume and the effect of the shortening of scouring air discharge time, and due to the increase of inflow load after spring.

Denitrification

Figure 10 shows the relationship between the daily average denitrification rate and the BOD-SS load for each series. The denitrification rate calculated from the nitrogen balance for 24 hours—adjusted by excluding the denitrification amount (estimated value) due to the extraction of excess sludge—was found to be lower than

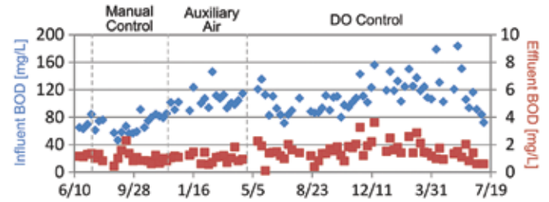

Figure 5.* Biochemical oxygen demand (BOD) removal performance—the LOOP-MBR pilot removed approx. 89 percent of incoming BOD

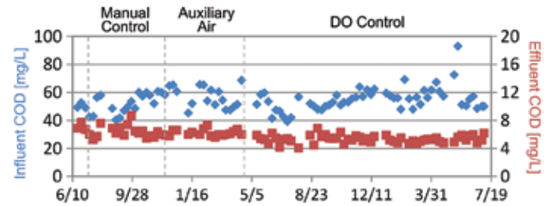

Figure 6.* Chemical oxygen demand (COD) removal performance—the LOOP-MBR pilot removed approx. 89 percent of incoming COD

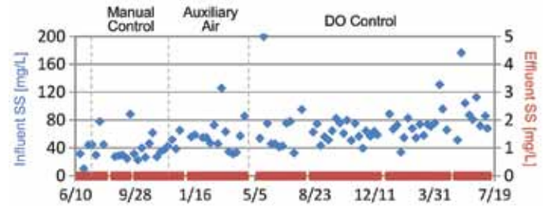

Figure 7.* Suspended solids (SS) removal performance—the LOOP-MBR pilot removed all incoming SS

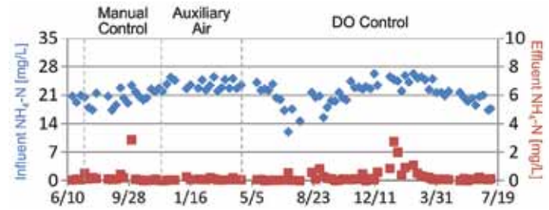

Figure 8.* NH_4-N removal performance—the LOOP-MBR pilot successfully removed influent NH_4-N

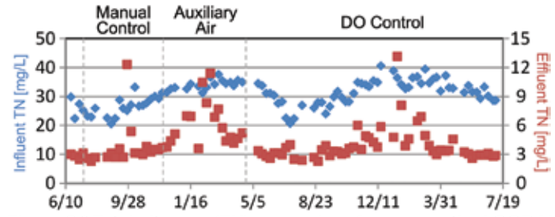

Figure 9.* Total nitrogen (TN) removal performance—the LOOP-MBR pilot successfully removed nearly 90 percent average TN (TN composed of 2 mg/L NO_3-N and 1 mg/L organic-N)

*Performance over the course of the study, June 2019 to July 2021. Influent samples in blue and effluent samples in red. The various regimes of aeration control are shown with respect to temporal progress of the pilot study with vertically dashed grey lines, "Manual Control," "Auxiliary Air," and "DO Control" respectively.

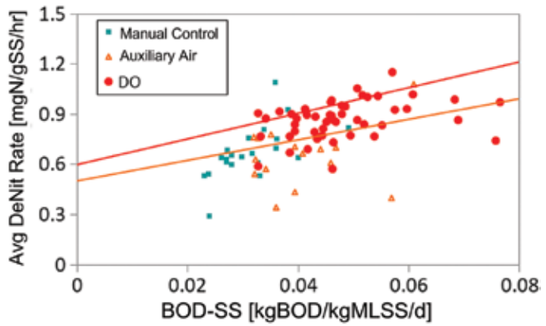

Figure 10.* BOD-SS loading versus average denitrification rate over the course of the pilot plant operation.

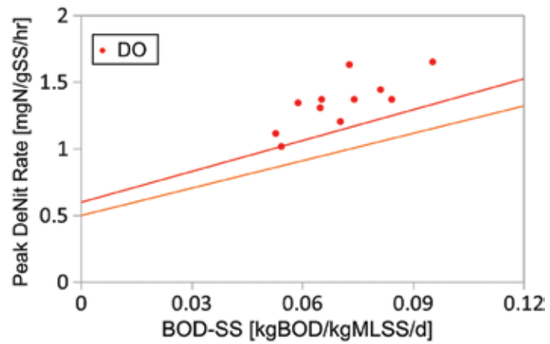

Figure 11.* BOD-SS loading versus peak denitrification rate over the course of the pilot plant operation.

*The **orange line** shows the denitrification rate equation that is used by JSWA for determining anoxic tank capacity. The **red line** is the calculated denitrification rate from the design standard of the industrial partner.

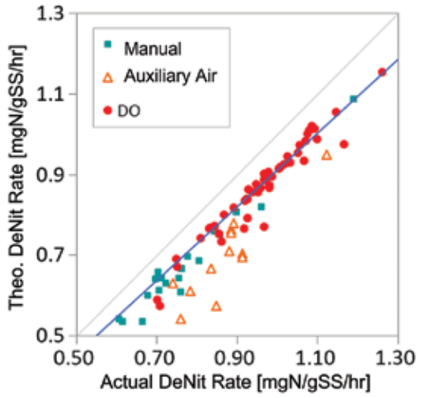

Figure 12. Actual denitrification rate versus theoretical denitrification rate over the course of the pilot plant operation data points on the blue line indicate when there was agreement between the theoretical and actual denitrification rates.

the orange line in the figure. This denitrification rate was especially remarkable during auxiliary diffusion (without DO control). However, when samples considered to have been affected by rainfall after DO control implementation were excluded, the design criterion of the orange trend line was exceeded. In calculating the BOD-SS load, the amount of sludge in anoxic tanks was included.

Since the denitrification rate and BOD-SS load calculated from the composite sample analysis results are affected by the low load operation time, the denitrification rate and BOD-SS load are estimated to be smaller than the peak data. The denitrification performance of the demonstration process is believed to be maximized at the peak time of the inflow water quantity. Therefore, an attempt was made to calculate the denitrification rate by taking the nitrogen balance between 10:00pm and 12:00am when the peak load was applied.

The BOD-SS load should normally be set based on daily average data. However, the comparison of the denitrification rate with the design criterion based on the BOD-SS load during the peak load period is useful because it is an evaluation under more severe conditions.

Figure 11 shows the relationship between the denitrification rate (nitrogen removal rate due to nitrification and denitrification) and the BOD-SS load calculated during the peak load (maximum daily x 1.4Q) in the daily sample. The value was equal to or higher than the orange trend line.

Based on the results of Figures 10 and 11, the capacity of the anoxic tank can be determined by using the design standard. However, in actual facility design, a facility for adding organic substances as a backup must be installed when the BOD/N ratio deteriorates.

Figure 12 shows the relationship between the nitrogen removal rate and the MLSS load on the nitrogen to be denitrified (the sum of denitrified nitrogen and nitrate nitrogen in treated water, excluding nitrogen taken into excess sludge). The denitrification removal rate tended to increase without auxiliary diffusion. The decrease in the amount of DO brought into the anoxic tank from the aerobic tank may have increased the denitrification rate. On the other hand, the denitrification rate clearly decreased without DO control, suggesting the denitrification performance was adversely affected by auxiliary diffusion.

Under DO control, most of the pilot's analytical results were on the theoretical elimination straight line. One factor for the relatively large proportion of TN removal rates that did not meet the target values was the lack of carbon required for denitrification. Although several analytical results exceeded the theoretical removal rate line, there was no tendency to exceed the theoretical removal rate line especially in the analytical results without auxiliary diffused gas, which were assumed to have tended to lack DO. Therefore, it was unlikely that denitrification was progressing in the aerobic tank.

SUMMARY

The initial stage of this study showed that DO control would be crucial for this demonstration. After the introduction of DO control, it was possible to continue stable operation and demonstrate processing performance, excluding problems such as equipment failure. The treated water quality in Table 4 was obtained as data for the evaluation period under a fluctuating load condition with a daily influent fluctuation ratio of 1.4 times. It was confirmed that the performance necessary for achieving the desired pilot study goal could be demonstrated.

The nitrogen removal rate (η DN) in the nitrification denitrification reaction was ≥ 90 percent when conditions for complete nitrification were available and the organic substance source necessary for the denitrification reaction was maintained in the raw water. (The η DN calculated under the experimental conditions was 91 percent.)

Since the target nitrogen removal rate is high, the treated water quality must be monitored and the BOD/N ratio of the influent source water controlled. Additionally, because the treatment process assumed the same treatment to be performed in each stage of the reaction tank, equalizing the influent load, scour aeration, membrane filtration flow rate, etc., is important.

The LOOP-MBR pilot achieved the goals of the study. Neither a post-denitrification tank nor a constant source of organic matter was needed. As the actual circulation ratio increased, the MLSS concentration in the anoxic tank and the volume treatment efficiency both increased.

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New England's stormwater nutrient dilemma

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ABSTRACT | Approximately 100 New England-based stormwater professionals, representing municipal governments, regulatory agencies, nonprofit organizations, academia, and consulting, gathered for a day-long workshop in May 2023 to discuss successful nutrient management approaches underway in the region. At the workshop, they discussed ideas about innovations in regional watershed management, nutrient-focused stormwater controls, pollution prevention and source control, program development, and long-term stormwater control measure tracking and accounting. This article summarizes the recommended actions from this workshop.

KEYWORDS | Nutrient control, innovation, stormwater control measures, source control, regionalization

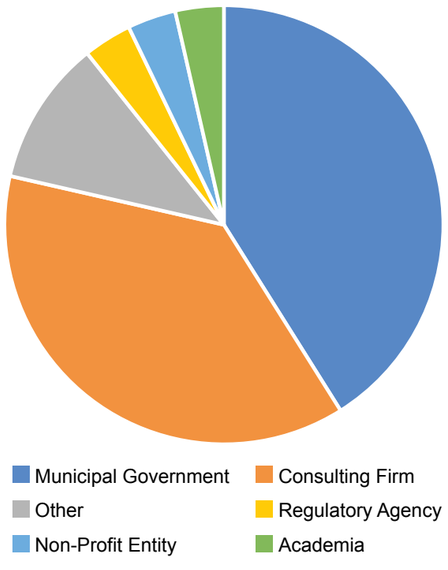

Figure 1. Breakdown of attendees at workshop

With new nutrient waste load allocations included in the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Stormwater Sewer System (MS4) Permits in Massachusetts and New Hampshire, the stage is set for unprecedented nutrient reduction implementation strategies that will span the next several decades. For the Charles River watershed alone, these requirements are estimated to cost upward of $1 billion to $3 billion in green infrastructure and source control investments for the 35 municipalities within it.

Each municipality with a MS4 Permit must meet waste load allocations for their own stormwater discharges. This approach is likely to reduce efficiency and efficacy, and carries a much higher price tag than collaboratively managing waste load allocations at a watershed level. This, coupled with the recent petitions to Region 1 to exercise their Residual Designation Authority that is anticipated to require thousands of private sector, non-residential parcels to also obtain NPDES stormwater permits in the Charles River, Mystic River, and Neponset River watersheds, further highlights the need for regional management approaches.

PRECEDENT FOR REGIONAL MANAGEMENT

In 1955, Minnesota passed the Watershed Act, allowing water resource management districts to be established based on watershed boundaries (see Figure 2) rather than municipal or county boundaries. This empowered watershed districts to prioritize and address water resources issues of greatest concern based on geography. Watershed districts in Minnesota each have taxation and regulatory authority within their district. This approach has successfully addressed issues at the watershed scale; the Watershed Act and programs in Minnesota may be a model for solving the nutrient control dilemma in the Charles River watershed and other watersheds in New England.

INNOVATIONS IN STORMWATER CONTROL MEASURES

Typical stormwater control measure (SCM) designs to treat stormwater for nutrients are constantly evolving, but with the need to meet Total Maximum Daily Load goals on a watershed-scale, stormwater professionals must ensure that water quality treatment approaches function at a high level. Ideas for innovative SCMs include bioretention media amended with drinking water treatment residuals (DWTRs), urban trees, and replacement of stormwater piping with infiltration.

