JOURNAL

OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

VOLUME 56 NUMBER 1 / ISSN 1077-3002 SPRING 2022

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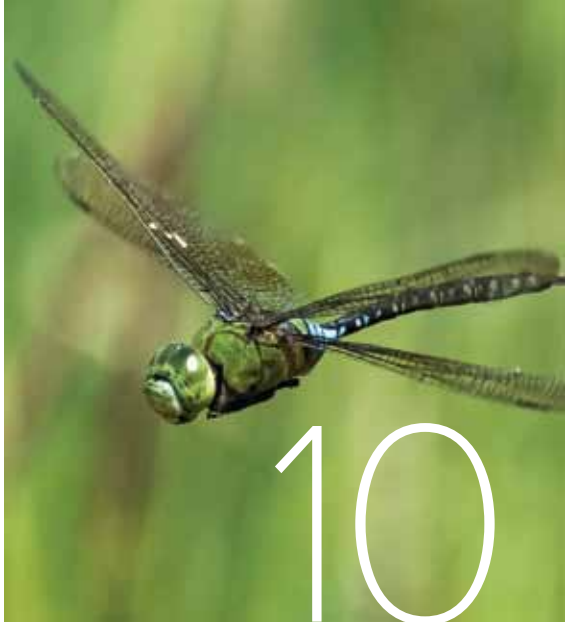

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On the cover: Grey and green infrastructure—Clippership Wharf living shoreline mid tide (photo by Ed Wonsek)

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The concepts, ideas, procedures and opinions contained in the articles in this publication are those expressed by the various authors who submit the material for publication. The New England Water Environment Association, its executive committee, the editors, the executive director, and administrative staff hereby assume no responsibility for any errors or omissions in the articles as presented in this publication, nor are the concepts, ideas, procedures and opinions in these articles necessarily recommended or endorsed as valid by NEWEA, its executive committee, the editors, the executive director or staff. References to specific products or services do not constitute endorsement of those offerings by NEWEA. The Journal's committee reserves the right to make any editorial changes deemed necessary for publication of submitted papers.

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OUR ASSOCIATION WAS ORGANIZED NINETY-THREE 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.

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2022 RATES ($)

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Corporate	420
Regulatory	50
Academic	190
Young Professional	75
PWO	110
Dual	50
Student	15

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President's Message

As I assume the presidency of NEWEA for 2022, I say thank you to all my friends and colleagues who have supported me throughout my exciting and fulfilling 40-year journey as a water professional that has culminated in this great honor. What a fitting capstone to my career. Reflecting on the list of our association's past presidents, I see the names of industry legends, mentors who have been instrumental in my professional and personal growth, and many of my old friends who are still meaningfully contributing to our great industry. I am proud and humbled to be associated with this distinguished group of past presidents and industry leaders. As NEWEA enters its 93rd year, I pledge to continue to grow and prosper our association as we execute our mission to promote education and collaboration while advancing knowledge, innovation, and sound public policy to protect the water environment and our quality of life.

I also thank you, our NEWEA membership, for contributing to and supporting the *Journal*. This valuable technical treasure has been published for the past 55 years, providing our industry a well-respected forum to share professional achievements, new technologies, cutting-edge research, and best management practices. I have personally used NEWEA's *Journal* often as a technical resource. I hope you will be able to use this issue as a future resource, as we focus on two relatively new, but critical, challenges facing our industry: climate change and the resiliency required to address it.

Climate change is not new. Evidence of it was identified in the mid-1800s. From the 1930s to the 1970s leading scientists—monitoring temperatures, precipitation, and changing geographic characteristics—warned of the dangers of climate change. But their concerns were largely ignored and ultimately dismissed. Over the past 40 years climate change has quickly advanced from a radical theory to a scientifically verified problem that threatens the well-being of our planet. Some of the world's greatest engineers and scientists are working collectively and collaboratively to address global climate change impacts though international treaties to

reduce carbon emissions, lessen the use of fossil fuels, and incorporate green practices into our everyday lives.

While engineers and scientists combat climate change globally, our industry and our association must address it locally. New England's environmental infrastructure is on the front line of combatting the impacts of climate change. Wastewater treatment plants (WWTPs), pump stations, sewer systems, and stormwater systems are all severely affected by rain events and flooding. WWTPs and pump stations are generally constructed at the low point of the region to facilitate gravity flow to them. Moreover, WWTPs are typically constructed along major waterways into which they discharge their effluent. These geographical locations are the most vulnerable to climate change-induced flooding. Two New England communities were recent examples where climate change devastation severely damaged their environmental infrastructure. In Rhode Island in 2010, 8 in. (20 cm) of rain caused the already swollen Pawtuxet River to flood the West Warwick WWTP, forcing it to shut down for days and causing millions of dollars in damages. In 2011, a series of powerful tropical-like thunderstorms moved through mid-Vermont causing the Winooski River to flood the Montpelier WWTP, closing it for days, and again, causing millions of dollars in damages.

Much of our region's stormwater and wastewater infrastructure is aging and failing. This infrastructure was not designed for today's population, amount of urban impervious area, environmental regulations, and, surely, climate change wet weather events. Our industry must be proactive to address climate change locally while advocating for change globally. For the wastewater utility I manage in Manchester, New Hampshire, every capital improvement project is contractually required to address climate change. During the design of our WWTP projects, we address climate change impacts such as water temperature and its impact to the treatment processes. We address increased ambient air temperature and its impact on our air intake equipment and operating motors. The most critical climate change impacts are in sizing pipelines. In Manchester we are constructing several sewer separation projects, building a new drainage system to serve the city for the next 100 years. Working with our engineers, we conducted a climate change workshop to determine the design criteria for all drainage pipes, accounting for National Oceanic and Atmospheric Administration (NOAA) design guidelines and adding our own climate change adjustment factor.

Critical to addressing climate change is infrastructure resilience, which is defined as the ability to reduce the magnitude and/or duration of disruptive events. To reduce these impacts our industry needs strategies to anticipate, absorb, adapt to, and/or rapidly recover from potentially disruptive climate change events. EPA has led this issue by developing a route-to-resilience tool (RtoR). The RtoR has five planning components—assess, plan, train, respond, and recover—to define a utility's resilience needs. Many New England communities have developed resilience studies to identify their most vulnerable environmental infrastructure. Unfortunately, infrastructure is often locked into its current geographic locale and cost-prohibitive to relocate. In these cases, utilities face expensive mitigation. New environmental infrastructure should always evaluate climate change impacts and incorporate resiliency so that it is sustainable for 100 years.

We hope you will be educated and entertained by this first *Journal* issue of 2022 focusing on climate change and resiliency. In coming issues we will focus on my presidential theme, celebrating the 50th anniversary of the Clean Water Act, examine the use of "big data" through instrumentation and controls, and close 2022 with the Infrastructure Act and how it can fund our industry's future work. Once again, I thank our membership for its support and continued contributions to the growth and sustainability of our industry. In closing, if I can do anything to assist with our membership's needs, goals, and growth, please contact me, because, following the motto of our former President Harry Truman, "The Buck Stops Here."

From the Editor

Hello NEWEA members! For those I haven't met, my name is Jennifer (Jen) Lawrence, and I am truly honored to serve as the next editor of the *Journal*. I have big shoes to fill, stepping into this role following Allie Greenfield. Over the past two years, Ms. Greenfield encouraged me to guest edit journals, develop issue content, and even submit two feature articles myself! Over the next three years as *Journal* editor, I will do my best to continue Ms. Greenfield's (and all previous editors') long-standing tradition of sharing current events and innovative work with NEWEA membership. I am also honored to announce that James Barsanti will be joining me as the *Journal's* vice chair. Mr. Barsanti, who served as NEWEA president in 2017, brings over 35 years of experience in the water industry. I am excited to combine our unique experiences and bring the *Journal* to the next level.

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One of the first changes you'll see in this *Journal* is the Innovation Council Update; we will be piloting this new section in the next few issues. Big thanks to Megan Goldsmith, the Innovation Council intern, for getting this first Innovation Council Update off the ground. Please check out her piece; Ms. Goldsmith has created a database of water innovators across New England, and it is available to all NEWEA members looking to make connections in the innovation ecosystem. In upcoming editions, Ms. Goldsmith hopes to share even more information about the database, including interviews with innovators in the ecosystem.

The Innovation Council Update is not only a great addition to the Journal , but also quite timely with this issue's theme of climate change and resiliency. New England is warming significantly faster than the global average, and extreme precipitation has increased by 50 percent.[1,2] On top of that, sea levels in our region are expected to rise 16 in. (41 cm) by 2050 (in comparison to 2000 levels).[3] If we have any dreams of combatting these climate issues in New England, we must work together, and work across traditionally siloed disciplinary lines to innovate change.

The four articles featured in this issue showcase the great work our industry has done along these lines. In the first article, Wayne Bates makes a compelling case for incorporating sustainability into the forefront of climate change and resiliency planning by partnering with architects to look holistically at a project's needs. The next two articles delve into resiliency planning for water and wastewater utilities, respectively. The last article, by Janine Burke-Wells, highlights an important component of climate change and resiliency planning—not only must we brace ourselves for the impacts of climate change, we must also proactively identify pathways to cut greenhouse gas emissions from our industry. I hope you enjoy the diversity of articles as thoroughly as I have!

As we plan for climate change, we must also remember to incorporate environmental justice into the forefront of our resiliency planning. Research has repeatedly shown that underserved communities, which have a limited capacity to adapt to environmental stressors, disproportionately bear the burden of climate change. As just one example, low-income urban communities have been found to be five to 12 degrees Fahrenheit (3 to 7 degrees Celsius) hotter than nearby higher income neighborhoods because they have fewer parks and trees that dissipate heat, and more asphalt that retains heat.[4] As NEWEA members, we should lead the change into the second half of the century, being mindful to fight for climate equity while building New England's resilience to climate change.

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Industry News

A cotton bleaching company will pay $1.5 million to settle allegations it spilled acid into the North River, Colrain, Massachusetts, that killled 270,000 fish and damaged the habitat of the Ocellated Darner dragonfly, a state-listed rare species

EPA and Massachusetts Settlements Require Manufacturer to Pay Nearly $1.5 Million for 2019 North River Fish Kill

Massachusetts Attorney General (AG) Maura Healey, EPA, and the Baker–Polito Administration announced on December 7 that Barnhardt Manufacturing Company, a North Carolina-based cotton bleaching company, has agreed to pay nearly $1.5 million to settle allegations that it spilled dozens of gallons of concentrated sulfuric acid from its Colrain facility into the North River, killing more than 270,000 fish, including thousands of state-listed rare species.