Planting urban trees can help stabilize soil with an established root system, reduce erosion and overall precipitation depths by intercepting rainfall, absorb airborne pollutants, and promote infiltration. However, trees have not been widely adopted as part of green infrastructure by the stormwater industry despite their benefits for both stormwater and mitigating urban heat island impacts. Urban greening programs that include extensive tree planting are anticipated to be important in future widespread green stormwater infrastructure initiatives. Yet, it is increasingly understood that leaves falling on pavement, or other impervious surfaces, generate most stormwater-based nutrient loads in suburban and urban environments. Thus, communities must tie urban greening programs together with aggressive fall cleanup. Providing nutrient removal credit for preservation of trees should be considered, given that some communities face tree clearing to construct SCMs.

Communities are also challenged by passive filtration systems that use compost and organic media to help green infrastructure plants flourish.

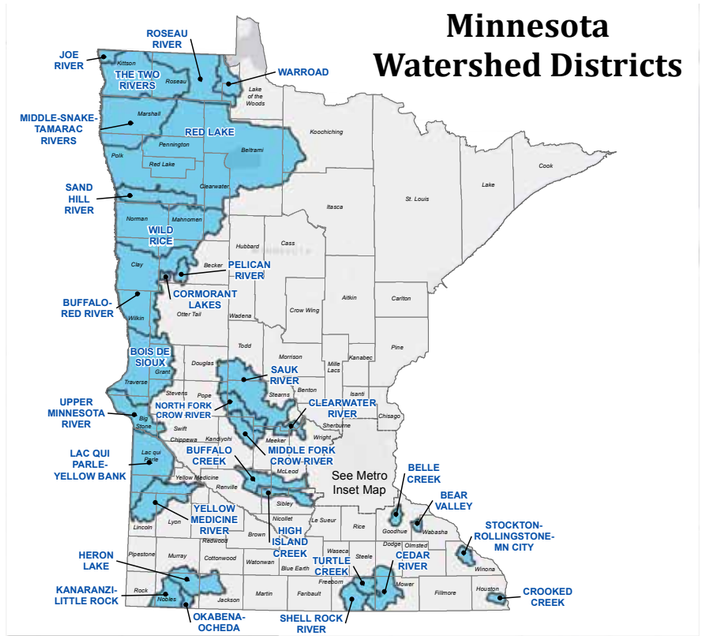

Figure 2. Watershed district map (source: Minnesota Board of Water and Soil Resources—bwsr.state.mn.us/watershed-districts)

When not applied correctly—too much compost used or layered too deep in the soil—stormwater can cause nutrients to leach out as it flows through the filtration media. Such as the issue with leaf litter, SCMs should do no harm; low phosphorus additives in compost, spot applications, and avoidance of organic-based media filtration entirely near nutrient impaired waterways may mitigate this issue. In addition, research has shown that adding DWTRs to filtration media can significantly increase nutrient removal due to the presence of iron and aluminum ions that bond to phosphorus ions (Ament, et al., 2021). However, any use of DWTRs must also be accompanied by testing to confirm the absence of per- and polyfluoroalkyl substances (PFAS). These insights about effective media filtration for nutrients must be well vetted before widespread design and implementation in the Charles River watershed or elsewhere in our region.

SOURCE CONTROL AND ENHANCED NON-STRUCTURAL POLLUTION PREVENTION PROGRAMS

Thinking creatively about nutrient control across New England will help stormwater managers maximize opportunities for non-structural best management practices before investing in widespread structural control interventions. Studies have shown that good housekeeping efforts, such as street sweeping and catch basin cleaning programs, yield the greatest reductions per unit cost for stormwater-based nutrient control (Piscataqua Region Estuaries Partnership and the University of New Hampshire Stormwater Center, 2022). This can only be improved by creating strategic alignment between emerging science and municipal operations.

The University of New Hampshire (UNH) Stormwater Center and the Piscataqua Region Estuaries Partnership (PREP) created an expert panel and advisory committee called Clean Sweep. Their aim was to develop consensus-based recommendations to modify pollutant load reduction credit policy for street cleaning based on research. The panel's work resulted in a technical memorandum, "Clean Sweep: Recommendations for New and Updated Credits for Street Cleaning in New Hampshire." This document summarizes the panel's findings to provide communities, consultants, and experts methods for quantifying Total Nitrogen and Total Phosphorus credits under the MS4 General Permit.

The memorandum suggests moving from a credit-based model on the acreage of streets swept to a measured approach. Credits, as suggested in the memorandum, would be based on the measured amount of organic matter collected from impervious surfaces throughout the year. Alternatively, the memorandum recommends updated model credits based on the street cleaning technology used, frequency of cleaning, seasonality, and location. The measured approach was adapted from Minnesota's street sweeping credit calculator and scaled for adoption in New Hampshire and Massachusetts. The measured approach was tested in New Hampshire during the fall of 2022 and spring of 2023 and resulted in an order of magnitude greater credits than the crediting policies in the current MS4 General Permits for Massachusetts and New Hampshire. The model-based approach would update the EPA's current Enhanced Street/Pavement Cleaning Program to establish a three-tier credit system according to several operations and land use factors. The updated modeled approach would not only result in greater credits but also would provide improved guidance on operational effort.

While street sweeping and catch basin cleaning programs are among the most important practices that improve surface water quality, how communities manage and dispose of the debris collected remains a challenge. Both Massachusetts and New Hampshire regulate solids resulting from street sweeping and catch basin cleaning from urban areas as a special waste that requires transport to approved landfills. Fall leaf litter collection primarily results in organic material, which is much different from catch basin cleaning residuals or material swept from streets in the spring. Collaboration is needed with other associations working on solid waste issues around non-landfill options for organic leaf debris.

PROGRAM MANAGEMENT AND TRACKING POST-CONSTRUCTION CONTROLS

Communities must account, track, inspect, operate, and maintain SCMs and source control programs to obtain credit under the permitting program. Many New England communities have had buried stormwater infrastructure in place for upward of 100 years with no clear records of the assets. Tracking utility assets and documenting them are time-consuming and expensive, but more communities are doing so due to MS4 General Permit requirements, leveraging the latest technology for more efficient program management.

Several tools have been developed to assist with effective accounting, tracking, and asset management. The Massachusetts Department of Conservation and Recreation (DCR) and Rhode Island Department of Transportation are using online GIS applications and dashboards to optimize and prioritize field work. Using the last five years of inspection data and recorded sediment level, DCR prioritizes catch basin inspection and cleaning using a GIS script that is auto populated based on existing data. Similarly, the New Hampshire Department of Environmental Services and the UNH Stormwater Center worked with the UNH Research Computing Center to incorporate GIS data through the New Hampshire Geographically Referenced Analysis and Information Transfer System. This work established the Pollution Tracking and Accounting Program and created an online tracking database and web interface to track SCMs and other nutrient reduction efforts across the Great Bay watershed. This tool is part of a larger project helping communities develop and standardize reporting and accounting tools to fulfill regulatory requirements.

CONCLUSION

As regulatory requirements demand expansion of stormwater infrastructure and green infrastructure, communities increasingly must maintain tracking technology to document the assets and create appropriate inspection and maintenance strategies for both public and private SCM assets. In many cases, this effort requires collaboration among several municipal departments tasked with managing local permitting, building and facilities, and operations. Interdepartmental collaboration can be improved with technology, but effective communications are still critical. Additionally, participants indicated overlaps with stormwater program needs and existing sanitary sewer collection system programs (e.g., fats, oils, and grease ordinances, industrial pretreatment programs, and sump pump management). This may be an opportunity for NEWEA committee collaboration to support the future of distributed SCM tracking program development.

Figure 3. Obstacles to managing nutrient dilemma (larger font represents obstacles most identified in workshop poll)

Figure 4. Solutions to managing nutrient dilemma (larger font represents highest-priority in workshop poll)

FINDING SUPPORT

During the workshop lunch break, polling questions were provided to attendees on several topics. Fifty-seven percent of respondents felt inadequately supported in meeting nutrient reduction goals. These respondents suggested more training, regulatory assistance, political support, uniform tools, staff, and funding will all be critical. Figures 3 and 4 illustrate participants' takes on obstacles and solutions when managing our nutrient dilemma.

Regional collaboration, sustainable funding, and effective outreach were among the top suggestions to help solve New England's nutrient dilemma, in addition to redevelopment, source reduction, and land conservation. It will take more than a village to restore the Charles River and its watershed. It will take collaborative partnerships across town and city governments, innovative approaches and programs, and financial resources to achieve permit compliance and a restored river.

The NEWEA Stormwater Committee anticipates a workshop session at NEWEA's annual conference to discuss these challenges and solutions. Additional anticipated initiatives include more consistent forums for information exchange, increased collaboration with the Innovation Council, and cross-committee engagement to identify effective sanitary wastewater programs already managing decentralized public and private infrastructure. Each initiative will help our organization lead the way toward smarter, more effective nutrient-based stormwater management and will be integral to expanding our one water, clean water community.

ACKNOWLEDGMENTS

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NEBRA Highlights

PFAS in biosolids—statewide updates

Most of the New England states have been conducting studies to understand the levels of per- and polyfluoroalkyl substances (PFAS) in wastewaters and sludges/biosolids. Most recently, Massachusetts, Connecticut, and Maine have issued reports on the findings from their sampling and analysis.

Massachusetts—The Massachusetts Department of Environmental Protection (MassDEP) has released a report that you can find on NEBRA's website[1] summarizing PFAS analytical data from organic residuals with approvals for land application. The Approval of Suitability (AOS) permit holders must test for 16 PFAS, which include the six PFAS for which soil and groundwater standards are in place in Massachusetts. The report reviewed quarterly data from the third quarter 2020 through the first quarter of 2022. Key findings include the following:

- Paper sludges contained higher percentages of long-chain carboxylic PFAS, composts had higher percentages of short-chain PFAS compounds, and perfluorooctanesulfonic acid (PFOS) was highest in other types of residuals.
- No "overall" trend is apparent in PFAS levels over time, and no "distinct" differences exist by AOS type, CFR 503 designation, or Industrial Pretreatment Program status.
- Type 1 composts had the highest total concentrations of PFAS, with 4 of 11 compost facilities averaging above 50 ppb for the sum of the 16 targeted PFAS.

As a result of the report recommendations, MassDEP issued revised testing guidance[2] which reduces the Field Duplicate analyses to one to two times per year. MassDEP will continue to require analyses using the modified EPA Method 533 until EPA Method 1633 has been multi-lab validated. Additional information and data are available at Testing of PFAS in Wastewater and Residuals | Mass.gov.[2]

Connecticut—The Connecticut Department of Energy and Environmental Protection (CTDEEP) has issued a report, "Water Pollution Control Facility PFAS Sampling Study," following a rigorous sampling program that looked at 35 water resource recovery facilities (WRRFs) and numerous PFAS analytes. The report identified eight of the most prevalent PFAS species, found in more than 50 percent of all samples, as PFOS, PFOA, perfluorobutanesulfonic acid (PFBS), perfluorobutanoic acid (PFBA), perfluoro-n-pentanoic acid (PFPeA), perfluorohexanoic acid (PFHxA), perfluorohexanesulfonic acid (PFHxS), and perfluoroheptanoic acid (PFHpA). For wastewater, the most prevalent PFAS is PFPeA (a 5-carbon version of PFOA) in the influent. In the effluent, the study saw PFPeA again and PFHxA (the 6-carbon version of PFOA). As with other studies, this one found, in general, an increase in PFAS concentrations from the influent to the effluent. Liquid sludges were dominated by PFPeA, 6:2 fluorotelomer sulfonic acid (6:2 FTSA), and PFHxA, while the more solid sludges, or cake, contained predominantly PFOS.

The 35 WRRFs were selected by CTDEEP to ensure geographic coverage and representativeness of community size, as well as WRRF inputs and processes. Several NEBRA member WRRFs were included in this study. As part of the study, CTDEEP also sampled and analyzed composite sludges and incinerator scrubber water at four WRRFs. The scrubber water had similar PFAS species as found in WRRF effluent but at lower concentrations.

CTDEEP plans to build its database and continue with sampling, but likely will require WRRFs to start doing so as soon as EPA finalizes the Method 1633 for wastewater and solid media. CTDEEP is also planning to evaluate sources of PFAS into the WRRFs. To read the full report and associated documents, go to Municipal PFAS (ct.gov).[3]

Maine—The Maine Department of Environmental Protection (DEP) recently released a report on wastewater effluent monitoring for PFAS[4] that was required by legislation passed in 2021 (Public Law 2021, Chapter 641). The monitoring focused on the sum of six PFAS currently regulated under the state's drinking water laws.

The Maine DEP report includes three sections:

1. Effluent/surface water discharges from WRRFs
2. Effluent from select Spray Irrigation facilities
3. Effluent from select Industrial/Commercial WRRFs

New York—The New York Department of Environmental Conservation (NYDEC) has issued a draft Program Policy on biosolids recycling in New York State[5], Program Policy 7 under the NYDEC Division of Materials Management (DMM7). DMM7 is considered an interim strategy to control PFAS compounds, specifically in biosolids. DMM7 mirrors the approach by Michigan and other states to establish a limit below which biosolids may continue to be land applied. NYDEC is proposing 20 parts per billion for PFOS and PFOA. Biosolids with concentrations above 50 ppb will not be allowed to be recycled to land in New York. The interim policy is intended to reduce risks in recycling biosolids while EPA works on risk-based standards. NEBRA submitted a comment letter on behalf of its New York members asking that the NYDEC consider the "risks of not land applying biosolids, in terms of soil health and climate change impacts." Biosolids have been used in the state to help remediate problem soils, such as high lead and arsenic in apple orchards and potato fields from past pesticide applications. NYDEC supports beneficial use, but source reduction will be critical to ensure continued recycling of biosolids in New York.

DEC interim guidelines for PFOA and PFOS in biosolids recycled

PFOA or PFOS In biosolids, dry weight (µg/kg or ppb)*	Action required for biosolids that are recycled
20 or less	No action required
> 20 but <50	Additional sampling required—DEC will take appropriate steps to restrict recycling after one year if the PFOS or PFOA levels are not reduced to below 20 ppb or less
50 or greater	DEC will take action to prohibit recycling until PFOS or PFOA concentration is below 20 ppb

* In addition to dry weight results, DEC may require analyses using the Synthetic Preclpitation Leaching Procedure and use those results to determine whether the biosolids source can be recycled.

Minnesota—Outside the Northeast, the Minnesota Pollution Control Agency (MPCA) has published a report that shows the costs of PFAS cleanup to be unaffordable. The MPCA report[6] says that removing and destroying PFAS from water and biosolids leaving Minnesota's wastewater treatment facilities could cost between $14 billion and $28 billion over 20 years.

Other significant findings included the following:

- PFAS can be bought for $50 to $1,000 /lb ($110 to $2,200 / kg), according to MPCA estimates, but costs between $2.7 million and $18 million /lb ($6 million to $37 million / kg) to remove and destroy from municipal wastewater, depending on facility size.
- Small wastewater treatment facilities would face per-pound costs over 6 times greater than large facilities, due to economies of scale.
- New "short-chain" types of PFAS are more difficult and up to 70 percent more expensive to remove and destroy compared to old "long-chain" PFAS.

Maine passes measure to alleviate emergency situation with sludge

The Maine Legislature has passed a new law to alleviate the impacts on sludge disposal at the state's main landfill by increasing bulking materials available to mix with wet wastes. LD718, "An Act to Facilitate the Management of Wastewater Treatment Plant Sludge at the State-owned Juniper Ridge Landfill," passed out of the Environment and Natural Resources Committee unanimously. It also passed the House unanimously, was approved by the Senate on June 20, and was signed by the governor on June 23. As an emergency measure, it became effective immediately.

LD718 changes the rules for two years, so it is only temporary, but it will allow for continued safe landfilling of biosolids in Maine, the only option available in-state. It also requires, by January 15, 2024, "the Department of Environmental Protection, in consultation with the Public Utilities Commission, to evaluate options for and develop recommendations regarding state regulation of the transportation, landfill disposal, and other management of sludge generated from wastewater treatment plants…." The new law has reduced the amount of biosolids being shipped to New Brunswick, Canada, according to sources. It has also provided relief from disposal surcharges for some Maine WRRFs.

EPA updates guidance on pathogens and vector attraction in sewage sludge

Earlier this year, EPA updated its guidance on Pathogens and Vector Attraction in Sewage Sludge (see Pathogens and Vector Attraction in Sewage Sludge | Science Inventory | US EPA[7]). The guidance document, originally published in 1992 and last updated in 2003, was commonly referred to as the "White House document," because it had a picture of the White House lawn under construction with biosolids. But that non-official document designation confused many who are new to biosolids. The document is a resource for anyone involved with the treatment of sewage sludge for land application.

This latest, most significant update comes as one of 13 responses—or corrective actions—to address the EPA Office of Inspector General's 2018 report on its review of EPA's Biosolids Program. Besides the new cover, major changes to the guidance include the following:

- Addition of the preferred EPA Methods 1680, 1681, 1682
- Addition of a list of approved Processes to Further Reduce Pathogens (PFRPs) and Processes to Significantly Reduce Pathogens (PSRPs)
- Addition of language that specifies that vector attraction reduction (VAR) must occur simultaneously with pathogen reduction (i.e., VAR cannot precede pathogen reduction processes)
- Clarification that a Pathogen Equivalency Committee determination is not an endorsement by EPA[8]

EPA hosted a 50-minute webinar on May 23—"Biosolids Webinar Series: Updates to Pathogens and Vector Attraction in Sewage Sludge"[9] as part of its EPA biosolids webinar series.[10] Sign up for future EPA biosolids webinars if you have not already.

EPA Biosolids Science Advisory Board panel wraps up its work

EPA's Science Advisory Board (SAB) panel on biosolids held its last meeting on July 5 to finalize its report to EPA. The 36-page report includes comments, suggestions, and

recommendations for EPA on its biosolids risk assessment framework. The SAB biosolids panel was created in 2022 and was charged with reviewing EPA's proposed methodology for screening and assessing contaminants in biosolids for their risk to humans and the environment. EPA's stated goal for this panel was to help modernize, standardize, and streamline the biosolids risk assessment process.

In addition to a peer review of EPA's overall risk assessment approach, the SAB was asked to review EPA's Biosolids Screening Tool (BST) for its scientific credibility and usability. The BST will be used for screening-level assessments of contaminants in biosolids. At the latest meeting, the panel of experts discussed their draft report section by section, with the goal of reaching consensus on the text and recommendations. The panel also reviewed and discussed the draft User Guide for the BST and suggested improvements. The panel's preliminary draft report (may be final this autumn) can be found at the EPA website.[11]

A theme repeated by panel members was "compounding conservatism," with concern that the EPA models are layering conservative assumptions on top of conservative assumptions resulting in overestimation of risk. The panel's consensus opinion is that the Public Information Curation and Synthesis (PICS) process is sufficient if the SAB's recommendations are followed. One concern expressed by most of the panel is that EPA should consider the biosolids matrix and how PFAS behave in that matrix, which differs from that in other substance matrices.

Both WEF and the National Association of Clean Water Agencies (NACWA) provided written comments on the draft SAB report. NACWA's comments included the following:

- "The framework needs an off-ramp for chemicals where a risk assessment would be unwarranted or provide meaningless results. The off-ramp is particularly relevant for chemicals (e.g., pharmaceuticals) that are intentionally ingested in food and consumer products."
- "A risk assessment off-ramp is also necessary for chemicals that are present in biosolids at or below background soil concentrations."

The full SAB biosolids panel must approve the final peer review report and cover letter, and then it will be sent to EPA Administrator Michael Regan. It is not clear what will happen with the report or whether EPA must make any changes as a result. The minutes and all documents related to the Biosolids SAB panel can be found at the EPA website.

New and recommended on NEBRA's YouTube channel

The June Lunch & Learn was about landfill capacity in the Northeast. Jennifer Griffith with the Northeast Waste Management Officials Association (NEWMOA) reviewed and provided updates on NEWMOA's April 2021 report, "Solid Waste Disposal Capacity in the Northeast." The report was intended to inform conversations about the future of landfill management in the region, and it certainly sparked conversations with NEBRA members.[12]

Read more on these topics and stay abreast of the latest biosolids/residuals news and events at nebiosolids.org/news. For upcoming events, go to the events page of NEBRA's website.

1. https://www.nebiosolids.org/resources#/pfas-biosolids/
2.https://www.mass.gov/doc/required-laboratory-procedures-for-testing-pfas-in-residuals/download
3. https://portal.ct.gov/DEEP/Municipal-Wastewater/Municipal-PFAS
4. https://www1.maine.gov/dep/spills/topics/pfas/PL2021 ch641 PFAS Sum of 6 Report- April 2023- Final-rev.3_5-30-23.pdf
5. https://www.dec.ny.gov/regulations/81768.html
6. https://www.pca.state.mn.us/news-and-stories/groundbreaking-study-shows-unaffordable-costs-of-pfas-cleanup-from-wastewater
7. https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=356976&Lab=CESER
8. https://www.epa.gov/biosolids/pathogen-equivalency-committee
9. https://www.youtube.com/watch?v=NkxLt0solWE
10. https://www.epa.gov/biosolids/epa-biosolids-webinar-series
11. https://sab.epa.gov/ords/sab/r/sab_apex/sab/meeting?clear=19&p19_id=1004&session=2343485472583#draft

Janine Burke-Wells, Executive Director
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For additional news or to subscribe to NEBRAMail, NEBRA's email newsletter, visit nebiosolids.org

Event Proceedings Spring–Summer 2023

On April 26, Poo & Brew attendees toured the Charles River Pollution Control District in Medway, Massachusetts

LABORATORY PRACTICES SPECIALTY SEMINAR
PFAS SAMPLING PROCEDURES AND ANALYTICAL METHODS

May 3, 2023
Narragansett Bay Commission, Providence, RI

This Laboratory Specialty seminar focused on the importance of proper sampling and the analytical procedures for PFAS in Water and Wastewater. The one-day seminar program included morning presentations on effluent PFAS testing; PFAS testing methods/guidance; and NBC's PFAS sampling protocol. Following the morning sessions, attendees were brought on a tour of NBC's Lab. Afternoon sessions featured presentations on sampling and analysis of PFAS in biosolids and passive sampling procedures. The seminar concluded with a discussion panel.

Sponsors: Alpha Analytical, Flygt, and Wilkem Scientific

STORMWATER CONFERENCE
THE FUTURE OF STORMWATER IN NEW ENGLAND—STRATEGIES TO SOLVE OUR NUTRIENT DILEMMA

May 10, 2023
Framingham, MA

This interactive conference highlighted the latest innovations in regional watershed management, nutrient-focused stormwater controls, pollution prevention and source control, and long-term Stormwater Control Measure (SCM) tracking and accounting. Mark Doneux of Capitol Region Watershed District delivered the keynote on how watershed districts work in Minnesota, followed by a panel discussion on regional perspectives of watershed districts in New England and three rotating workshop sessions.

Sponsors: University of New Hampshire Stormwater Center and Woodard & Curran

RCAP/SMALL COMMUNITY TRAINING

June 14, 2023
Upper Blackstone Clean Water, Millbury, MA

RCAP Solutions and NEWEA partnered to host a workshop for small and rural wastewater utilities to build financial, managerial, and operational capacity for their systems. Topics addressed included safety, regulation review, pumps, collection, operations & maintenance, and activated sludge. Funding from the EPA made this event possible.

POO & BREWS

NEWEA's Young Professional 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 who are professionals in all stages of their water industry careers.

Three Poo and Brews were held in recent months. On April 26, attendees toured the Charles River Pollution Control District in Medway, Massachusetts, and enjoyed a reception at CraftRoots Brewing. The next event on May 24 featured a tour of Cheshire Water Pollution Control Department in Cheshire, Connecticut, and a reception at Counterweight Brewing. The Young Professional Committee partnered with the Association of Environmental Engineering and Science Professors (AEESP) to host walking tours of green infrastructure in Boston and a reception at Night Shift Brewing on June 23.

Sponsors: ADS Environmental Services; AECOM; Aqua Solutions, Inc.; Arcadis; Brown and Caldwell; Carlsen Systems, LLC; CDM Smith; Dewberry; Environmental Partners; EST Associates, Inc.; F.R. Mahony & Associates; Flow Assessment Services; GHD, Inc.; Green Mountain Pipeline Services; Hayes Group; Hazen and Sawyer; HDR; Jacobs; Kleinfelder; Multiple Hearth Services; MWH; NEFCO; Stantec; The MAHER Corporation; Tighe & Bond, Inc.; Veolia; Weston & Sampson; Woodard & Curran; Worcester Polytechnic Institute; and Wright-Pierce

Swales, Ales, and Homebrew Contest

David Gould (center) describes the positive effects of dam removal

On July 26, the Watershed Management Committee kicked off its first in a series of events termed Swales & Ales (a watershed management take on Poo & Brew) in tandem with its fourth Annual Source Water Brewers Competition.

SWALES

Starting on Billington Street in Plymouth, Massachusetts, David Gould, director of the Department of Marine and Environmental Affairs for the Town of Plymouth, led a walking tour of Town Brook, where several dams have been removed in the last two decades, including the *first* coastal dam removal in Massachusetts. David started by providing a history of the brook (legend has it that the Wampanoags took herring from this brook to show the Pilgrims how to fertilize corn) and explained how the first dam removal came about from a realization that removing the dam made more sense than replacing a damaged fish ladder. He explained that the success of the initial dam removal in 2002 paved the way for five subsequent barrier removals, which were all paired with stream restoration and beautification projects along Town Brook. Attendees followed a well-maintained trail alongside Town Brook and learned about the marked improvements to fish passage that took place following each dam removal. About 7,000 herring were counted upstream of one of the dams in 2003 compared to almost 200,000 in 2016, and the numbers continue to climb. The tour concluded at the Billington Street Rain Garden, which treats stormwater before it reaches Town Brook and provides habitat to birds and insects. Additional information about Plymouth's recent watershed management projects can be found at noaa.maps.arcgis.com.