The state and federal settlements will also require the company to comply with water pollution, hazard management, and chemical accident prevention laws at its bleaching facility and associated wastewater treatment facility.

According to the AG's complaint, on September 1, 2019, between approximately 53 and 60 gal (200 and 227 L) of concentrated sulfuric acid sprayed out of an outdoor above-ground storage tank at Barnhardt's Colrain facility directly onto the ground. The AG's Office alleges that Barnhardt knew the storage tank had a leak and neglected to repair it. Dozens of gallons of acid allegedly flowed into a nearby brook and down a 3 mi (5 km) stretch of the North River, a pristine river and popular recreational fishery that feeds into the Deerfield River. According to the complaint, the acid dissolved nearly everything in its path, killing more than 270,000 fish and damaging more than 14 ac (6 ha) of protected wetland resource areas and over 12 ac (5 ha) of designated habitat of two state-listed rare species—the Longnose Sucker fish and the Ocellated Darner dragonfly. Barnhardt also allegedly discharged wastewater from its facility in excess of permitted limits on numerous occasions, improperly operated and maintained its wastewater treatment facility, and mismanaged hazardous waste oil.

EPA's administrative settlement alleges, among other things, that the company failed to maintain its sulfuric acid tank, violating the General Duty Clause of the Clean Air Act, which requires users of extremely hazardous substances to prevent and mitigate accidental releases.

"EPA's case complements the Commonwealth's by addressing the root cause of the spill," said EPA New England Acting Regional Administrator Deb Szaro. "It's critical that companies handling hazardous chemicals identify hazards and ensure that their facilities are designed and maintained safely. Carefully following the Clean Air Act's chemical accident prevention provisions helps prevent releases from occurring in the first place."

The AG's Office alleges Barnhardt's acid spill and facility operations violated numerous Massachusetts environmental laws and regulations, including the state Wetlands Protection Act, Endangered Species Act, Clean Water Act, and Hazardous Waste Management Act, and caused significant damages under the Commonwealth's Oil and Hazardous Material Release Prevention and Response Act and Inland Fisheries Statute.

"The sulfuric acid spill caused by this company was devastating for the Colrain community and left long-lasting damage to the North River," AG Healey said. "Today's settlements will hold Barnhardt accountable for harming this rich ecosystem and will provide significant funding to restore nearby natural resources and fisheries."

Under the terms of the settlement with the AG's Office, Barnhardt must comply with state regulations to protect water quality and natural resources at and around its facility and undertake additional training, planning, and operations to prevent future releases. The company will also pay up to $500,000 in penalties, including $200,000 to the Commonwealth's Natural Heritage and Endangered Species Fund. Barnhardt will also pay to replace or enhance one or more culverts in the Deerfield River watershed in Colrain, at a cost of $300,000, and pay the state more than $360,000 to fund environmental restoration projects, as compensation for the harm to natural resources and fisheries, and reimbursement for natural resource damages.

EPA's settlement requires a civil penalty payment of approximately $305,000 to the U.S. Treasury, and completion of work at Barnhardt's facility to ensure chemical hazards are identified and addressed.

The state settlement was negotiated in collaboration with the Massachusetts Department of Environmental Protection (MassDEP) and the Massachusetts Division of Fisheries and Wildlife (DFW). EPA brought its administrative case on a separate but parallel track.

Note: All EPA industry news provided by EPA Press Office

Data Innovation Challenge Highlights Water Quality Indicators

On February 1, EPA announced the National Aquatic Resource Surveys (NARS) Data Analysis Innovation Challenge, which invites research institutions to use large, nationally consistent statistical survey datasets to evaluate the health and impact of the nation's aquatic ecosystems. Through this data challenge, participants will evaluate successes and remaining challenges 50 years after the passage of the Clean Water Act.

Authorized by Sections 104(a)(5) and 305(b) of the Clean Water Act, NARS is a collaborative program implemented by EPA, states, and tribes to assess the quality of the nation's coastal waters, lakes and reservoirs, rivers and streams, and wetlands. These surveys provide a point-in-time assessment of the condition of these resources, identify the extent of key stressors across the United States, and track changes over time.

Through this data challenge, EPA encourages researchers to apply advanced analytic methods to NARS data to examine questions related to national priorities including climate change, environmental justice, nutrient management, and other critical water quality challenges. Participants will have the opportunity to win prize money as well as gain national recognition for their institutions.

NARS is implemented on a five-year rotating basis among water body types and is in the third cycle. The four surveys that make up NARS are the National Coastal Condition Assessment (NCCA), National Lakes Assessment (NLA), National Rivers and Streams Assessment (NRSA), and the National Wetland Condition Assessment (NWCA). For each survey, EPA selects sampling locations using a statistical survey design, and crews use consistent methods to collect data at more than 1,000 sites during a summer index period. More than 20 years of chemical, physical, and biological data are now available, including newly released data from the four most recently completed surveys. Example data include benthic macroinvertebrates, fish, vegetation, zooplankton, nutrient concentrations, sediment chemistry, soil chemistry, physical habitat measurements, and microcystin concentrations. These datasets provide an opportunity to conduct scientific research on issues of national importance, analyze patterns and associations among co-located variables, and explore innovative approaches to improve assessments of water quality.

Action Plan to Accelerate Cyber Resilience for the Water Sector

On January 26, EPA and its federal partners announced the Industrial Control Systems Cybersecurity Initiative – Water and Wastewater Sector Action Plan to help protect water systems from cyberattacks. The plan focuses on high-impact activities that can be surged within 100 days to safeguard water resources by improving cybersecurity across the water sector.

The plan is part of President Biden's industrial control systems (ICS) initiative, which he established pursuant to "National Security Memorandum 5, Improving Cybersecurity for Critical Infrastructure Control Systems." The ICS initiative is a collaboration between the federal government and critical infrastructure community to deploy technologies that provide cyber-related threat visibility, indicators, detections, and warnings.

"Cyberattacks represent an increasing threat to water systems and thereby the safety and security of our communities," said EPA Administrator Michael S. Regan. "As cyber threats become more sophisticated, we need a more coordinated and modernized approach to protecting the water systems that support access to clean and safe water in America. EPA is committed to working with our federal partners and using our authorities to support the water sector in detecting, responding to, and recovering from cyber incidents."

The plan promotes and supports the water sector's adoption of strategies for the early detection of cyber threats and allows for the rapid sharing of cyber-threat data across the government to expedite analysis and action. Actions include the following:

- Establishing a task force of water sector leaders
- Implementing pilot projects to demonstrate and accelerate adoption of incident monitoring
- Improving information sharing and data analysis
- Providing technical support to water systems

The initiative's goals are outlined in the plan, which was developed by EPA, the National Security Council (NSC), the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency (CISA), and the Water Sector Coordinating Council and Water Government Coordinating Council (WSCC/GCC).

"Securing our nation's critical infrastructure is a top priority for President Biden and his Administration. In the past year, the Administration has worked closely across the U.S. government and critical infrastructure partners to ensure they have our full support in shoring up their cyber defenses," said Deputy National Security Advisor for Cyber and Emerging Technology Anne Neuberger. "The action plans for the electric grid and pipelines have already resulted in over 150 electricity utilities serving over 90 million residential customers and multiple critical natural gas pipelines deploying additional cybersecurity technologies. This plan will build on this work and is another example of our focus and determination to use every tool at our disposal to modernize the nation's cyber defenses, in partnership with private sector owners and operators of critical infrastructure."

"The expansion of the President's ICS cybersecurity initiative to the water sector is an important step forward in securing our nation's water utilities from malicious cyber activity. The water sector action plan will provide owners and operators of water utilities a roadmap for high-impact actions they can take to improve the cybersecurity of their operations," said National Cyber Director Chris Inglis. "I commend the Water Sector Coordinating Council and their federal partners for their continuing efforts to improve the present and future resilience of water utilities on which each American depends."

EPA and its federal partners intend to work with water sector stakeholders to encourage, incentivize, and assist in

rapidly deploying ICS cybersecurity monitoring technologies. By implementing this plan, partners across the government will lay the foundation for supporting enhanced ICS cybersecurity across water systems of all sizes—improving cyber preparedness.

City of Lebanon Meets Consent Decree Requirements by Eliminating CSO Outfalls

On January 18, EPA recognized Lebanon, New Hampshire, for removing all its combined sewer overflow (CSO) outfalls, eliminating the need for the consent decree established between EPA and the city in 2009. In November, the United States District Court for the District of New Hampshire terminated the consent decree between the United States, the State of New Hampshire, and the City of Lebanon, because the city satisfied the prerequisites for termination by eliminating all its CSO outfalls.

"This is a significant accomplishment. The City of Lebanon's success in eliminating combined sewer overflows into the Connecticut River in accordance with the consent decree benefits downstream communities with improved water quality," said EPA's Ms. Szaro. "This kind of progress on infrastructure shows how much the city has prioritized the health of their environment by ensuring that wastewater will not discharge into the Connecticut River or its tributaries."

Prior to the consent decree, the city was discharging up to nearly 14 MG (53 ML) of combined wastewater and stormwater per year from as many as 60 to 70 CSO events. Lebanon completed multiple sewer separation projects over the last decade and, in 2021, because of work done as required by the consent decree, the city had zero CSO discharges. It spent over $70 million to complete these projects and eliminated seven CSO outfalls that were the source of untreated sewage and stormwater. The city took this opportunity to not only perform the work required by the consent decree but to also improve all the infrastructure in the project areas. The city upgraded its water lines, installed granite curbing, asphalt, and concrete sidewalks, and performed full-depth road reconstruction, transforming the neighborhoods and building projects to benefit residents for decades.

In 2009, EPA alleged that Lebanon had violated the Clean Water Act based on discharges from its CSO outfalls into the Connecticut River, the Mascoma River, and the Great Brook that contained concentrations of *E. coli* bacteria that violated water quality standards. EPA and the City of Lebanon entered into a consent decree, where the city agreed to continue to implement its Long-Term Control Plan that would result in elimination of CSO discharges from its combined sewer system.