The brew judging gets under way

James Plummer presents the plaque to Joseph Zaleski whose brew received the most votes

The Mayflower brewmaster inspecting an entry

Scott Mangold and Wayne Bates celebrate their draw for second place in the voting

ALES

Following the tour of Town Brook, attendees met at Mayflower Brewing Company for the Watershed Management Committee's fourth Annual Source Water Brewers Competition. Attendees sampled the suds of eight homebrewers, seven of whom were hopeful to claim triumph over reigning victor, Joseph Zaleski.

The competition was fierce, and the brew names were fiercer:

- Devil's One More Time (Jalapeno Beer by Mario Leclerc of Town of Seabrook, NH)
- Sanitary Sewer Saison (by Scott Mangold of Jacobs)
- Poo Beer (Nit-Wit by Ryan Flood of Water Analytics)
- Purple, because Aliens Don't Wear Hats (West Coast IPA by Steve Wolosoff of GEI Consultants)
- Glitter PFOA Sparkles (IPA by Danielle Dolan of Collaborative Community Consulting)
- Another "Pore" Decision Lager (by Wayne Bates of Tighe & Bond)
- Market Street Mango (Fruited American Pale Ale by Chris Dill of Rhode Island Department of Environmental Management)
- You're the Shore, I'm the Tidal Wave (Fruited Berliner Weisse by 2022 Champion, Joseph Zaleski of Woodard & Curran)

While enthusiastic sampling of homebrews and voting took place, Mayflower Brewing Company staff provided tours to attendees interested in learning more about the company's processes. The contest was close and when voting concluded, Joe Zaleski held onto his title as champion of the Source Water Brewing Competition, while Wayne Bates and Scott Mangold shared second place.

Thank you to all who helped make this event a success:

- Sponsors: Mayflower Brewing Company, GEI Consultants, and Woodard & Curran
- David Gould and the Town of Plymouth
- Janice Moran and the rest of the NEWEA staff
- All our Source Water Brewers

Safe source water today means good beer tomorrow!

Committee Focus

Public Awareness

The Public Awareness Committee helps raise an understanding of our industry beyond NEWEA membership. The *Journal* reached out to its current chair, Faye DeMoura, to learn more about the committee and its recent and upcoming activities.

Journal *Can you tell us about the committee?*

Our committee is all about public education! Helping our communities understand the work we do is key to maintaining a thriving workforce. Just take the theme of this *Journal* (nutrient control) for example: Nutrient control can be costly for municipalities and utilities to make sure their systems do not harm our waterways with nutrient overload. Ratepayers are often unaware of the importance or need to upgrade a treatment plant for nutrient control. Education about the need can be helpful to generate ratepayer buy-in.

Scott Lander and Stacy Thompson (Dr. Flush and Professor Flow) engage students at York Sewer District's annual "Imagine a Day without Water"

Our committee has 13 active members, and a handful of others who contribute when they can. These members represent all areas of our industry—engineers, municipal employees, consultants, operators, utility superintendents, and marketing professionals. Our current list of goals is long:

- Participate in industry and public education events
- Develop outreach materials such as toolkits, videos, or social media posts
- Champion and seek funding for the Water for Life outreach campaign
- Create Water Champion stories
- Support the Paul Keough award nominations

■ *What are some of the committee's recent and upcoming activities?*

Our committee created a script and updated youth education materials for the York Sewer District's annual "Imagine a Day without Water" that takes place at local schools. 2023 was the committee's third year participating in the event and second year having a table that runs the Dr. Flush and Professor Flow session, which includes a "What not to flush" activity for the students.

We also recently rolled out our *Water for Life* video series. These videos can be found on YouTube, with the following titles to search:

- Video 1: *A Day in the Life of a Water Professional*
- Video 2: *Three Projects, One Goal: Highlighting Stormwater Management in New England*

Finally, we updated the PFAS Awareness Campaign (see newea.org), and created the video *What My Parents Do for Work*, also on YouTube.

Upcoming Public Awareness Committee activities

We are developing the third video in the *Water for Life* series, focused on innovation. We are also working on a Public Awareness session for the 2024 Annual Conference: We're going to have a panel this year—a new format for us. We are also creating a toolkit for utilities and municipalities to host open houses to educate the public.

■ *This all sounds amazing! How can we help?*

Talk about the work that we do with anyone you come across. Grassroots education inspired by one-on-one direct contact is effective. You can make a difference.

The Public Awareness Committee is an active, engaged one that is always looking for people who are willing to lend a hand in the projects we take on. Not sure how you can help? No problem. Every one of us needs water every day. That makes us all qualified to contribute to the Public Awareness Committee. All are welcome!

YP Spotlight—*Thomas Waterfield*

These past few months, our region has experienced a record number of toxic cyanobacteria blooms. While cyanobacteria themselves are naturally occurring, their blooms indicate unbalanced growth, largely from nutrient runoff from fertilizer and human and animal waste.

Thomas Waterfield, an environmental engineer at CDM Smith, has been sampling for these blooms in Massachusetts. We reached out to Thomas to learn more about his experiences as a young professional, and also his perspective on nutrient control.

Journal *How long have you been in the clean water industry?*

I have been in the industry since I graduated college. I started at CDM Smith in January 2020 and joined NEWEA not too long after that. Working with the many brilliant people at CDM Smith and NEWEA has been the most exciting part of my experience so far. Every day brings something new or a different challenge to overcome and working with a group of like-minded and intelligent people to achieve a common goal leaves you with a sense of accomplishment you can't find anywhere else.

■ *What got you excited about working in the clean water industry?*

This will be a long one. I was born and raised in Pembroke, Massachusetts, a small-to-medium sized town in the South Shore of Massachusetts about 10 miles off the coast, where small brooks meander through the woods and parts of North River pass through until it reaches the ocean. The South Shore's diverse ecosystems and water bodies were a staple of my childhood. Countless summers going to the beach, kayaking along the North River, exploring new walking trails, and observing all the species that make marshes and estuaries their homes. The older I got, the more my love grew for our environment, water bodies, wetlands, and native species. However, with age came more knowledge, and I started to see the negative impacts humans were having on our environment, both locally and nationally. Local ponds and lakes were no longer allowing recreational activities due to poor water quality, native (aquatic) species dwindling in number, and estuaries being lost or destroyed.

Then, on one blistering hot day in Pennsylvania, a single moment kick-started my career. I was at my older sister's college graduation and the guest speaker was none other than Bill Nye (the Science Guy). He ended his speech by saying, "It will be your generation that helps preserve and change this world. I dare you all to be the ones that drive this change." I knew from that point on that I wanted to be someone who made a difference. I wanted to be someone who helped keep our waters clean; to allow future generations clean drinking water and clean water bodies so that the childhood memories I have will live on with future generations.

Thomas Waterfield

■ *What environmental challenges do you feel are particularly pertinent to New England, especially as our climate continues to become warmer, and more volatile?*

I think nutrient loading of our water bodies, due to roadway runoff, old septic tanks, and inefficient treatment, will become even more of a challenge because of the volatile weather we are seeing even today. Rainfall will continue to increase, as will severe storms, which will only compound this issue. New England is home to many native species that call these locations their homes, and we are already seeing how nutrients can impact these locations and species.

■ *Tell us a fun fact about yourself.*

I am a direct descendant of the first governor of Massachusetts, John Winthrop!

2023 Stockholm Junior Water Prize

Naomi Park of Connecticut Wins International Competition

SIWI STOCKHOLM JUNIOR WATER PRIZE

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

WEF organizes the national SJWP competition and solicits electronic research paper entries for each state competition and returns New England entries to NEWEA following the announced deadline. By having applicants apply directly through WEF's website, project presentations can be ranked fairly by local volunteer judges. This year, applications were received from four New England states.

Naomi Park of Greenwich, Connecticut, was awarded the international Stockholm Junior Water Prize for her research on collecting Styrofoam debris in the ocean and using this material as a filter to reduce carbon levels in the ocean.

Naomi previously won the Connecticut state competition and the national competition, receiving the $10,000 prize. She then moved on represent the United States and compete at the international competition in Stockholm August 20-24, where she was named the 2023 winner and was presented with the crystal trophy by HRH Crown Princess Victoria of Sweden. As the international winner, Naomi was the recipient of the $15,000 prize.

To learn more about her project, read her abstract below or visit the SJWP site to read her full paper.

Thank you to the state associations for their continued support and to our NEWEA judges—Carina Hart, Amy Mueller, Tracy Chouinard, and Jacqueline Collins—for volunteering their time and expertise to review papers. NEWEA's SJWP coordinator is Annalisa Onnis-Hayden.

Connecticut

Naomi Park
Greenwich High School
Greenwich, CT

2023 SJWP Winner

Concurrent removal of rising, soluble ocean carbon dioxide and oil-in-water contaminants via multi-functional remediation framework

The oceans absorb nearly a third of airborne CO_2 emissions, while concurrently, 1.3 million gallons of crude oil are spilled into oceans every year. Both issues continue to detrimentally affect marine biodiversity and human health. This research provides a highly efficient/practical method for the concurrent removal of CO_2 and soluble oil-in-water contaminants through the creation of a Multi-Functional Remediation Framework (MF-RF) utilizing hypercross-linked polymers (HCPs), synthesized from Styrofoam. First, Styrofoam HCPs were synthesized according to Dong et al. HCPs alone remediated 88% of the 1.7 g/L-soluble-benzene in seawater (via measure of benzene's fluorescence). Regarding CO_2, 95% of the contaminant was removed, or 3.12 E - 5 M $[CO_2] = [H+]$ (via pH measure). For the MF-RF, HCP sponges were constructed on 8 x 1.3 x 0.7 cm of melamine, with PTFE adhesion, and 450 mg HCP for pollutant removal/capture. The MF-RF remediated 92% of the 1.7 g/L-benzene contaminant, and 95% of CO_2. Realistic concurrent oceanic experiments with a 0.1 pH difference and maximum solubility of benzene highlight 92% remediation of oil, with only 12.6 min needed to reach suitable oceanic pH. Highload concurrent removal experiments with 100x more CO_2 demonstrate 71% remediation of oil and 85% remediation of CO_2. Via recycle/reuse studies, the MF-RF may be reapplied until its capacity is reached (5.99g oil/HCP-sponge and 3700ppmCO_2/HCP-sponge) and then simply lifted out for contaminant recovery/recycling.

Massachusetts

HyeonKi (Ian) Lee
Northfield Mount Hermon
Gill, MA

Development of cost-effective, sustainable microbial fuel cells for purifying manure polluted river

Water pollution is a growing problem that is detrimental in developing countries with the difficulty in building wastewater treatment facilities due to high costs. Apart from economical concerns, cultural practices such as open defecation can also contribute to the problem. As a solution, a Microbial Fuel Cell (MFC) can be utilized to purify water by decomposing organic matter, a major pollutant, through the catalyst actions of microorganisms. In this study, the MFCs' expensive components were replaced with cheaper materials, but the MFCs were able to purify the wastewater. The chemical oxygen demand (COD) of artificial feces decreased from 100 ppm before to 50 ppm after 48 hours of MFC's operation. The MFC also produced small amount of power (0.2 W) and maintained it for a week without any maintenance. With four MFCs connected in series, a light emitting diode (LED) light was operated, indicating the possibility to sterilize microorganisms with an UV LED in the future. Hence, MFC's performance can be maintained at low-cost, which concludes that MFCs can be widely distributed in developing countries as a potential water treatment device.

New Hampshire

Abhinav Avvaru
Nashua High School South
Nashua, NH

An economical high precision home nitrate detecting device for water monitoring at homes

There has been a rise in water pollution with nitrates over the past few years. Currently, there is no cost-effective option to detect nitrates in water. The current nitrate detection options are expensive and not economically feasible to be used in homes. Also, they cannot continuously monitor a water source to allow the user to see whether the nitrate concentration is slowly increasing.
The goal of this research is to develop an economic and practical device to detect nitrates. A chemi-resistor sensor, based on a nanocomposite derived from carbon nanotubes and doped conducting polymers, was created to detect nitrates in water. The sensor was tested with various concentrations of nitrates, and a regression model was established. The model was used to predict the concentration of nitrates present in water and display it on an LCD screen, based on the change in voltage in the sensor.

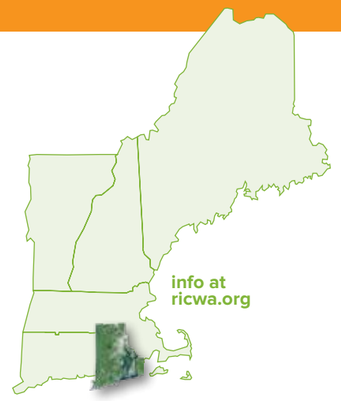
Maine

Alexander Busko
Bangor High School
Bangor, ME

The development of a pour-through oil-water column filter to effectively extract microplastics from water

A pour-through oil-water column filter that uses the non-polarity and density of vegetable oil was created for microplastic removal from water. Due to mutual nonpolarity, Ferreira (2019) demonstrated a molecular attraction between vegetable oil and microplastics. This filter integrates the density difference between vegetable oil and water to create a pour-through system. As microplastics-spiked water (influent) was poured into the filter, it sank, due to its higher density, through a vegetable oil layer. The oil captured the microplastics. The filtered water collected below the vegetable oil (effluent) and passively drained through the bottom of the filter. Influent and effluent samples were processed using a vacuum filtration system; the microplastic removal was determined using image processing. This algorithm calculated the area of the filter paper covered in microplastic pre- and post-filtration for comparison. A t-test of this analysis against a standard method produced an observed t-value of 0.57 and a critical t-value of 2.021, demonstrating statistical similarity. This filter removed an average of 99.36% microplastics, demonstrating that a high microplastic removal efficiency can be achieved with a simple system.

Rhode Island



by Eddie Davies
edavies@quonset.com

Established in 1952, the Rhode Island Clean Water Association (RICWA) is a nonprofit organization created to promote the advancement of knowledge concerning the nature, collection, treatment, and disposal of domestic and industrial wastewaters. As the NEWEA state director for the past three years, a regular part of my job has been to offer reports to the NEWEA *Journal* regarding my duties and the activities and notable news from the water quality protection community of the Ocean State. For this issue, we'll recognize the retirement of a giant in the field and mention some RICWA accomplishments over the past few months.

Bill Patenaude retires


Bill Patenaude

After more than 30 years of dedicated service to the Rhode Island Department of Environmental Management's (RIDEM's) Office of Water Resources, Bill Patenaude, principal engineer, has retired. During his time at the RIDEM's Office of Water Resources, Bill focused on water pollution control, leading training, licensing, and regulatory oversight, and he has been around long enough to see a growing public understanding of the importance of protecting the waters of the Ocean State. Bill worked in the Operations and Maintenance Section, which oversees, licenses, and regulates wastewater treatment facilities in Rhode Island. The section also approves and enforces operation and maintenance manuals, and reviews operational failures that result in violations.

Bill was integral in developing and implementing the first state-wide ongoing professional development program in the country for plant operators, the Wastewater Operator Leadership Boot Camp, a year-long professional development, networking, and succession-management training program for the wastewater profession. To participate, plant operators must be recommended by their supervisor and commit to attending the series of 12 workshops. Many of the courses are technical, but a focus is also placed on enhancing writing, communications, and other professional development skills. Introduced at RIDEM in 2007, the program concept has since been adopted by all New England states.

While congratulations are due for a job well done, he doesn't plan to disappear. Following his retirement, Bill, who never could sit still for long, is already back to the grind as a training specialist for NEIWPCC.

Annual golf tournament

On June 19, 136 golfers participated in RICWA's annual tournament at the Potowomut Country Club. This fundraiser raised over $7,500, and the proceeds support RICWA programs including the Scholarship Fund and Operations Challenge team participation. Thank you to the following:

Golf Committee members: Peter J. Connell (Chair), Bill Wilber, Bernie Bishop, Paul Desrosiers, Scott Goodinson, Eli Hannon, and Kim Sandbach

Volunteers: Bill Patenaude, Traci Pena, Chloe Pena, Jack Segal, Mike Spring, Melissa Mooradian, Kim Sandbach, Jim DeLuca, Matt DeLuca, James Lauzon, Patty Sheridan, Fern Johnson, Ralph Wilber, Tracy Santoro, and Lidia Goodinson

Sponsors: Synagro, Jacobs, Xylem, Hart Corporation, PARE Corporation, Arcadis, EJ Prescott, NEIWPCC, C3ND, The Maher Corp., Roto Pumps N.A., Aqua Solutions, BETA Group, CDM Smith, H2O Innovations, Hayes Pump, ISG/Inland Waters/Green Mountain, Traffic Signs & Safety Inc., Safety Source, Seacoast Supply, United Rentals Fluid Solutions, Weston & Sampson, and Wilkem Scientific

Rhode Island Operations Challenge team: Shaun Collum, Max Maher, Rob Norton, Dave Bruno, and Courtney Iava-Savage (not shown Eddie Davies)

Operations Challenge

Congratulations to team RIsing Sludge that competed in Operations Challenge during the NEWEA/New York Water Environment Association Joint Spring Conference at the Saratoga Hilton in Saratoga Springs, New York. Operations Challenge, the water sector's premier skills competition, is unmatched in delivering cross-training, team building, and professional development. RIsing Sludge demonstrated outstanding professionalism, teamwork, and a tireless drive to succeed as they secured 1st place in the Lab and Process events, 3rd place in Collections, 4th place in Pump Maintenance, and 5th place in Safety, achieving a second-place overall finish! With these results, the Rhode Island team has earned an invitation to compete in an upcoming national competition this fall in Chicago where it will represent both RICWA and NEWEA. The team includes Eddie Davies and Dave Bruno of the Quonset Development Corporation, Rob Norton of the City of Newport, Max Maher of Toray Plastics, Shaun Collum of the South Kingstown regional wastewater treatment facility, and Courtney Iava-Savage of Veolia.

Operator Boot Camp

Beginning this October, RIDEM and RICWA will host a year-long Wastewater Leadership Boot Camp program, aimed at grooming mid-level clean water professionals for upper management. This well-known "Operator Boot Camp" graduated its first class in 2008, with 13 participants receiving broad training. Training will be one day a month, moving locations throughout Rhode Island, and will include topics such as management and leadership basics, industrial pretreatment, microscopic observation, Rhode Island Pollutant Discharge Elimination System permitting development, facilities engineering and design, emergency response and preparedness, finance and budgets, and media relations.

Annual scholarships

RICWA provides annual scholarships to college students, sponsored by our members and through fundraising. Scholarships range from $500 to $1,000, depending on the number and quality of applications. Please check ricwa.org for application details.

2023 RICWA event highlights

- 8th Annual Chowder Cook-off (August 10 in Jamestown)
- Annual Trade Show and Luncheon (September 8, at the Warwick Crowne Plaza)
- Annual Holiday Party, Food Drive, & Elections (December 1)

Please check ricwa.org or our Facebook page for all association news and full event listings.

This will be my last report to the *Journal* as NEWEA's Rhode Island state director, as my three-year term will end in January. Thank you to everyone at NEWEA who has helped guide me through this amazing experience, and I look forward to my continued involvement with the association.

Connecticut State Director Report

by Vanessa McPherson
vanessa.mcpherson@arcadis.com

The Connecticut Water Environment Association (CTWEA) has set a great pace in our first year and is keeping the momentum going. Congratulations to our new officers—Jeff Lemay, president, and Ben Levin, vice president. Jane LaMorte will continue to serve as treasurer. On behalf of the CTWEA Board of Directors and membership, congratulations to Tom Sgroi for his fantastic presidency. His leadership has been steadfast in navigating the process to create our merged organization through an incredibly successful first year. We are grateful to Tom for his commitment, strong voice, and support. Tom will continue his involvement in CTWEA through our board and committee work.

2023 Wastewater Forum and Expo

The 2023 Wastewater Forum and Expo was on May 8 at the Aqua Turf Club in Plantsville. Jeff Lemay hit the ground running as president by leading the event,

which featured a packed presentation agenda and vendor networking area. The event was attended by some 180 wastewater managers, operators, and engineers and included over 30 vendor booths and exhibits. Highlighting the event were several speakers, including Carlos Esguerra from the Connecticut Department of Energy and Environmental Protection (CTDEEP). Once again, the expo featured an Operations Challenge pipe cutting competition with gift cards awarded to competitors with top times. Attendees received 4.75 training contact hour credits, and the group enjoyed the presentations, networking, and great food.

Government affairs

A highlight of the CTWEA Government Affairs Committee's work was participation in the 2023 National Water Policy Fly-In (Water Week) at our nation's capital. Jeff Lemay and I traveled to Washington, D.C., on behalf of Connecticut to attend the plenary sessions and meet with our legislators to provide information and advocacy for challenges and successes in our industry. The Connecticut delegation highlighted the state of our infrastructure, funding/financing, workforce development, and PFAS. This opportunity to engage directly with water professionals, members of Congress, and EPA and other federal agencies was rewarding and something everyone should consider participating in.

At the state level, our legislative session has closed with favorable outcomes for several bills that CTWEA tracked closely. Although Raised Bill No. 916 (Act Concerning Foreclosure, Assignment, and Other Enforcement Actions for Unpaid Sewer Assessments and other Fees and Charges) was not voted on, we expect to see work continue next year. Our group is discussing how to frame our case that this bill will affect the ability of municipalities to collect on sewer bills, something critical to effectively operate and maintain facilities. Raised Bill No. 1147 was an environmental justice one that had initially proposed hearings for any facility improvements planned at WPCFs, pump stations, and other existing clean water facilities. Through dialogue with the CTDEEP and legislators, modifications to the proposed legislation were included and the Raised Bill was passed.

CTDEEP has issued a report, "Water Pollution Control Facility PFAS Sampling Study," which included a rigorous sampling system for PFAS analytes in 35 WPCFs in the state. The 35 WPCFs were selected by CTDEEP to ensure representativeness in geographic coverage, community size, and WPCF input sources and processes. Samples were collected in the summer of 2021 and the winter of 2022 from various media including the influent, effluent, and sludges from WPCFs, fish tissue, and surface waters upstream and downstream from 10 WPCFs. The report is available on CTDEEP's website.

Operations Challenge team—Connecticut Storm Surge: (l to r) Nick Stevens, John Kaminski, Kevin Mauricin, John McGarty, Brad Vasseur, and Jason Nenninger

Operations Challenge

Connecticut Storm Surge is back this year, fueled by the enthusiasm of new members, including Nick Stevens (Greater New Haven Water Pollution Control Authority [WPCA]), John Kaminski (Canton), Kevin Mauricin, and John McGarty (both from Veolia – Norwalk water pollution control facility [WPCF]). Brad Vasseur (Greater New Haven WPCA) is a returning member. Jason Nenninger and Ryan Harrold continue to mentor and support the team, and we are grateful for their dedication. Coming up to speed did not stand in this group's way of excellent performance during the joint NEWEA/NYWEA Spring Meeting in Saratoga Springs, New York, where it secured the opportunity to represent New England and Connecticut in the National Operations Challenge competition at WEFTEC this fall in Chicago. The team is always looking for sponsors, so please visit our website to contribute in any way (time, financial support, supplies, etc.).

Sewer Open

CTWEA's Golf Outing, better known as the Sewer Open, was June 16 at the Skungamaug River Golf Club in Coventry. Once again, the tournament was sold out and Director Ray Bahr did an incredible job organizing the event with support from his committee. This tournament is a key fundraising event for programs that CTWEA supports annually. Tee sponsorships are used for scholarships to students who will pursue an environmentally related college degree, while golf green sponsorships support Operations Challenge. We raised $3,400 for the Scholarship Fund and $3,000 for Connecticut's Operations Challenge team. Additionally, thank you to all the attendees during the festivities who purchased Win the

Sewer Open

Driver raffle tickets, raising an additional $945 to support Operations Challenge. The golfing event would not be possible without the support of our generous sponsors. Please check out our website for a full writeup and to see the wonderful photos taken by Charlie Tyler.

Operator Exchange

Connecticut is paired up with Rhode Island this year for the Operator Exchange. After extending a call for applications, CTWEA selected Graydon Stewart to participate on behalf of Connecticut. Graydon is an Operator in Training III working at the Farmington WPCF. He has three years of experience in the industry, and Farmington is the second facility where he has worked. Graydon visited several facilities in Rhode Island in September and participated in the Rhode Island Clean Water Association annual trade show.

Events and happenings

- Fall Workshop—October 16, 2023
- Managers Forum—December 11, 2023

Other highlights

CTWEA's first-ever summer baseball outing was held to cheer on the Yard Goats in Hartford on August 4. Many thanks to our Networking and Events Committee for organizing and all of the event sponsors.

Become a member or supporter today! We are always looking for volunteers for our committees, so please express interest through our website, ctwea.org.