EPA implements the CWA National Pollutant Discharge Elimination System (NPDES) program in New Hampshire, but closely coordinates it with New Hampshire Department of Environmental Services. The state agency was involved in all aspects of the projects, as it is responsible for reviewing all wastewater infrastructure projects in New Hampshire as well as for providing funding through its Clean Water State Revolving Fund (SRF), which requires project oversight.


Mascoma River

EPA and Fall River Agree on Five-year Plan to Fix Wastewater Infrastructure and Reduce CSOs into Local Waterways

On December 20, EPA and the City of Fall River signed an administrative order on consent committing the city to continue implementing an agreed-upon five-year plan to reduce and treat combined sewer discharges coming from city wastewater pipes into the Taunton River and Mount Hope Bay.

"We are so happy to have an agreement with the City of Fall River to reduce wastewater discharges into the local waterways by implementing a five-year integrated infrastructure plan," said EPA's Ms. Szaro. "These wastewater infrastructure upgrades are important for ensuring the residents of Fall River have clean waterways. The integrated planning process is a smart way for cities to prioritize projects and develop a manageable spending plan that regulators agree to."

Fall River's wastewater system serves 90,000 residents from Fall River and parts of Westport and Freetown, Massachusetts, and Tiverton, Rhode Island. The system includes many areas of combined sewers, with regular overflows into the Taunton River and Mount Hope Bay. EPA expects that the infrastructure projects Fall River plans to do under the integrated plan will improve water quality and benefit the downstream communities. The proposed settlement is also consistent with EPA directives to strengthen enforcement of violations of cornerstone environmental statutes in communities disproportionately affected by pollution, with a focus on remedies with tangible community benefits.

Since 1992, the city has been addressing CSOs under a federal court order resulting from a case brought by the Conservation Law Foundation (CLF). EPA is not currently a party to the settlement. The city has spent over $200 million to address CSOs, including a 38 MG (144 ML) storage tunnel, multiple sewer separation projects, and a wastewater treatment plant expansion. The work has significantly reduced the number and volume of CSO discharges, but many remain.

In 2015, several wastewater infrastructure challenges—both CSOs and sanitary sewer overflows (SSOs)—still existed, resulting in wastewater discharging directly into Fall River waterways and flooding within the city. Also, an aging wastewater treatment plant required rehabilitation and upgrades to meet pollution reduction goals. To manage the infrastructure needs and cost, Fall River needed a plan to prioritize work and meet requirements. Thus, an integrated plan was developed that evaluated all the city's Clean Water Act obligations and prioritized them, focusing on projects with the best environmental-cost benefits. The city revised the spending plan in 2019, and in 2020 the city and EPA agreed on a modified five-year plan focused to improve infrastructure from 2020–2025.

The order agreed upon requires the city to implement the first five years of its integrated plan. Fall River estimates it will spend about $20 million per year to do the following:

- Implement CSO separation, CSO storage, and infiltration/inflow reduction projects:
  - Upgrade pump stations and other sewer facilities (expected to reduce inflow and optimize operation to reduce overflows)
  - Implement projects to rehabilitate and upgrade the wastewater treatment plant (upgrades to allow adding nitrogen removal in the future)
  - Optimize the operation of CSO chlorination facilities, including monitoring of chlorine and bacteria levels in the discharges
  - Study the effectiveness and feasibility of new CSO screening/disinfection facilities (potentially including non-chlorine disinfection)
- By 2025, create a revised integrated plan addressing future CSO, wastewater treatment plant, and collection system projects

The city will spend $126.8 million implementing the first six years of its integrated plan.

Increased Water Infrastructure Funding Will Provide $536 Million in New England

With funding authorized by the Bipartisan Infrastructure Law, EPA's Mr. Regan announced funding levels on December 2 for states, Tribes, and territories in 2022 through EPA's SRF programs to upgrade water infrastructure. Under this funding, the six New England states will receive will receive the amounts listed in the table.

State	Amount
Connecticut	$76,907,000
Maine	$68,390,000
Massachusetts	$188,890,000
New Hampshire	$72,644,000
Rhode Island	$66,451,000
Vermont	$63,041,000
Total	$536,323,000

Both nationally and locally, the increased funding investments will create jobs while upgrading America's aging water infrastructure and addressing key challenges like lead in drinking water and per- and polyfluoroalkyl substances (PFAS) contamination. In a letter sent to governors, the administrator encouraged states to maximize the impact of water funding from the law—an unprecedented nationwide total of $50 billion investment—to address disproportionate environmental burdens in historically underserved communities across the country.

"With President Biden's leadership and congressional action, the Bipartisan Infrastructure Law has created an historic opportunity to correct longstanding environmental and economic injustices across America," said Mr. Regan. "As leaders, we must seize this moment. Billions of dollars are about to start flowing to states, and it is critical that EPA partners with states, Tribes, and territories to ensure the benefits of these investments are delivered in the most equitable way."

"We are very proud that across New England, in 2022 we will see an investment of over a half-billion dollars for improving and updating our water infrastructure," said EPA's Ms. Szaro. "The five years of funding in the Bipartisan Infrastructure Law is a once-in-our-lifetime influx of much-needed resources that will jumpstart local economies across the region and will ensure better protection of public and environmental health for decades to come. EPA will work closely with our state partners to ensure that projects in underserved communities are given careful consideration to receive funding."

The 2022 allocation is the first of five years of $43 billion in dedicated EPA SRF funding that states will receive through the Bipartisan Infrastructure Law. For more than 30 years, the SRFs have been the foundation of water infrastructure investments, providing low-cost financing for local projects across America. However, many vulnerable communities facing water challenges have not received their fair share of federal water infrastructure funding. Under the Bipartisan Infrastructure Law, states have a unique opportunity to correct this disparity.

Proposed Multi-Purpose Machine Gun Range Project at Joint Base Cape Cod

On December 1, EPA announced its decision to provide additional information and offer a public participation process for the Sole Source Aquifer review for the proposed Multi-Purpose Machine Gun Range at Joint Base Cape Cod.

EPA anticipates releasing the draft Sole Source Aquifer determination in the spring of 2022 with a possible extension. At that time, EPA will open a 30-day public comment period with an accompanying docket. In addition, EPA will hold a public hearing to accept verbal comments. Information on the date, time, and how to register for the public hearing will be released in the coming months.

As part of EPA's Sole Source Aquifer program, in 1982, the aquifer was designated as the sole or principal source of drinking water for Cape Cod. As a result, projects proposed to be constructed on Cape Cod receiving federal financial assistance may be subject to a Sole Source Aquifer review, as outlined in the Safe Drinking Water Act.

In August 2021, EPA elected to conduct a Sole Source Aquifer project review and began compiling and evaluating technical information available through the many cleanup investigations and efforts by EPA and other agencies and commissions. EPA continues to evaluate this information and responses from the Massachusetts Army National Guard to its technical questions related to the review.

Grey and green infrastructure—an engineering and landscape architecture approach to sustainable and resilient design

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ABSTRACT | For an infrastructure project to be both sustainable and resilient, designers, communities, and stakeholder groups must consider the long-term social, economic, and environmental aspects, in addition to addressing real or potential hazards that allow the asset to remain in continuous service. While the "resiliency" of communities from climate change impacts is receiving much attention, sustainability requires that projects are also equitable, inclusive, and adaptive, protecting both our built and natural environments.

Historically, engineers have relied on structural solutions, also referred to as grey infrastructure, to manage and control storms by preventing them from reaching our built environment. While these physical barriers are critical to many built environments, they often create a man-made barrier between the natural environment and communities. More recently, engineers and landscape architects have designed purpose-built green infrastructure that uses the natural environment to manage storms while providing places that benefit nature and society.

KEYWORDS | Resiliency, sustainability, triple bottom line, three responsibilities, grey infrastructure, green infrastructure, climate change

This article discusses the importance of resiliency and the need for sustainable grey and green infrastructure designs in our efforts to adapt to climate change. The definitions below provide background on this subject.

Sustainability. The often-referenced 1987 United Nations Brundtland Commission[1] defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." To measure sustainable development requires further definition and most often incorporates three responsibilities—environmental stewardship, economic prosperity, and social well-being. These three responsibilities are also referred to as the "triple bottom line" that measures the life cycle impact of each responsibility. Purpose-built projects that apply the three responsibilities while considering current and future infrastructure and societal needs transform single-use infrastructure projects into long-term multi-purpose solutions with ecological, societal, and economic benefits.

Resiliency. Merriam-Webster[2] defines resiliency as the "ability to recover from or adjust easily to adversity or change." According to the American Society of Civil Engineers (ASCE) Policy Statement 518, "Unified Definitions for Critical Infrastructure Resilience,"[3] resilience is defined as "the ability to plan, prepare for, mitigate, and adapt to changing conditions from hazards to enable rapid recovery of physical, social, economic, and ecological infrastructure."

Grey infrastructure is the hard-armoring of environments using physical structures such as dams, levees, dikes, seawalls, bulkheads, and revetments. These engineering technologies typically result in vertical barriers that protect people and assets during a hazardous event. However, these man-made controls often create a year-round barrier between the built and natural environments.

Green infrastructure incorporates soft-armoring features, such as living shorelines, storm surge basins, groundwater recharge systems, and bioretention basins. These features provide protection during a hazardous event, but under normal conditions can be a resource area that can connect communities and the built environment to the natural environment.

As communities plan for and adapt to a changing climate, resiliency is a major concern for local governments and property owners, and the communities in which they serve or live. Storms of increasing frequency and intensity are affecting the Northeast, putting lives and livelihoods at risk as they batter our shorelines, overwhelm waterways and stormwater systems, and damage property. Across the region, private landowners, municipalities, institutions, and state and federal agencies want resilient solutions to protect communities and reduce the risk of catastrophic flooding and other major damage from climate change.

As the demand for resilient infrastructure is increasing, so too are the stakeholders' demands on public officials and property owners. Stakeholders want information, involvement, and inclusion in these infrastructure projects, increasing the need to make public and private infrastructure projects more inclusive, adaptable, and experiential. This has opened the door to opportunities to bring infrastructure, once a barrier or hidden, out in the open, celebrate it, and make it part of the tapestry of the community. By engaging stakeholders early in the design project, the place and purpose can be better understood, resulting in not only an adaptable and resilient solution that protects the built environment into the future, but a sustainable and inclusive one that can educate, engage, and serve the public by reconnecting the built environment to the natural environment. Early community engagement will also help to reveal concerns, prevent the spread of misinformation, create consensus, and build trust. Stakeholders want to be heard; integrating their feedback will lead to a more holistic design that protects assets and people while unlocking its potential long-term benefits.