Maine State Director Report

by Paula Drouin
pdrouin@lawpca.org

Hello, from Maine, where we hope that fall will provide us relief from the record high rain events and volumes New England experienced over the summer. In reading news stories and seeing photos from other states in the region, I know Maine is not alone in dealing with these severe wet weather events and the aftermath of them. In addition to treatment systems and waterways being repeatedly overwhelmed and flooded, multiple roadways and areas of in-ground infrastructure have been washed out, amounting to millions of dollars' worth of damage. We owe a sincere thank you to the frontline water and utility workers who tirelessly show up to keep our community services operational.

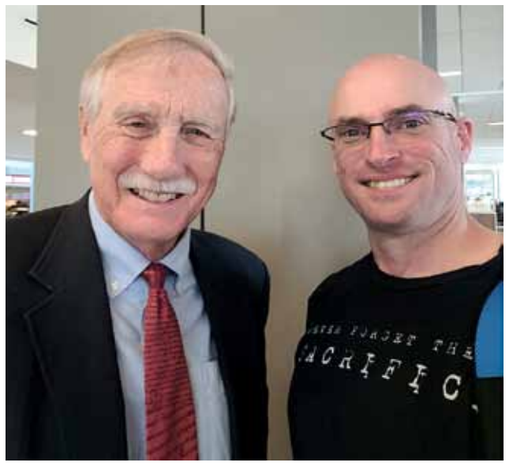
New association strategy

The Maine Water Environment Association (MEWEA) is transitioning to an association model that, similar to NEWEA's, will institute a council director-based committee organizational structure. At my last report, this was just an idea, but it became a by-law modification proposal that was approved by the membership earlier this year and will be implemented in January 2024. There will be three council directors (treatment systems operation, personnel advancement, and outreach) who will oversee the 14 committees, providing them with resources, helping them meet their needs and goals, and bridging any communication gaps among the committees and the Executive Committee. We hope this structure will strengthen the association and maximize volunteer efforts.

Events

MEWEA once again had a successful "Why Water Is Worth It to ME" annual poster contest, which engages hundreds of students from grades K–12 statewide to submit artwork. This year, a record 550 students entered! Hannah Case, a 4th grader from Poland Community School, earned recognition after competing for the last three years. "The poster contest is fun and exciting. This year I had to make two posters, because my dog chewed up the first. Do not worry though, you usually only have to make one," Hannah commented. Over a dozen businesses in downtown Biddeford displayed many of the students' artwork on Main Street in June, owing to a partnership with the Heart of Biddeford, a municipal nonprofit working to improve the quality of life in town. "The Saco River is a critically important part of Biddeford's identity and one of the most valuable assets in this community. We all share the responsibility to raise appreciation for clean water in Maine," said Heart of Biddeford's Kiara Frishkorn. Thank you to all the water heroes who participated and supported this event.

Our Maine group of industry representatives traveled in April to Washington D.C. for the National Water Policy Fly-In where they had valuable meetings with our elected officials. Past President Phil Tucker even captured an airport selfie with Senator King! We must always keep showing up with our message and remind them how important our work is.



An airport selfie: Senator Angus King (left) and Phil Tucker

For the "Why Water Is Worth It to ME" annual poster contest—over a dozen businesses in downtown Biddeford displayed student artwork in June

MEWEA, the Maine Water Utilities Association (MWUA), and Portland Water District hosted the first Water & Wastewater Professionals Day on June 22 at Hadlock Field. Over 300 tickets to the game were sold and attendees gathered for a beautiful evening in Portland. Everyone attending enjoyed a cookout with hamburgers, hot dogs, and pulled BBQ chicken. Prior to the Portland Sea Dogs taking on the Reading Phils, there was a water group photo under the Jumbotron.

The MEWEA/MWUA Summer Outing was on August 10 at the Cumberland Fairgrounds. The day started with a two-hour training on excavation safety and heat safety. A high-energy pipe competition had teams race against time to tap into a cement-lined, pressurized ductile iron pipe and install a corporation. After that, attendees transitioned to networking with a cornhole contest and BBQ lunch. All had a fantastic time.

MEWEA's fall convention was held on September 21–22 at Sunday River in Newry. While many sessions focused on biosolids management and PFAS, attendees also learned about using technology to help with everyday operations and decisions, industrial pretreatment, and pump station solutions. Keynote speaker Yolanda Brooks of the Maine Center for Disease Control and Prevention discussed the past, present, and future of wastewater surveillance in Maine, including areas they would like to improve upon and laboratory and reporting methods that have been used.

Legislative updates

In 2022, Maine passed LD1911, which banned beneficial reuse of biosolids, forcing all material remaining in-state to be disposed of at landfills. LD1639 then largely limited the amount of bulky waste that could be imported and used at landfills, material needed to mix with biosolids to maintain structural integrity. These two pieces of legislation served as a one-two punch that pushed the state into a biosolids disposal crisis. This session, an emergency piece of legislation to relieve the crisis was signed into law by Governor Janet Mills. The bill, LD 718, allows the operator of Juniper Ridge, the state's landfill in Old Town, to import more bulky waste and construction and demolition debris. While LD 718 provides the needed immediate relief, legislators say they will have to find a more long-term solution. Portland Water District is taking the lead in exploring the possibility of a regional sludge treatment facility that could use advanced thermal destruction technologies, such as pyrolysis and gasification, to safely and economically reduce or eliminate PFAS from biosolids.

Looking ahead

Imagine a Day Without Water is a national education campaign that brings together diverse stakeholders to highlight how water is essential, invaluable, and in need of investment. This year, the day of action will take place on October 20, and will include events, resolutions, student contests, social media engagement, and more—all across the country. I would encourage facilities and state associations to consider signing on. Any effort, large or small, that brings awareness to the value of water and its intrinsic role in public and environmental health is worthwhile. More information is available at imagineadaywithoutwater.org.

New Hampshire State Director Report

by Michael Trainque
mtraink75@gmail.com

Greetings from the Granite State. As we move into autumn, I will share facts about New Hampshire. It was the first state to declare its independence in 1775. The first American summer resort was in Wolfeboro. The alarm clock was invented in Concord (maybe not such an exciting fact to some). The highest ground wind speed of 372 km/hour (231 mph) was recorded on Mt. Washington in 1934. Now on to the good stuff.

Congratulations to several New Hampshire individuals for their awards and recognition:

- Anthony Druoin (EPA Region 1 Wastewater Trainer of the Year)
- Town of Newmarket (NEWEA Wastewater Utility Management Award)
- Chris Perkins (NEWEA Alfred E. Peloquin Award)
- Mark Corliss (NEWEA Operator Award)
- Sharon Nall (NEWEA Energy Management Achievement Award)
- Christopher Crowley (EPA Region 1 Industrial Pretreatment Program of the Year)
- David Lovely (EPA Region 1 Wastewater Treatment Plant Operator of the Year Excellence Award)

We also thank Rob Robinson, 2022 New Hampshire Water Pollution Control Association (NHWPCA) president.

Education Committee

NHWPCA has reinvigorated its Education Committee with a modified mission and goals. The committee's focus has been broadened to include outreach to attract individuals over the age of 18 to a career in the water and wastewater industry. The committee is working on outreach and educational materials, including a draft syllabus for a course to be offered at a local technical school. It is also continuing to coordinate classes for new and existing wastewater treatment facility operators and providing operators with resources to take the wastewater licensing exams.

Scholarships

The NHWPCA's Scholarship Committee awarded two 2023 scholarships. Out of five applications for the high school scholarship, the committee awarded scholarships to Makenna Tullar of Newfound Regional High School in Bristol and Carina Walter of Keene High School. Makenna is a member of the National Honor Society and is completing high school in three years, while maintaining part-time jobs and performing housekeeping at a local private school. Carina is a member of the National Honor Society as well as the National Art Honor Society, participates in high school sports, and volunteers for watershed cleanup events, all while maintaining a part-time job. She has been accepted to five colleges.

Exchange operators

The Operator Exchange in New Hampshire is scheduled to take place September 26–28, 2023 to coincide with the NHWPCA Fall Meeting scheduled for Friday, September 28, 2023.. Carrie Lafond of Fairfield, Vermont will be visiting New Hampshire and Tim Jarest of Peterborough, New Hampshire visited Vermont in early November. Carrie's New Hampshire will started with a morning tour of the Hanover Wastewater Treatment Facility (WWTF) on September 26 followed by lunch at a local restaurant. In the afternoon Carrie toured the Sunapee WWTF. On September 27 Carrie toured the Peterborough WWTF in the morning followed by lunch in Peterborough. In the afternoon Carrie visited the Jaffrey WWTF, ending the day with a group dinner in Durham. On Friday, Carrie was in Durham attending the NHWPCA Fall Meeting which included morning tours of the Durham WWTF followed by a luncheon and meeting at the Three Chimneys Inn.

Government Affairs

The NHWPCA Government Affairs Committee is developing a biosolids roadmap. The goal is to engage stakeholders and regulators in developing sustainable solutions for future biosolids management and disposal. All six New England states are grappling with this issue, so it is in our collective interest to work together since the actions in one state can affect adjacent states. For example, 20 percent of all biosolids generated in New Hampshire are transported to adjacent states for disposal.

Annual Trade Fair

The NHWPCA Annual Trade Fair was held on April 14 at the Sheraton Hotel on Tara Boulevard in Nashua. The trade fair included vendor exhibits, technical sessions for continuing education units (CEUs), a formal luncheon, an awards ceremony, and a raffle. The trade show had 140 registrants for the luncheon and 30 exhibitors. Sherri Caneer of World Water Works presented on intensification, which uses hydrocyclones to enable treatment facilities to produce a more densified or granular sludge as part of enhanced nutrient removal. Steve LaRosa and Corey Repucci of Weston & Sampson presented on operational and managerial challenges treatment facilities face due to PFAS regulations and biosolids disposal concerns.

Sporting Events

The NHWPCA and New Hampshire Water Works Association (NHWWA) had their second annual softball double-header on July 29. The event featured the NHWPCA (green) team against the NHWWA (blue) team at Steven's Park in Manchester. The game was a "nail-biter," with the blue team winning 35–10. There seems to be a familiar pattern here! Although the day was sunny and beautiful prior to the game, a deluge early on caused a 45-minute delay. At the time the green team was ahead 7–3, but after the delay, the blue team outscored the green team by 29 runs. Thanks to the 25 softball players, Sam Currier for umpiring, and Mike Theriault for bringing refreshments for all in attendance. Perhaps the green team needs to recruit some ringers for next year? The second game of the double-header, however, the planned Fisher Cats game in Manchester that evening, was rained out.

The NHWPCA held its 34th annual Golf Tournament on August 3 at the beautiful Beaver Meadows golf course in Concord. This is a reunion event as much as a golf tournament. Several retired industry leaders including George Harrington (Flow Assessment Services), Mike Hanscom (Concord), Sharon Nall (NHDES), Denis Messier (Somersworth), and Bruce Kudrick (Hooksett) played and caught up with old friends and colleagues. Players hailed from all New England states, and each received a golf umbrella (to ensure it would not rain). Players enjoyed a continental breakfast and early morning beverages, while they hit the driving range and putting green prior to the "serious" competition. At 8:15 am, 28 teams totaling 112 players commenced 18 holes of fun and games followed by a delicious luncheon.

Upcoming events

Manchester will host the NHWPCA annual Winter Meeting on December 8 at the Manchester WWTF. Morning tours of the facility will feature the solids train upgrade project and other recent upgrades. The luncheon, presentation, and business meeting following the tours will be at the Puritan Backroom Restaurant. Rumor has it that Santa will be making an appearance for the raffle after the business meeting! Ho, Ho, Ho!

NHWPCA expresses its gratitude to all the exhibitors and sponsors that make these various events possible.

Anthony Drouin and Devon Pasco in a biosolids discussion on the trade fair exhhibit floor

Chris Perkins and Bob Trzepacz discuss business on the exhibit floor

Bruce Kudrick and George Harrigton enjoy the golf tournament

Christina Adams and retiree Sharon Nall pose on an early green

Massachusetts State Director Report

by John Digiacomo
jdigiacomo@natickma.org

As I am writing this, it has been seven months since I had the honor of being elected as the NEWEA state director for Massachusetts. To say it has been a whirlwind and a learning experience would be an understatement. 2023 has been a busy year for both NEWEA and the Massachusetts Water Environment Association (MAWEA). During the spring, I attended two legislative events representing both NEWEA and MAWEA. Between April 25 and 26, I attended the 2023 National Water Policy Fly-In in Washington, D.C., with numerous other NEWEA leaders and members (together with WEF and other WEF member associations). This is the largest annual grassroots advocacy event for water policy issues; it is crucial to helping engage and educate our government representatives on the amazing work we do, emphasizing the need for funding for both current and future legislation and initiatives, and requesting support for legislation we feel will positively affect our industry.