COMBINING SUSTAINABLE AND RESILIENT CRITERIA

The most visionary and successful projects are resilient, adaptable, and responsive to the needs of the communities they serve. Decisions made, based not only on cost but on the long-term *value* a purpose-built project offers, can protect both people and critical assets while providing economic, social, and environmental benefits for the owners and the community. Simply building up a shoreline, riverbank, or other inland waterfront to protect the community from hazards is not enough anymore, nor is it a preferred long-term solution for a community. Owners and stakeholders see that this vital infrastructure offers an exciting opportunity to create new and vibrant open spaces—spaces that when enhanced with features such as pathways, seating, lighting, and native plantings offer a sense of place, a welcome spot for gathering, recreating, and educating, or somewhere to relax and enjoy the view. For a project to be truly sustainable, however, it must consider the social and environmental benefits over its lifetime, not just the first cost. Teams must evaluate the direct and indirect benefits and costs so that the final design is not only resilient but also purpose-built, balancing the triple bottom line of social, environmental, and economic responsibilities.

Because resilient and sustainable designs must protect critical assets, work in harmony with the environment, and respond to community needs to create a vibrant, thriving public realm, design teams must consist of multi-disciplinary experts who bring depth and diversity to each infrastructure challenge. It is equally important in this social media-driven age that the team engage the community and stakeholder groups, seeking instantaneous information to develop purpose-built projects that protect and attract people and wildlife, rather than cutting them off.

CASE STUDIES

As thought leaders in sustainable and resilient design, engineers and landscape architects strive to balance safety, equitable access to the natural environment, and an experience for the community. The approach and features of several projects are provided below, including the following:

- Senator Joseph Finnegan Park at Port Norfolk
- Climate Ready South Boston
- Clippership Wharf
- Tuscan Village, a mixed-use redevelopment of the former Rockingham Park in Salem, New Hampshire

Senator Joseph Finnegan Park at Port Norfolk—Urban Wild

The 14 ac (6 ha) Senator Joseph Finnegan Park at Port Norfolk, located in the Dorchester community of Boston at the mouth of the Neponset River, was transformed from an industrial site—as the former home of the Shaffer Paper Factory—into a neighborhood open space, improving access to the waterfront and restoring a sensitive ecological habitat. This project, on behalf of the Massachusetts Department of Conservation and Recreation (DCR), transformed an ugly blemish on the Dorchester neighborhood. Work included cleaning up the site, replacing shoreline flood control features, restoring salt marsh and wetlands, and removing crumbling buildings. Impervious pavement, invasive phragmites, and by-products of industrial activities were replaced with meadow grass, salt marsh, and various

Senator Joseph Finnegan Park: **Figure 1.** Proposed planting schedule **Figure 2a and 2b.** Before and after conditions **Figure 3.** Post-construction

tree species, converting the site into a resilient and sustainable natural resource area within an urban environment (Figure 1). With these changes, the natural environment has been reconnected to the built environment with walking trails, resting spots, and landscape architectural features (Figures 2 and 3).

From a resiliency perspective, replacing the grey hardscape with a green softscape creates a natural barrier to reduce the impact of tidal fluctuations and storm events.

Environmentally, the remediated site is cleaner, reduces runoff, filters stormwater, increases evapotranspiration, reduces the heat island effect, and provides a wildlife habitat in an urban environment.

Socially, the site provides open space to exercise, meditate, meet, and experience nature. In addition, educational signage provides information on the green infrastructure features.

Climate Ready South Boston—Grey and Green Infrastructure

Climate Ready South Boston includes a combination of grey and green infrastructure features to protect the community and infrastructure of South Boston. The goal of the project is to identify vulnerable resources and develop near- and long-term strategies for protecting the city from rising sea levels, coastal flooding, and storm surges (i.e., resilience) while creating social, environmental, and economic benefits and value (i.e., sustainability) to South Boston. Stakeholder engagement included focus group meetings and public open houses; options were presented and feedback collected from developers, residents, and other stakeholders on preferred solutions. Options explored for protecting South Boston are shown in Figure 4 and include the following grey and green infrastructure solutions:

- Building vertical seawalls (grey)
- Promoting the resilient design of buildings and structures (grey)
- Constructing a raised harbor walk and park spaces (grey and green)
- Constructing living shorelines (green)
- Creating natural barriers such as salt marsh or sand dunes (green)

Released in the fall of 2018, the report provides a resiliency roadmap and implementation strategy for sustainably protecting South Boston and offers solutions that attempt to balance safety with welcoming open spaces that enrich the community.

Several solutions have been incorporated along the Seaport's Fan Pier (Figure 5), including vertical seawalls, raised harbor walks, and park space that provides flood protection, public access, and green space in an urban environment.

Figure 4. Climate Ready South Boston—green and grey features

Figure 5. Climate Ready South Boston—Fan Pier living shoreline

Figure 6. Views of Clippership Wharf during low tide (left) and mid tide

Figure 7. Clippership Wharf—community access and resource connection

Clippership Wharf and Living Shoreline

Clippership Wharf is a new, resilient, multi-family residential development and waterfront destination on two abandoned wharves in East Boston. The design protects the site and enhances the waterfront while transforming the open space into passive and active recreation opportunities. With the inclusion of stakeholder engagement, the design considered numerous points of public access to the water and the spectacular views of the Boston skyline, while protecting the built environment. The design includes a tiered site with features that can be submerged during tidal changes (Figure 6) and a harbor walk at the lower level, public access and open spaces at mid-level, and residences and courtyard above.

Figure 8. Clippership Wharf—educational placard

From a resiliency standpoint, the green infrastructure, in the form of open spaces and a living shoreline—featuring saltwater marshes, rocky beaches, and plentiful wildlife habitats—creates a natural flood barrier that protects tenants and other inland properties. Grey infrastructure features, including a stepped seawall and hardened building structures, create a barrier to storm surges and sea-level rise.

Socially, a living shoreline features a connection to the natural environment that people can observe and explore; terraced seawalls provide places for the public to rest and explore; and educational placards and signs demonstrate the function and benefit of the green and grey infrastructure features (Figures 7 and 8). The continuation of the harbor walk across the property provides public access to the water and places for residents and the public to walk, sit, and experience the outdoors.

Environmentally, this remediated industrial site reduces the risk of exposure to toxic contaminants and makes the area cleaner and safer. The shoreline and landscape features create a natural environment for people and wildlife, while reducing the impacts of storm events, increasing the pervious area for infiltration, and providing a natural buffer to coastal storm events.

Figures 9a, 9b, 9c. Daylighting of Policy Brook at Tuscan Village Figures 10a and 10b. Tuscan Lake
Figure 11. Green infrastructure rain garden at Tuscan Village

Tuscan Village—sustainable redevelopment including daylighting of Policy Brook

Tuscan Village is a multi-phased, mixed-use development on the historic Rockingham Park racetrack site in Salem, New Hampshire. The 170 ac (69 ha) site includes both residential and commercial uses, with the South and Central Village portions consisting of approximately 800,000 ft² (74,000 m²) of retail, office, and residential uses. The vision for this property was to reconnect the development to the natural environment that existed prior to the racetrack, while providing new features for exercise, exploration, and recreation.

One sustainable feature of this redevelopment is the daylighting of Policy Brook (Figures 9a, 9b, and 9c), which had been culverted to construct the racetrack. The daylighting project created more than 3,000 lf (914 m) of natural stream and adjacent floodplain, providing opportunities to celebrate and experience the brook. Numerous green infrastructure features such as raingardens and a man-made lake resulted in a resilient, sustainable design with direct and indirect benefits. For example, an old irrigation pond that served the former racetrack was restored and redesigned to create the nearly 3 ac (1.2 ha) Tuscan Lake (Figures 10a and 10b). The lake helps provide stormwater management for the site and offers outdoor recreational opportunities, including a beach, kayaking, canoeing, and fishing. Adjacent to the lake is Lake Park, which connects the built environment to this man-made natural environment and is a gathering area, with programmable spaces for family activities that overlook the lake.

From a resiliency perspective, replacing the culvert with a natural channel and embankment reduces the impact of storm events both upstream and downstream by reducing peak flows, providing storm surge storage, and incorporating stream calming. The lake and rain gardens also minimize potential storm impacts by reducing peak flows.

Environmentally, daylighting Policy Brook into an open stream with a landscaped embankment improved water quality and created a more robust habitat for aquatic and terrestrial species. The open stream features, combined with other green infrastructure such as the lake and rain gardens (Figure 11), also mitigate the environmental impacts of major storm events.

Socially, the daylighted brook, lake, and green infrastructure provide natural resources for Tuscan Village residents and visitors to enjoy year-round.

Finally, converting the abandoned racetrack into a sustainable mixed-use development provides an economic benefit to the community, businesses, and residents through increased property values, commercial and rental income, and a re-established tax base.

CONCLUSIONS

"The Mending Wall" by Robert Frost is a poem about Mr. Frost and his neighbor maintaining the wall between their two properties. The neighbor says that "good fences make good neighbors," whereas Mr. Frost questions the need for a wall by asking:

> Before I built a wall I'd ask to know
> What I was walling in or walling out,
> And to whom I was like to give offense.[4]

Resiliency requires that we plan, prepare for, mitigate, and adapt to the changing conditions caused by climate change, and that as a society we must do so to reconnect our built environment to the natural environment. In many cases, these walls are critical to our infrastructure, but we must continue to ask, "To whom do these structures give offense?" The thoughtful combination of green and grey infrastructure results in sustainable and resilient purpose-built infrastructure that protects the built environment, celebrates the natural environment, and provides viable and vibrant spaces for people to live, work, and play.

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Water system climate vulnerability assessment in Brewster, Massachusetts

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ABSTRACT | As a coastal community, the town of Brewster, Massachusetts is vulnerable to storm surges and sea level rise along Cape Cod Bay. In recent years the Brewster Water Department abandoned two sections of water main along the coast due to breaks in now inaccessible areas. In connection with this project, a new water distribution system model was developed and calibrated to evaluate the hydraulic impacts of the recent water main abandonments, and to identify and evaluate additional areas within the distribution system that may be vulnerable to climate impacts. The analysis aimed to help the department determine where to focus planning climate resiliency and the need and priority for reinforcement, looping, replacement, and extension of distribution system water mains. Suggested improvements focus on the impacts of hurricane storm surges and sea level rise projected between 2040 and 2060; however, the analysis also includes sea level rise projections up to 2100.