When I was asked to attend, I thought it would be a great experience, but honestly, I wasn't sure if my participation was really going to "make a difference." I learned quickly how wrong I was in having that concern. Our Massachusetts delegation, which also included NEWEA Executive Director Mary Barry and Emma Page from the Boston Water and Sewer Commission, met with seven of the Massachusetts representatives and senators. We were joined on some visits by representatives from the Springfield Water and Sewer Commission (Joshua Schimmel, Jaimye Bartak, and Katie Shea). Our national representatives are busy and dealing with so many issues it is difficult for them to be versed in all of them. All the representatives and staffers were more than appreciative of our group spending time away from our jobs and families to come to Washington to share our feedback and expertise.

While too many issues were discussed with the representatives to list here, one issue we stressed is that we all can "make a difference" by attending this amazing legislative event. All the congressional delegations were aware of the issue of non-flushable wipes, but after meeting with our group, they said they were unaware of the huge toll that wipes (especially those that are not "flushable") have on the sewer systems and their financial ramifications. Many non-flushable wipes are composed of manufactured plastic fibers. Owing to their strong fibers, these wipes do not break down as they travel through the sewer system and become obstructions in clogged pumps and blocked sewer systems that lead to backups and equipment failures.

John Digiacomo in Washington, D.C., with the U.S. representative for the Massachusetts 4th congressional district—Jake Auchincloss

During our visit, a bill was introduced in the Senate (S 1350 – The WIPPES Act). The WIPPES Act would direct the Federal Trade Commission, in consultation with our federal agencies, to issue regulations on "Do Not Flush" labeling requirements for products that include baby wipes, household wipes, and disinfecting wipes. After our meetings, both Senator Elizabeth Warren's office and Senator Ed Markey's office thanked us for the information we presented, and in particular non-flushable wipes. Our meeting helped them understand what an extensive issue this is, and they agreed this legislation is urgent in remedying this situation. Both of the Massachusetts senators agreed to sign on to this important bill as co-sponsors.

Having these high-profile senators signing this bill is important, and the Massachusetts delegation who met with them should be proud to facilitate this support. It shows that even one person can make a difference! If you would like to "make a difference" and attend the 2024 National Water Policy Fly-In, please reach out to me or the NEWEA Government Affairs Committee chair, Jeff McBurnie. A few weeks after going to Washington, I attended a similar legislative event in Boston at the State House on May 11 (also attending were the Massachusetts Water Works Association and American Council of Engineering Companies of Massachusetts). We met with our local state representatives and senators to discuss many of the same issues that were discussed with the federal congressional delegations.

MAWEA Events—Past and Future

After a quieter than normal 2021 and 2022 due to Covid-19, 2023 has been busy for MAWEA. With a new year starting (and with the guidance of the NEWEA office staff who are now helping MAWEA with administrative control), the MAWEA Board of Directors met early in the spring to brainstorm how to better set up MAWEA for the future as well as produce ideas and initiatives for our membership.

The MAWEA Spring Operators Trade Show and Barbeque was held at Mt. Wachusett on May 18. It was one of the first in-person events that the organization had in over two years, and you could feel the excitement everyone had for being together again. As part of this trade show, the MAWEA Board of Directors held a roundtable discussion with members in attendance. The directors gave an update on MAWEA business, but the most important part of this discussion was allowing members to provide feedback about the association and how it could better serve them. This format was well received and will likely be a part of future MAWEA events. Thank you to all the vendors and exhibitors and to Mass Chaos (our Massachusetts Operations Challenge team) members for running the pipe cutting participation event. Everyone had an amazing time, and it showed how difficult it is to take part in Operations Challenge events.

Annual Golf Outing banquet

The MAWEA Annual Golf Outing took place at the Heritage Country Club in Charlton on June 14. The 108 golfers in attendance had an enjoyable time, the dinner was delicious as always, and the weather was perfect!

Mass Chaos—WEFTEC bound again

The Mass Chaos team will be taking part again in the national Operations Challenge competition at WEFTEC in Chicago between October 2–4. The team participated in the Operations Challenge competition at the NEWEA/NYWEA Joint Spring meeting in Saratoga Springs, New York, in June and performed well enough to qualify to attend the 36th annual Operations Challenge. This year's team comprises Scott Urban (Holyoke), Kelly Olanyk (Springfield), Roel Figueroa (Holyoke), Paul Russell (Russell Resources), and coach Mike Williams (Holyoke). The team is thrilled to represent Massachusetts again in Chicago and is excited to see if it can improve on last year's second place finish. Good luck Mass Chaos!

Mass Chaos: Roel Figueroa, Paul Russell, Scott Urban, and Kelly Olanyk

Vermont State Director Report

by Michael A. Smith
smithm@wseinc.com

For this issue's news from the Green Mountain Water Environment Association (GMWEA), we are deviating from the typical updates about PFAS and legislative changes for infrastructure funding to relay a recent success story. As most of you are aware, Vermont was recently subjected to catastrophic flooding across the state that led to dozens of washouts, hundreds of swift water rescues, and the massive destruction of property as well as transportation and water and wastewater infrastructure. The major flooding occurred on the afternoon and evening of July 10. Heavy widespread rainfall, totaling 7 to 9 in. (18 to 23 cm) in some locations, resulted in catastrophic flash flooding comparable to 2011's tropical storm Irene.

The main difference between this event and Irene was that the former lasted for approximately 24 hours, while this most recent one resulted in several days of continuous heavy rain on top of already saturated soil conditions from an unusually wet summer. As a result of the July 10 storm event, several communities were heavily affected, including neighboring cities Barre and Montpelier, and the villages of Ludlow, Hardwick, and Johnson. Large evacuations minimized the potential for loss of life, especially in Montpelier, which is just downstream from the Wrightsville reservoir where the dam nearly overtopped. According to EPA reports, warming oceans increase the amount of water that evaporates, producing heavier rain and snow events that can lead to such devastation. While July's flooding in Vermont will go down in history for the communities affected, the National Oceanic and Atmospheric Administration predicts that destructive flooding of this nature will likely occur 5 times as often by 2050. Weather events of this type and dealing with them appear to be our new reality.

As a result of this catastrophic storm event, most of Vermont's wastewater infrastructure was affected; however, three wastewater treatment facilities were incapacitated: Ludlow, which operates an oxidation ditch facility; Hardwick, which operates a lagoon facility; and Johnson, which operates an extended air facility. Each community suffered major damage to its infrastructure, including loss of wastewater lift stations, controls, electric motors, and supervisory control and data acquisition (SCADA) systems. In an impressive display of support, major municipal wastewater systems provided mutual aid through sharing of equipment and staff. In addition, the Vermont Water/Wastewater Agency Response Network (VTWARN) system was activated. VTWARN allows water and wastewater systems in Vermont to receive rapid mutual aid and assistance from other systems so they can continue to provide services if impaired by unforeseen staff absences, material shortages, or equipment failures. This system is available to all water and wastewater systems, public or private, in Vermont.

VTWARN is one of 50 water and wastewater mutual aid networks in the United States. VTWARN was established in 2008 and is managed by the Vermont Department of Environmental Conservation, Vermont Rural Water Association (VWRA), and GMWEA.

Response by neighboring communities and VTWARN made it possible to bring incapacitated wastewater infrastructure back online, with the Johnson wastewater treatment facility (WWTF)—most severely damaged—finally coming online during the week of August 7. GMWEA's leadership recognizes and thanks those communities who helped during this tragedy and the people who manage and facilitate VTWARN, the VRWA operators who mobilized to address this environmental catastrophe, and all the communities who voluntarily supported their neighbors. We also recognize the Dam Safety Program staff who monitored conditions upstream of critical dams and manually operated control gates throughout the storm.

Congratulations to Bob Protivansky

Bob Protivansky was recently appointed Rutland's commissioner of public works. Before being appointed in May, Bob was the chief operator for the Rutland WWTF and was recently named Vermont operator of the year by NEWEA. Bob has worked for the city for 24 years, beginning in 1999 as a Grade I operator covering third shift at the Rutland WWTF, which is staffed 24/7. He worked his way up to assistant chief operator and was promoted to chief operator in 2007 for the Rutland WWTF, the state's largest. Bob helped resurrect Vermont's WARN system and was most notably involved in the Vermont initiative for biological and environmental surveillances (VIBES), tracking Covid-19 in wastewater, and correlating it to case volume in the city. Congratulations on your appointment, Bob! Well deserved.

New Members May–August 2023

Nikita Bhalerao
Veolia
Paramus, NJ (YP)

Matthew Brown
Veolia
Norwalk, CT (PWO)

Eilish Corey
Town of Wellesley
Wellesley, MA (PRO)

Gregorio Corsale
Metropolitan District
Rocky Hill, CT (UPP)

Brielle Curley
Barton & Loguidice, LLC
Glastonbury, CT (PRO)

Bella D'Ascoli
Northeastern University
Boston, MA (STU)

Alex DePasquale
Wright-Pierce
Middletown, CT (YP)

Ashley Donnelly
Infiltrator Water Technologies
Old Saybrook, CT (PRO)

Ethan Edwards
Boston, MA (YP)

Ethan Ellison
Champlain Investment
Burlington, VT (PRO)

John Fortin
Salem & Beverly Water
Beverly, MA (PWO)

Justin Gagne
Wright-Pierce
Dover, NH (YP)

Gerardo Gentil
Northeastern University
Lynn, MA (STU)

Rick Goyette
Sherwin-Williams Co.
Ware, MA (PRO)

Ann Houseman
Hazen and Sawyer
Boston, MA (YP)

Joachim Katchinoff
CREW Carbon
Cambridge, MA (YP)

Mara Kilburn
Precision Trenchless LLC
Schenectady, NY (PRO)

Jason Kluza
City of Essex Junction
Essex Junction, VT (UPP)

Alefiya Kothawala
Wright-Pierce
Middletown, CT (YP)

Sravani Kowtha
Amherst, MA (STU)

Daniel Kruger
Town of South Windsor WPCF
South Windsor, CT (UPP)

Jared Krupa
Torrington, CT (STU)

Seth Lake
Wright-Pierce
Middletown, CT (YP)

Joshua Lindell
Aquapoint.3 LLC
New Bedford, MA (COR)

Andrew Martioski
Town of South Windsor
South Windsor, CT (UPP)

Kevin Mauricin
Veolia
Norwalk, CT (PWO)

Brian McCarthy
CDM Smith
East Hartford, CT (PRO)

Kenneth McGowan
City of Essex Junction
Essex Junction, VT (UPP)

Chris Merrikin
Walpole, MA (STU)

Addison Minott
BWSC
Boston, MA (PRO)

Kim Nace
Brattleboro, VT (PRO)

Elizabeth Norris
Kleinfelder
Lebanon, CT (YP)

Kelly O'Connell
Jamaica, VT (YP)

Juan Paredes
Town of Greenwich
Greenwich, CT (UPP)

Daniel Parisi
Town of Cromwell
Cromwell, CT (PRO)

Megan Patton
Bolton, CT (YP)

Christopher Perron
Northeastern University
Boston, MA (STU)

Alex Renaud
Northeastern University
Boston, MA (STU)

Mitchell Ryan
Greenfield, MA (YP)

Zoe Schmitt
CDM Smith
Boston, MA (YP)

Geonho Seo
Green International Affiliates
Malden, MA (STU)

Aaron Sylvia
WSP USA, Inc.
Providence, RI (PRO)

Mark Szarek
Groveland, MA (PWO)

Corey Theriault
Arcadis
Bethel, ME (PRO)

Julia Wahl
Woodard & Curran, Inc.
Easthampton, MA (YP)

Michael Zabilansky
Metropolitan District
Hartford, CT (UPP)

Academic (ACAD)
Affiliate (AFF)
Complimentary (COMP)
Corporate (COR)
Dual (DUAL)
Executive (EXEC)
Honorary (HON)
Life (LIFE)
Public Official (POFF)
Professional (PRO)
Wastewater Treatment Plant Operators (PWO)
Retired (RET)
Student (STU)
Utility Partnership Program (UPP)
Young Professional (YP)

Upcoming Meetings & Events

Congratulations to NEWEA's Communications Coordinator Jordan Gosselin (right) and Brendan Libby who were married in Wolfboro, New Hampshire on September 16, 2023

ENERGY/PLANT OPS TECHNICAL SESSIONS & TOUR
NBC, Providence, RI
October 17, 2023

JOINT NY/NE COLLECTION SYSTEMS/ASSET/SUSTAINABLITY
The Stamford Hotel, Stamford, CT
October 24–25, 2023

NORTHEAST RESIDUALS & BIOSOLIDS CONFERENCE & EXHIBIT
The Venue, Portsmouth, NH
November 1–2, 2023

JOINT NEWEA/NEWWA TECHNOLOGY & ASSET MGMT FAIR
NEWWA Office, Holliston, MA
November 8, 2023

SMALL COMMUNITIES SPECIALTY CONFERENCE
Gillette Stadium, Foxborough
November 13, 2023