KEYWORDS | Climate, vulnerability, resiliency, planning, drinking water, coastal

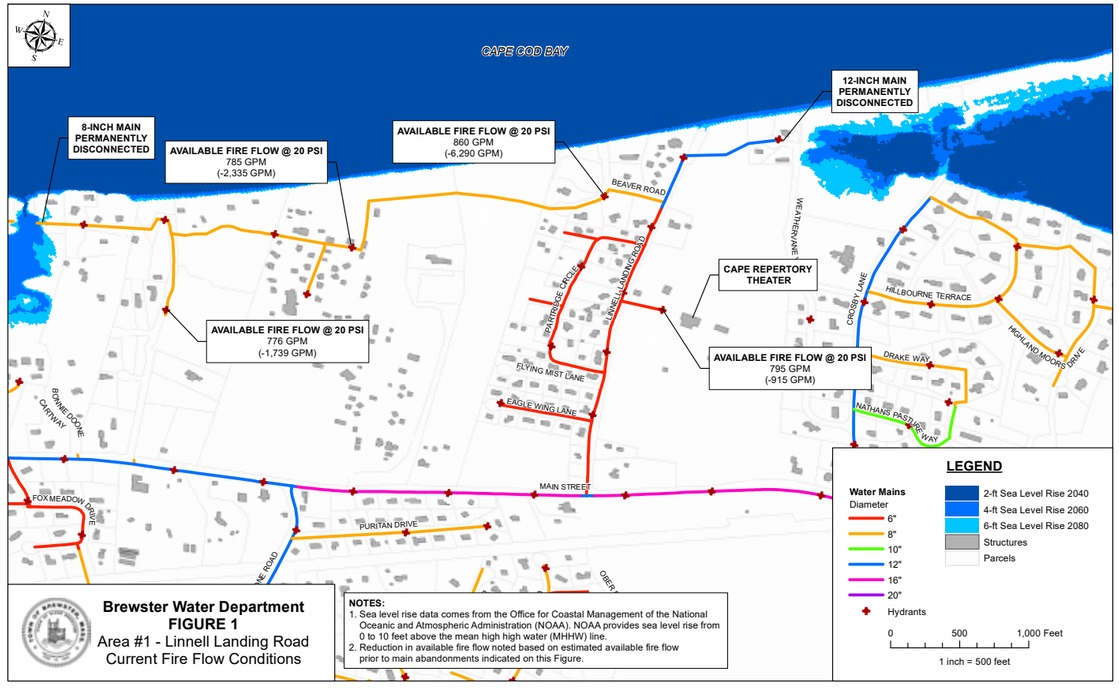
Both storm surges and sea level rise could inundate the town of Brewster's coastline with water. A storm surge is a temporary rising of sea level that occurs due to atmospheric pressure changes and wind associated with a storm event—typically a hurricane. According to the Commonwealth of Massachusetts 2013 State Hazard Mitigation Plan, the commonwealth has a 6 percent to 30 percent chance of a tropical storm or hurricane occurring each year, with the highest likelihood along the coast. A Category 3, 4, or 5 hurricane has a 1 percent or 2 percent chance of affecting Massachusetts each year.

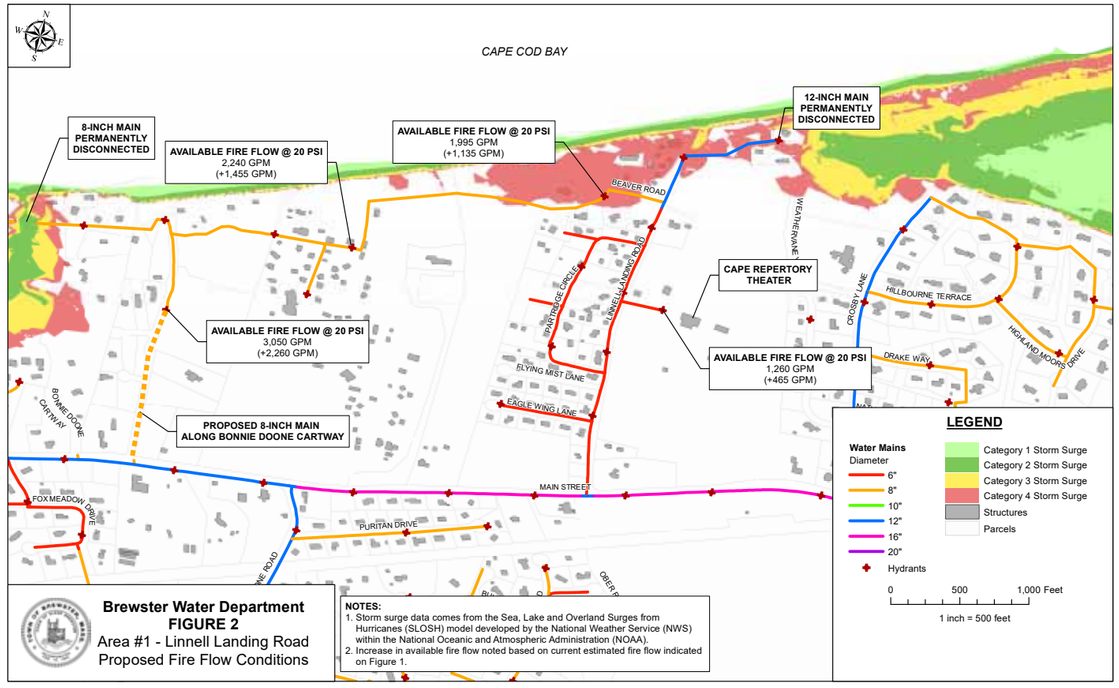
Table 1. Projected sea level rise

Year	Above mean high high-water level, ft (m)				
	Intermediate Low	Intermediate	Intermediate High	High	Extreme
2040	0.79 (0.24)	1.21 (0.37)	1.71 (0.52)	2.23 (0.68)	2.46 (0.75)
2060	1.21 (0.37)	2.1 (0.64)	2.95 (0.90)	4.07 (1.24)	4.72 (1.44)
2080	1.57 (0.48)	3.08 (0.94)	4.56 (1.39)	6.23 (1.90)	7.58 (2.31)
2100	1.9 (0.58)	4.2 (1.28)	6.43 (1.96)	9.09 (2.77)	11.22 (3.42)

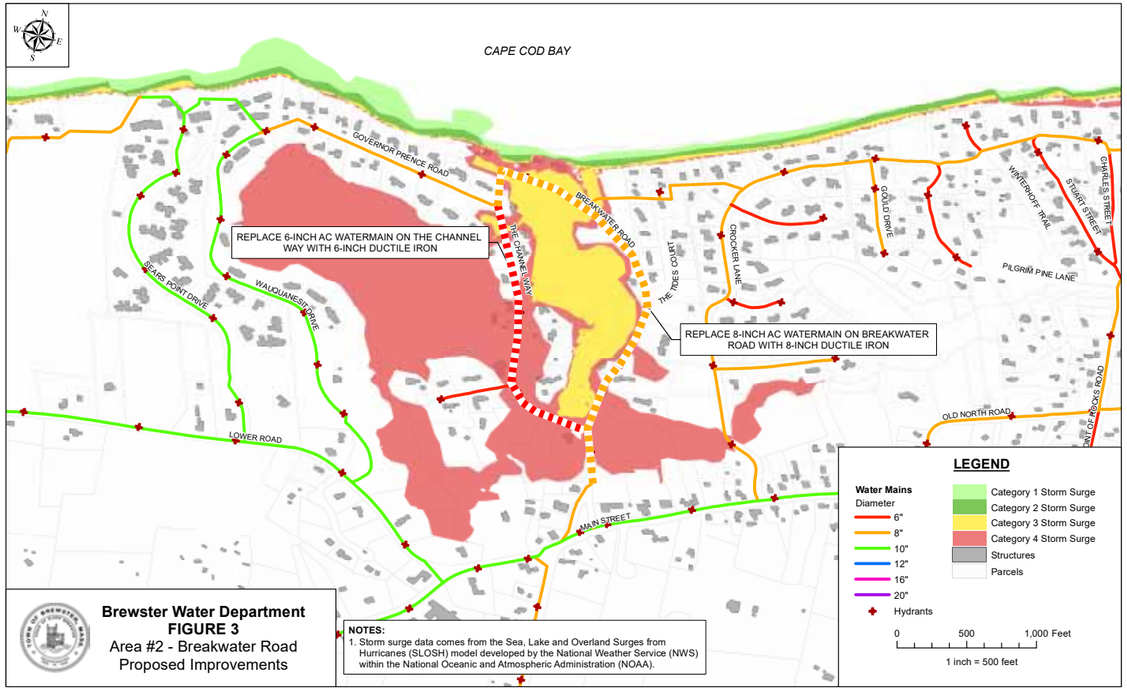
The National Oceanic and Atmospheric Administration (NOAA) uses the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model to estimate the storm surge heights and map the extent of flooding in coastal areas for hurricane categories 1 through 4. When preparing for incoming coastal storms, the Brewster Water Department should consider the extent to which areas could become inaccessible because of future storm surge. After the flooding has passed, Brewster should inspect these areas to ensure there is no damage to the distribution system infrastructure.

Unlike storm surges that have temporary impacts, sea level rise is the gradual and permanent increase of the average global sea level. Two drivers of sea level rise are the expansion of warming seawater and the additional water from melting ice sheets and glaciers. As the factors contributing to sea level rise are complex, NOAA offers a range of projections for sea level rise in Cape Cod Bay. These projections represent different scenarios for sea level rise from low to extreme. Table 1 shows the projected sea level rise for Cape Cod Bay above the mean high high-water (MHHW) level, also referred to as the average level of the highest daily tide over the past 19 years. NOAA's projections are specified for Sandwich, Massachusetts.





Figures 1 and 2. Area No. 1 – Linnell Landing Road (see descriptions beginning on next page)



Brewster Water Department
FIGURE 3
Area #2 - Breakwater Road
Proposed Improvements

NOTES:
1. Storm surge data comes from the Sea, Lake and Overland Surges from Hurricanes (SLOSH) model developed by the National Weather Service (NWS) within the National Oceanic and Atmospheric Administration (NOAA).