DE&I UNCONSCIOUS BIAS TRAINING WEBINAR
November 15 & 16, 2023
November 27 & 30, 2023

NEWEA ANNUAL CONFERENCE & EXHIBIT
Boston Marriott Copley Place Hotel, Boston, MA
January 21–24, 2024

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

NHWPCA PFAS TRAINING
Franklin Training Center
October 5, 2023

CTWEA FALL WORKSHOP
Aqua Turf Club, Plantsville, CT
October 16, 2023

GMWEA FALL TRADE SHOW
Double Tree Hotel, Burlington, VT
November 2, 2023

NHWPCA WINTER MEETING
Puritan Conference Center, Manchester, NH
December 8, 2023

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

U.S.	International System of Units (SI)	U.S.	International System of Units (SI)
Liquid volume		**Length**	
gallon (gal)	liter (L)	inches (in.)	centimeters (cm)
cubic feet (ft^3)	cubic meters (m^3)	feet (ft)	meters (m)
cubic yards (yd^3)	cubic meters (m^3)	miles (mi)	kilometers (km)
acre-feet (ac ft)	cubic meters (m^3)	**Area**	
Flow		square feet (ft^2) or yards (yd^2)	square meters (m^2)
million gallons per day (mgd)	million liters per day (ML/d)	acre (ac)	hectare (ha)
for larger flows (over 264 mgd)	cubic meters per day (m^3/d)	square miles (mi^2)	square kilometers (km^2)
gallons per minute (gpm)	liters per minute (L/min)	**Weight**	
Power		pounds (lb)	kilograms (kg)
horsepower (hp)	kilowatts (kW)	pounds per day (lb/d)	kilograms per day (kg/d)
British Thermal Units (BTUs)	kilojoules (kJ) / watt-hours (Wh)	ton – aka short ton (tn)	metric ton or tonne (MT)
Velocity		**Pressure**	
feet per second (fps)	meters per second (m/s)	pounds/square inch (psi)	kiloPascals (kPa)
miles per hour (mph)	kilometers per hour (km/h)	Inches water column (in wc)	kiloPascals (kPa)
Gas		**Head**	
cubic feet per minute (ft^3/min)	cubic meters per minute (m^3/min)	feet of head (ft of head)	meters of head (m of head)

THANK YOU

TO ALL OUR 2023 ANNUAL SPONSOR PROGRAM PARTICIPANTS

- **Platinum**
  - Dewberry
  - EST Associates, Inc.
  - Flow Assessment Services, LLC
- **Gold**
  - AECOM
  - Aqua Solutions, Inc.
  - Brown and Caldwell
  - Carlsen Systems, LLC
  - Environmental Partners
  - F.R. Mahony & Associates
  - GHD, Inc.
  - Hayes Group
  - Hazen and Sawyer
  - HDR
  - Hoyle, Tanner & Associates, Inc.
  - INVENT Environmental Technologies, Inc.
  - Jacobs
  - MWH Constructors
  - The MAHER Corporation
  - Tighe & Bond, Inc.
  - Veolia
  - Weston & Sampson
  - Worcester Polytechnic Institute
  - Woodard & Curran
  - Wright-Pierce
- **Silver**
  - Arcadis
  - CDM Smith
  - Fuss & O'Neill
  - Green Mountain Pipeline Services
  - Kleinfelder
  - NEFCO
  - SDE
  - Stantec
  - Synagro Northeast, LLC
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- **Bronze**
  - ADS Environmental Services
  - BMC Corp
  - CUES, Inc.
  - Multiple Hearth Services
  - Vaughan Company, Inc.

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

Join NEWEA's 2024 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 Jordan Gosselin
Email: jgosselin@newea.org
Phone: 781-939-0908

NEWEA
WORKING FOR WATER QUALITY

Advertiser Index

Upcoming *Journal* Themes

Winter 2023—**Innovative Solutions**

Spring 2024—**Pre-Treatment**

Summer 2024—**Emerging Contaminants**

Fall 2024—**Wet Weather**

Winter 2024—**Biosolids Management**

NEWEA/WEF* Membership Application

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

Personal Information (please print clearly)

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

Business Name (if applicable) | Job Title

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

City, State, Zip, Country

Home Phone | Cell Phone | Business Phone

Email Address | Date of Birth (mm/dd/yyyy)

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

☐ Check here if you do NOT wish to receive information on special offers, discounts, training and educational events, and new product information to enhance your career.

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

ACQ. Code (for WEF use only) I WEF23

Membership Categories (select one only)

		Dues
☐ **Professional**	Individuals involved in or interested in water quality	$215
☐ **Young Professional**	Water quality professionals, with fewer than five years working experience and under the age of 35, are eligible to join. This program is available for new member applicants and Student Members and is available for 3 years..	$88
☐ **Professional Operator**	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 # _____	$127
☐ **Academic**	Instructors/Professors interested in subjects related to water quality.	$215
☐ **Student**	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.	$27.50
☐ **Executive**	Upper level managers interested in an expanded suite of WEF products/services.	$385
☐ **Corporate** (member benefits for one person)	Companies engaged in the design, construction, operation or management of water quality systems. Designate one membership contact.	$446
☐ **Dual**	If you are already a member of WEF and wish to join NEWEA	$50
☐ **Associate Membership**	This membership category is a NEWEA only membership reserved for the general public who have an interest in water and the environment but are NOT currently employed in the industry (e.g., attorney or supplier). Examples of Associate Members include: teachers; journalists who cover water quality issues; citizen samplers/members of various watershed/sportsman/conservation organizations, etc.	$45
☐ **New England Regulator**	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
All memberships receive these:	■ Water Environment & Technology ■ Water Environment Research Online ■ WEF Conference Proceedings Archive Online ■ WEF SmartBrief ■ Complimentary WEF Webcasts	

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 upp@wef.org to join.

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
www.newea.org

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☐ Visa
☐ American Express
☐ Master Card
☐ Discover

Card # | Security/CVC

Signature | Exp. Date

Name on Card (please print)

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.
By joining NEWEA/WEF, you acknowledge the WEF Code of Conduct (www.wef.org/wef-member-code-of-conduct) is applicable for all members.

NEWEA/WEF Membership Application

MEMBERSHIP PROFILE

Please take a few moments to tell us about your background and professional interests.

What is the nature of your ORGANIZATION? (select only one–required) (ORG)

1 Consulting, Contracting, Planning Services

2 Educational Institution

3 Industrial Systems/ Plants

4 Manufacturer or Distributor of Equipment & Supplies (including representatives)

5 Non-profits/NGOs

6 Finance, Investment, and Banking

7 Laboratories

8 State or Federal Government

9 Utility: Wastewater

10 Utility: Drinking Water

11 Utility: Stormwater

12 Utility: Wastewater, Drinking Water, and Stormwater

13 Utility: Wastewater and Drinking Water

14 Utility: Wastewater and Stormwater

15 Other

_____

(please define)

What is your Primary JOB FUNCTION? (select only one) (JOB)

1 Executive Level

2 Management Level

3 Elected or Appointed Official

4 Educator

5 Student

6 Consultant/Contractor

7 Engineering/Design

8 Operator

9 Scientist/Researcher

10 Legislator/Regulator

11 Analyst

12 Sales/Marketing

13 Manufacturer's Representative

14 Communications/ Public Relations

15 IT/OT

16 Other

_____

(please define)

What are your KEY FOCUS AREAS? (circle all that apply) (FOC)

1 Air Quality and Odor Control

2 Biosolids and Residuals

3 Climate

4 Collection Systems and Conveyance

5 Disinfection and Public Health

6 Drinking Water

7 Energy

8 Finance and Investment

9 Industrial Water Resources

10 Intelligent Water Technology

11 Laboratory Analysis and Practices

12 Nutrients

13 Operations

14 Public Communications and Outreach

15 Regulation, Policy, Legislation

16 Research and Innovation

17 Resource Recovery

18 Safety, Security, Resilience

19 Small Communities

20 Stormwater and Watershed

21 Utility Management and Leadership

22 Watershed Management

23 Wastewater Treatment, Design, and Modeling

24 Water and Wastewater Treatment

25 Workforce

Demographic Information (Check box) The following is requested for informational purposes only.

Gender: ☐ Female ☐ Male ☐ Non-binary

Education: ☐ Doctorate ☐ MA/MBA/MS ☐ BA/BS ☐ AA/AAS ☐ Technical School ☐ High School

Race/Ethnic Origin (Check box) The following is requested for informational purposes only.

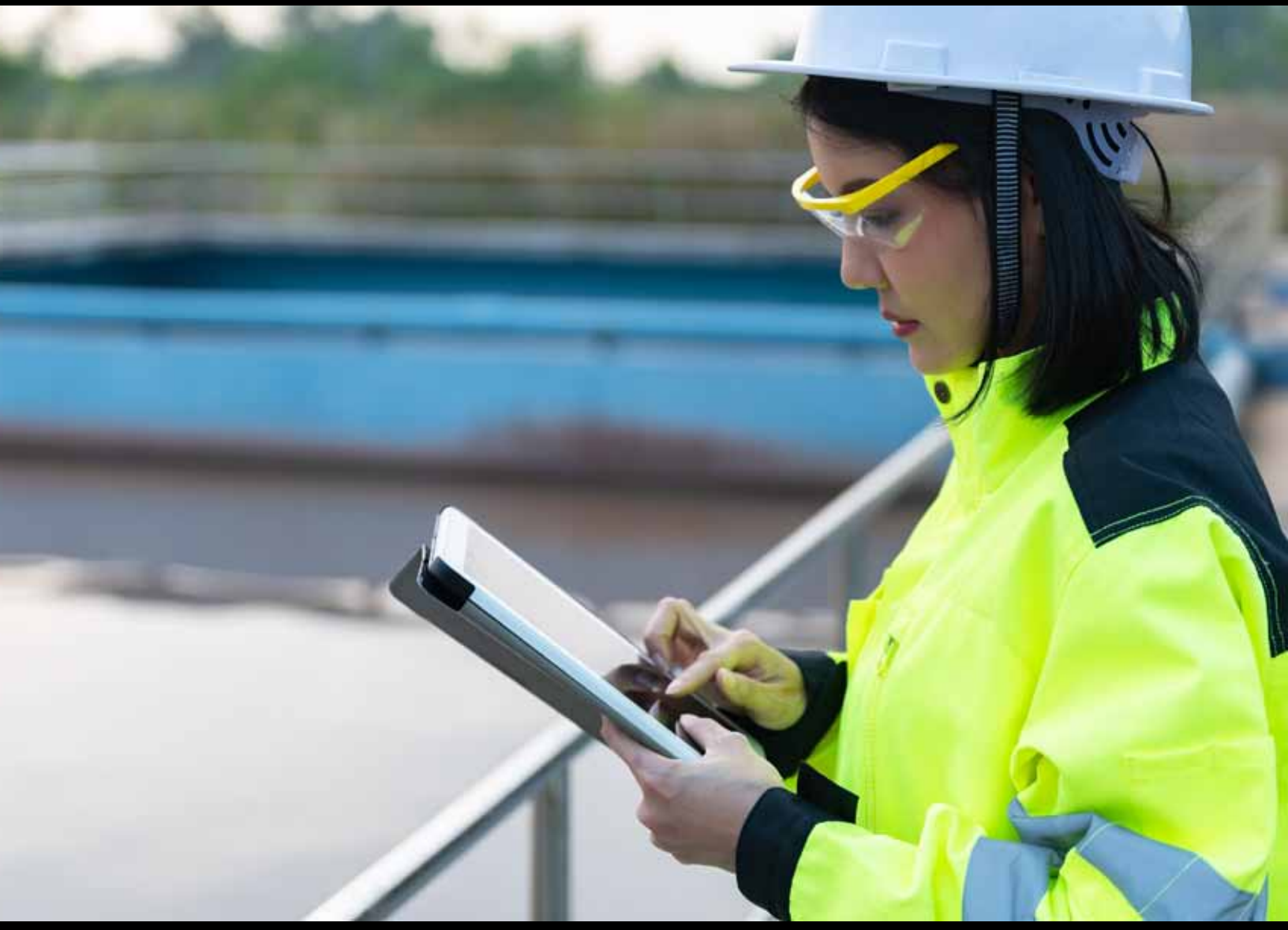
☐ African-American (Not of Hispanic Origin) ☐ American Indian or Alaskan Native ☐ Asian ☐ Caucasian ☐ Hispanic/Latino ☐ Pacific Islander or Native Hawaiian ☐ Other

How Did You Learn About NEWEA/WEF?

Referring member's name: _____ Referring member's email: _____

Innovative Solutions Throughout The Water Cycle

- Treatment and Conveyance
- Climate Resilience
- Client Enterprise Solutions
- Municipal and Industrial Sectors



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