For this analysis the "high" sea level rise projections were used to be conservative but realistic. NOAA's mapping data shows the extent of flooding from sea level rise based on elevation and land use. Shown are the extents of 2 ft (0.6 m), 4 ft (1.2 m), 6 ft (1.8 m), and 9 ft (2.7 m) of sea level rise to represent the projected high levels for 2040, 2060, 2080, and 2100, respectively. Where sea level rise is expected to inundate land with sub-grade utilities, the department will need to abandon and reroute the infrastructure affected. Unlike inundation caused by temporary storm surges, these locations will be permanently under water from sea level rise. Areas with water mains that are permanently flooded due to sea level rise will be inaccessible, and the resulting exposure of ductile iron mains to salt water will accelerate corrosion and increase the frequency of water main breaks. Based on the available storm surge and sea level rise projections, flooding from storm surge or sea level rise is not expected to affect any of the department's structural facilities or water sources. However, actual future conditions may deviate from projected impacts.

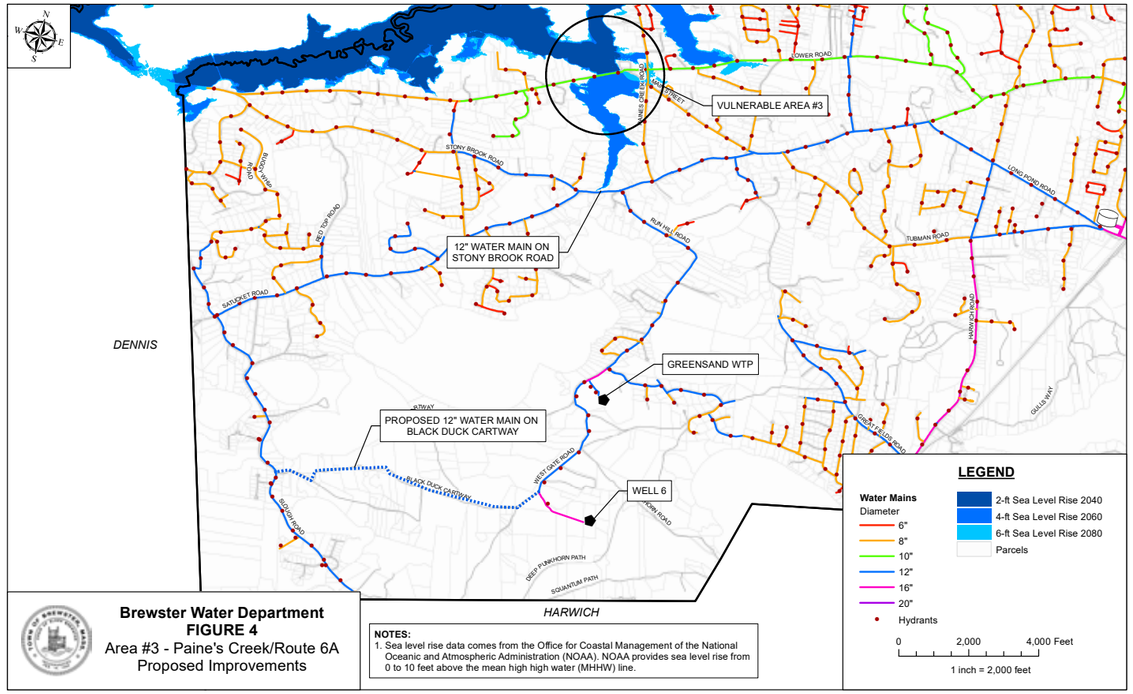
VULNERABLE AREAS

Three areas of the Brewster water distribution system vulnerable to storm surges and projected sea level rise were identified. Using the calibrated hydraulic model, the impacts of existing and potential water main abandonments on available fire flows, looping, and transmission main continuity were evaluated and recommended improvements to mitigate impacts of concern were developed.

Area No. 1 – Linnell Landing Road

The first vulnerable area identified (Area No. 1) is Linnell Landing Road in northeastern Brewster off State Route 6A. In response to main breaks in this area, the department abandoned sections of inaccessible water main located under sand dunes to the west and under tidal land to the east of Linnell Landing Road, forming a dead end. Using the calibrated hydraulic model, these main abandonments have reduced fire flow availability in this area by an estimated 50 percent to 75 percent (Figure 1—see previous page). The department is concerned with this area because of the lack of water main looping and reduced fire flow availability, especially at the Cape Repertory Theater on Linnell Landing Road.

This area was determined also to be prone to flooding from a Category 4 storm surge or from sea level rise in 2100. Both scenarios result in flooding the end of Linnell Landing Road, the entirety of Beaver Road, and part of the cross-country main. In addition, a water main break on Beaver Road would cause water service loss to all customers in the Bonnie Doone Cartway and Chapman Lane area. Therefore, to provide redundancy and improve fire flow



Brewster Water Department
FIGURE 4
Area #3 - Paine's Creek/Route 6A
Proposed Improvements

NOTES:
1. Sea level rise data comes from the Office for Coastal Management of the National Oceanic and Atmospheric Administration (NOAA). NOAA provides sea level rise from 0 to 10 feet above the mean high high water (MHHW) line.

availability in Area No. 1, it was recommended the department install a new polyethylene-encased 8 in. (20 cm) ductile iron water main along Bonnie Doone Cartway from Route 6A to the end of the existing main at 121 Bonnie Doone Cartway. Installation of this water main will allow the department to eliminate the dead end and improve fire flow availability in the area, including an estimated 500 gpm (32 L/s) of additional available fire flow at the Cape Repertory Theater (Figure 2—see page 23).

Area No. 2 – Breakwater Road

The second vulnerable area identified (Area No. 2) is Breakwater Road and The Channel Way located near low-lying wetlands adjacent to the coast in north-central Brewster. According to NOAA sea level rise projections, water mains in this area do not appear vulnerable to sea level rise until 2100; however, this area is vulnerable to storm surges from Category 3 and 4 hurricanes (Figure 3). The 6 in. (15 cm) and 8 in. (20 cm) water mains in this area are constructed of asbestos cement (AC) and are therefore fragile and prone to breaks. Storm surge flooding could also result in shifting soils around these mains, increasing the likelihood of main breaks.

An analysis was performed in Area No. 2 of the impact to local fire flow availability if the department were to disconnect the water mains on Breakwater Road and The Channel Way permanently. It was determined that disconnecting this main may modestly reduce available fire flow in the area, even though fire flow can still be provided by the 10 in. (25 cm) main along Route 6A. Therefore, disconnecting the mains in this area was not recommended as it would reduce water system connectivity and compromise the water system's redundancy and reliability. Instead, it was recommended the department prioritize replacing the vulnerable AC pipe with a more durable ductile iron pipe and encasing the pipe in polyethylene to help protect it from potential corrosion (Figure 3).

Area No. 3 – Paine's Creek Road/Route 6A

The third vulnerable area identified (Area No. 3) is Paine's Creek Road/Route 6A. This area has the most expansive impact due to sea level rise. By 2060, projections show high tides encroaching on the 8 in. (20 cm) AC water main on Paine's Creek Road, the 10 in. (25 cm) AC water main along Route 6A, and the 10 in. (25 cm) AC water main along Lower Road (Figure 4). By 2100, high tides are projected to cover approximately 1,500 lf (460 m) of Route 6A, 950 lf (290 m) of Paine's Creek Road, and 2,400 lf (730 m) of Lower Road. In addition, high tides are projected to cover approximately 1,000 lf (300 m) of the 8 in. (20 cm) AC water main on Robbins Hill Road. Storm surges from Category 3 or 4 hurricanes will result in similar flooding.

Hydraulic modeling suggests the 12 in. (30 cm) AC main along Stony Brook Road can solely provide fire flow to western Brewster if the department abandons the 10 in. (25 cm) main along Route 6A and Lower Road. However, a single main servicing many of the department's customers without any redundancy is a significant vulnerability for the town. In addition, this single main includes a stream crossing over Stony Brook, where a leak or break would not be easily identified or repaired. To improve system redundancy and reliability, it was recommended that the Department install a new polyethylene-encased 12 in. (30 cm) ductile iron water main connecting the 12 in. (30 cm) main on Slough Road to the 12 in. (30 cm) main on West Gate Road via Black Duck Cartway (Figure 4). This would provide an alternative path for water if the 10 in. (25 cm) main must be abandoned, and it eliminates a dead end in the system.

CONCLUSION

Preparing for the impacts of sea level rise and storm surges is beneficial for increasing the resiliency of the Brewster water distribution system and mitigating future concerns for the Department. The Brewster water distribution system is robust and well-looped, which helps minimize the impact of future flooding. By implementing strategic water main improvement projects, the department will increase water system resiliency and reliability and in turn prevent customers from losing access to drinking water and fire protection.

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Designing for coastal wastewater resiliency—WWTP hardening in Fairfield, Connecticut

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ABSTRACT | In October 2012 Hurricane Sandy caused record storm surge flooding in coastal areas of Fairfield, Connecticut, and widespread damage throughout the town. Portions of the town's wastewater treatment plant (WWTP), located directly adjacent to a low-lying coastal salt marsh, were submerged and substantially damaged due to the storm. Consequently, the WWTP's influent did not receive full treatment for more than a week. The town used emergency funding through the U.S. Department of Housing and Urban Development and the Connecticut Department of Housing to design and construct a flood control structure and pump station to protect the WWTP and surrounding critical town facilities from a 100-year flood. This article provides an overview of the project, discusses the design process and challenges, and highlights the risks to wastewater facilities in similar coastal environments.

KEYWORDS | Coastal resiliency, wastewater, pump station, flooding, floodwall

The Fairfield wastewater treatment plant (WWTP) is a 9 mgd (34 ML/d) facility that treats sewage from 17,000 customers within the town. The facility is in a Federal Emergency Management Agency (FEMA)-defined AE flood zone (base floodplain where base flood elevations are provided), subject to inundation by the 1 percent annual chance (100-year) flood. Based on the National Hurricane Center's national storm surge hazard maps, the WWTP site is vulnerable to storm surge from a Category 2 storm, with most of the surrounding area and access to the site vulnerable to a Category 1 storm.

Fairfield's unique geography makes it particularly susceptible to coastal storm surge events. The area of the town south of Interstate 95—where the WWTP is located—was historically an expansive, low-lying coastal salt marsh. This salt marsh is protected by a system of dunes and barrier beaches that absorb the wave energy from Long Island Sound. Two creeks, Ash Creek to the north and Pine Creek to the south, drain the salt marsh and allow tidal flushing. Over time, the salt marsh was partially infilled for residential development and the construction of municipal facilities, including the WWTP. During large coastal storm events, the area floods through two sources: tidal flooding through the unprotected outlets of Ash Creek and Pine Creek and overtopping of the dunes and barrier beaches. During Hurricane Sandy, the storm surge overtopped the barrier beaches and became trapped in the low-lying salt marsh surrounding the WWTP. This area remained flooded for more than a week.

Despite the extensive damage to the WWTP facility, Hurricane Sandy was categorized as a Category 1 storm when it hit Fairfield. Had the storm surge from Hurricane Sandy gone any higher, larger areas of the WWTP would have been fully submerged. A 100-year flood event would fully inundate the WWTP and damage much of the facility, costing an estimated $35 million to $50 million to repair.

PROJECT DESCRIPTION

The town's immediate priority after Hurricane Sandy was to repair the vast damage that the storm inflicted on the town's seawalls, bulkheads, roadways, dikes, and other coastal infrastructure to restore access and safety for the public. Once the initial repair and recovery was completed, the town assessed the additional coastal vulnerabilities that Hurricane Sandy had exposed and planned to improve resiliency against even larger storm events.

Rendering of floodwall and resiliency improvements

The town used emergency funding through the U.S. Department of Housing and Urban Development (HUD) and the Connecticut Department of Housing for some of these resiliency improvements. In 2015, it secured funding through HUD's Community Development Block Grant – Disaster Recovery (CDBG-DR) program for several coastal resiliency projects, including the WWTP hardening project. This program funds projects after a Presidentially declared major disaster for disaster relief, long-term recovery, and restoration of infrastructure.

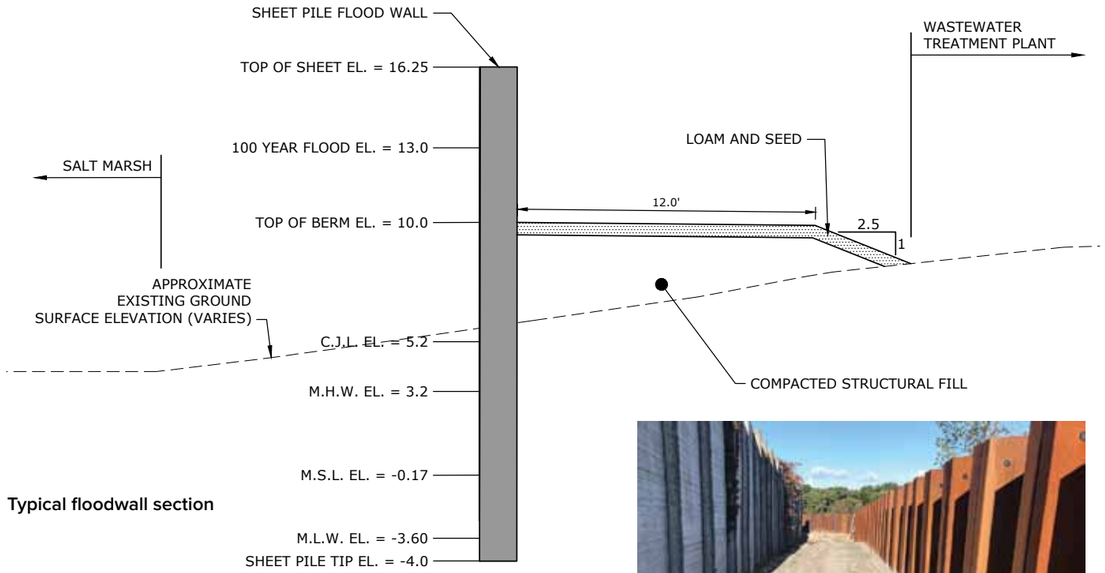
The hardening project included the construction of approximately 2,900 lf (884 m) of sheet pile wall around the WWTP and surrounding critical facilities, including the Fairfield County fire training school, town conservation building, and town animal shelter. The project also raised parts of Richard White Way, the main access road to the site; it intersects with the sheet pile wall to provide access to the WWTP during major storm events while maintaining a continuous flood control structure. This continuous floodwall ringing the plant creates a "bathtub" to trap rainfall within the plant during rainfall events. To address this condition, two stormwater pump stations were designed to discharge rainfall collected within the floodwall against a potential storm surge event.

DESIGN CONSIDERATIONS AND SOLUTIONS

The main design considerations for protecting and hardening the WWTP included the floodwall materials and configuration, stormwater pump stations, and facility access.

Floodwall Design

The primary consideration in the design of a structure to protect the WWTP was the desired extent of flood protection and the resultant height requirement for the associated structure. The NEIWPCC document *Technical Report No. 16 – Guides for the Design of Wastewater Treatment Works*, commonly referred to as TR-16, provides design criteria for all Connecticut state-funded wastewater projects. Largely as a result of Hurricane Sandy, TR-16 was



Typical floodwall section

Completed sheet pile floodwall

revised to recommend that all critical wastewater equipment and structures must be flood protected to the 100-year (1 percent chance) storm elevation plus 3 ft (0.9 m) at a minimum, or else the 500-year (0.2 percent chance) storm elevation. At the Fairfield WWTP site, the 100-year storm elevation, also known as base flood elevation (BFE), is Elevation 13.0 North American Vertical Datum of 1988 (NAVD 88) and the 500-year storm elevation is Elevation 16.25 NAVD 88. Owing to the critical nature of the facility and impact of a major flood event, the flood protection structure would be designed to meet the 500-year storm elevation. To do so, the structure would vary between 6 ft (1.8 m) and 12 ft (3.7 m) above existing grades around the perimeter of the WWTP site and surrounding facilities.

Selection of the appropriate materials of construction and cross-section for a flood protection structure is a balance among cost, constructability, material lifespan, and ease of permitting. The conceptual design analyzed potential flood protection solutions, including an earthen berm, concrete floodwall, and steel sheet pile floodwall.

An earthen berm generally offers cost-effective flood protection; it is also considered green infrastructure. However, an earthen berm requires a significant footprint and access to an economical source of suitable fill material. Its core is typically composed of a low-permeability material to limit seepage and is surrounded by compacted earthen fill. The side slopes must be relatively flat to maintain the structure's stability, generally no steeper than 3H:1V. The berm's required height for the Fairfield project would have necessitated a footprint of more than 70 ft (21 m) in some areas to meet stability and permeability requirements. Owing to the wide footprint, this option would have affected substantial tidal wetland resources close to the WWTP's perimeter. As a result, an earthen berm was determined to be infeasible for most of the project area.

Concrete floodwalls are typically used when space is limited, and an earthen berm section would be too large to reach the desired height to protect a facility. Several types of concrete floodwalls can be used depending on soil conditions, required height of protection, and space limitations. The most common configurations are T-walls and I-walls, named for the shape of the floodwall and footing. Both types may also require sheet pile or some control below the concrete floodwall to limit seepage in a flood condition as well as pile support depending on subsurface conditions. A geotechnical analysis of the subsurface soils determined that steel sheet pile would be required below the concrete floodwall and piles would be required in some areas. The concrete floodwall alternative was not cost-effective in this location due to the subsurface soil conditions.

The final floodwall option analyzed was a steel sheet pile wall. A steel sheet pile wall requires a tiny footprint, an important consideration due to the limited space between the plant perimeter and coastal wetland resources. Steel sheet pile floodwalls are similar to a concrete I-wall and derive their strength from adequate embedment below the ground surface. In sandy and silty soils, a sheet pile is typically driven using a vibratory hammer mounted on a crane, pile-driving rig, or large excavator. A steel sheet pile can be installed more quickly than concrete floodwalls and does not require excavation for the wall footing. In applications with high groundwater such as coastal sites, not having to excavate below grade also eliminates dewatering costs and potential environmental complications. Steel sheet pile floodwalls are designed to resist bending moments and shear stresses, and limit deflection. These walls can be cantilevered with no lateral support or designed with anchors or an earthen berm for additional lateral support.

A cantilevered steel sheet pile floodwall combined with a limited height earthen embankment was selected and designed to protect WWTP. The limited earthen embankment, added for lateral support, reduced the depth of sheet pile required below grade. This floodwall was ultimately selected because of its smaller footprint, constructability, and cost-effectiveness.

Pump Stations

The Fairfield WWTP site contains a network of gravity storm drains that collect and discharge stormwater runoff to the surrounding marsh areas. These outlets were unprotected and subject to backflow in a coastal storm surge event. The proposed construction of a floodwall ringing the plant created a "bathtub" that would trap rainfall and runoff within the plant if coupled with a high-tide or storm surge. The site topography created two distinct low-lying areas that would be most frequently prone to flooding at the project's furthest north and south areas. To address this internal flooding risk, two pump stations were designed to discharge stormwater collected within the floodwall area.

Recent trends suggest that rainfall events have increased in intensity over the last several decades. Heavy and extreme precipitation events have become much more frequent in the Northeast because of climate change. In 2013, the National Oceanic and Atmospheric Administration (NOAA) updated precipitation frequency estimates in Atlas 14. These updated estimates should be used in designing stormwater pump stations.

Designing such pump stations in a coastal environment required additional considerations beyond those typical of an inland pump station design. The pumps had to meet a range of potential tidal tailwater conditions, from a standard low and high tide to a 100-year storm. High groundwater conditions also required the pump station wet wells to resist buoyancy effects. Constructability was also important, as soil and groundwater conditions required temporary earth retention systems and an engineered dewatering system for installation.

Pump station No. 2 vault

Pump Station No. 1 was located in the southern portion of the project area. The drainage area contributing to it is approximately 17.4 ac (7.0 ha) and includes most of the flood control structure area. In a storm event that exceeds the gravity storm drainage system's capacity due to high tides or excessive rainfall rates, runoff will be directed southerly through a high-level overflow within the piped storm drainage network to the pump station. Pump Station No. 1 includes two submersible pumps within a precast concrete wetwell. The wetwell floor is 17 ft (5.2 m) below grade to create enough volume to prevent excessive cycling of the pumps. With both pumps operating, Pump Station No. 1 has a total capacity of approximately 7,550 gpm (476 L/s), or 11 mgd (41.6 ML/d). The pump station limits flood elevations in a 100-year storm within the floodwall to protect the WWTP infrastructure. Pumped stormwater effluent discharges through the floodwall to Pine Creek through a 24 in. (60 cm) diameter high-density polyethylene (HDPE) pressure pipe that is protected from backflow by a duckbill tide gate.

Pump Station No. 2 is located in the north corner of the flood control barrier, adjacent to the WWTP's influent building. The drainage area contributing to Pump Station No. 2 is approximately 1.18 ac (0.5 ha) and includes the site's northern corner. The grades in this area were too low to direct flows to Pump Station No. 1; thus, a separate pump station was needed. In addition, the influent building was constructed at a lower elevation than most of the other buildings on site, increasing the needed pump capacity to prevent flooding in a storm event. Similar to Pump Station No. 1, Pump Station No. 2 will collect stormwater flows that exceed the capacity of


Roadway elevation to provide access over floodwall

the catch basins and piped gravity storm drainage system that collect runoff from this area. Pump Station No. 2 includes two submersible pumps within a precast concrete wetwell. With both pumps operating, Pump Station No. 2 has a capacity of 1,375 gpm (87 L/s), or 2 mgd (7.6 ML/d). Pumped stormwater effluent discharges through the floodwall through an 8 in. (20 cm) diameter HDPE pressure pipe that is protected from backflow by a duckbill tide gate to the adjacent salt marsh.

To eliminate the threat of flooding from backflow through the storm drainage outfalls, tide gates were also designed for the outlets of all gravity storm pipes exiting the floodwall. These tide gates open to allow stormwater flows to exit through the floodwall when pressure head in the upstream storm drainage systems is sufficient, but prevent storm surge and high tides from entering the system at the outfalls and potentially creating flooding within the floodwall structure. Duckbill tide gates and inline check valves were used for the storm drainage outfalls to provide the required protection.

Facility Access

Implementation of a floodwall around the WWTP and surrounding facilities created a potential impediment for site access. The site is bisected by Richard White Way, a local roadway that provides vehicular access to the WWTP and is also the main access to the town's solid waste transfer station. Creating access through a flood control structure is typically accomplished in one of two ways: a flood gate integral with the floodwall or elevating the roadway over the top of the floodwall. The town wanted to minimize the need for human intervention to protect the WWTP site, as staff have many responsibilities in a major storm event. Owing to the required width and height of potential flood gates and the project's goal of self-sufficiency, flood gates were eliminated as an option.

Two sections of Richard White Way required elevation of more than 9 ft (2.7 m) to provide access over the top of the floodwall structure. The roadway profiles in these two areas were redesigned per local roadway standards to create safe vehicular access while maintaining a continuous flood control structure around the WWTP and surrounding facilities. The roadway profiles accommodate the large commercial vehicles that use this roadway daily to access the transfer station and adjacent public works facility. Portions of the WWTP's driveway entrances were also redesigned and elevated to meet the new roadway profiles.

MICROGRID PROJECT

Hurricane Sandy also exposed potential vulnerabilities in the electrical transmission system, as much of Fairfield and the Connecticut coastline lost power during the storm. The WWTP hardening project has also enabled the town to pursue a parallel resiliency project that includes the installation of a microgrid serving the WWTP and adjacent facilities. The microgrid project will include installation of cogeneration and microgrid equipment at four critical facilities for the purpose of storm hardening and operability during extended electrical grid outages. The microgrid equipment will tie all four of the facilities together electrically during grid outages, so that they may operate in "island mode" and share the output from backup generators and grid-connected distributed generation.

These two projects together will greatly improve the resiliency of Fairfield's WWTP and protect it from future flood events.

SUMMARY

Hurricane Sandy and other high-intensity rainfall events exacerbated by climate change have illustrated the vulnerabilities to flooding faced by many WWTP facilities. These risks are elevated when a WWTP is in a coastal environment, subject to hurricane inundation and storm surge. Most of these facilities were not built to meet flood protection criteria identified in wastewater design guidelines such as TR-16, and the cost of floodproofing or elevating individual structures to meet these guidelines can be well beyond many municipal budgets.

Fairfield's WWTP hardening project shows one way that municipalities can protect these critical facilities from flooding. The sheet pile floodwall around the WWTP perimeter combined with the two stormwater pump stations within the floodwall will safeguard the facility from a 100-year storm. This project aimed to improve the town's resiliency by protecting this critical wastewater asset so that it would continue to provide treatment for residents and businesses during a major storm event.

ABOUT THE AUTHORS

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BEAM*2022—measuring biosolids impacts on climate change and resiliency

JANINE BURKE-WELLS, North East Biosolids & Residuals Association

ABSTRACT | How water resource recovery facilities (WRRFs) manage their "waste" solids can have a major impact on their carbon emissions. This article discusses an updated greenhouse gas calculator, the biosolids emissions assessment model (BEAM*2022), that can be used to estimate carbon emissions from up to 10 biosolids management options. It reviews carbon accounting, how BEAM*2022 was developed, how it works, and what it can be used for. The model is highly recommended for planning, and it can be customized for local utility conditions. BEAM*2022 can inform WRRF decision-makers about more sustainable biosolids management processes, which can have major impacts on carbon emissions and be integral to climate change solutions that are desperately needed.

KEYWORDS | Climate change, greenhouse gas emissions, biosolids management, carbon accounting, long-term planning

The biosolids-climate change nexus fits under the larger water-energy nexus. It takes a lot of water to make energy and a lot of energy to make clean water, so clean water professionals may have a greater responsibility to do whatever we can to reduce the impact we have on the climate. We need to find any way to reduce energy and water demands by water resource recovery facilities (WRRFs), reduce our utility's greenhouse gas (GHG) emissions, and improve resiliency. Biosolids management (treatment and end use) contributes a significant proportion of GHG emissions from WRRFs. Mitigating climate change requires major reductions in carbon emissions. How we manage our biosolids can definitely be part of the solution.

Biosolids are an endlessly renewable resource. Recycling them is not the cheapest or easiest solution, but we do so to enhance soil health, recycle nutrients, reduce fertilizer and pesticide use, and strengthen farm economies. Biosolids-based soil amendments also provide micronutrients such as zinc, iron, manganese, and copper that healthy soils need and that are not found in other products. Biosolids put carbon back in the soil and have been shown to help with carbon sequestration and drought tolerance. The concerns with biosolids will always be there: odors, over-application of nutrients, and, of course, trace contaminants like per- and polyfluoroalkyl substances (PFAS) and others addressed in the past.

WRRFs should understand the impacts their biosolids management decisions have on carbon emissions. Working within communities, where the wastewater solids are generated, WRRFs should decide what is the "highest and best use" of those materials—not looking at these materials as waste, but as resources to recover.

ACCOUNTING FOR CARBON FROM BIOSOLIDS MANAGEMENT

The North East Biosolids & Residuals Association (NEBRA) has a new Carbon Trading Committee interested in carbon accounting for biosolids management programs. This committee has already learned much about carbon offset trading programs from guest speakers and experts. It plans to evaluate current methodologies and carbon credit protocols that have been implemented, find where biosolids and residuals can fit into the system with beneficial reuse projects, and help NEBRA members develop carbon trading projects. The committee will also oversee the roll out and annual review of the updated 2022 biosolids emissions assessment model (BEAM*2022), making sure BEAM*2022 is up-to-date, with the goal of making it acceptable for regulatory and voluntary carbon trading programs. This GHG calculator will be available online.

Carbon accounting refers to measuring or modeling and validating carbon emissions and reductions. This involves accounting-type activities such as inventories and audits. Models help here since measuring carbon emissions or reductions in the field for every project is not feasible. Measuring or modeling our carbon emissions from various biosolids management practices will highlight the most impactful actions or areas to address and can lead to meaningful changes.

In the western United States, especially in California, Oregon, and Washington, a concerted effort is ongoing to maximize the benefits of biosolids. They are used extensively in agriculture, as well as in silviculture and forestry, and for restoring fire-ravaged lands, with much research showing how biosolids-based soil amendments improve poor soils. King County (Seattle, Washington area) is using carbon accounting through its own adaptations of the original BEAM, which was published by the Canadian Council of Ministers of the Environment (CCME) in 2009. King County is also conducting research into the longevity of climate impact from recycling biosolids. Its strategic plan for biosolids focuses on recycling. The climate action plan of San Francisco Public Utilities also includes biosolids recycling, driven in part by California's ban on disposing of organic materials—including biosolids—in landfills.

Numerous states in the Northeast have completed or are working on climate action plans. Vermont, for example, published its climate action plan in December 2021; it focuses on five "impact areas," including climate pollution, carbon capture, resilient working and natural lands, vital communities, and cross-cutting solutions. As recognized and supported throughout the western United States, recycling biosolids meets those criteria.

BEAM*2022—A USEFUL TOOL

NEBRA is excited to manage BEAM*2022, a GHG calculator related to biosolids processing and end use and disposal. This new, updated version was recently launched on a new website (biosolidsdGHGs.org). BEAM*2022 is an elaborate spreadsheet, using formulas and emission factors to calculate—in accounting terms—carbon debits (emissions) and credits (sinks). BEAM*2022 focuses on the major greenhouse gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Methane and nitrous oxide have much higher global warming potential (25 times and 298 times more than carbon dioxide, using the International Panel on Climate Change

Screenshot from the new website—biosolidsdGHGs.org

[IPCC] AR4 factors that EPA still relies on). The BEAM*2022 calculations are consistent with and use other emissions factors based on IPCC protocols. The new BEAM*2022 is available as a public service (subscriber-donation model). The objective is to offer a consensus-driven, standardized tool that utilities can use to compare carbon emissions from a range of current or potential future biosolids management scenarios to help inform their decision-making.

HISTORY OF BEAM*2022

The original BEAM was developed for the CCME by a consortium of well-known experts in the biosolids field. According to the original 2009 CCME *User Guide*, the BEAM model was developed to allow operators, engineers, and managers to assess potential GHG emissions from a range of biosolids management scenarios. The model can be used for the following:

- Estimating a program's GHG emissions, including establishing a baseline
- Comparing emissions from different biosolids management scenarios within a program
- Estimating the impacts on GHG emissions resulting from changes in a biosolids management program
- Understanding the factors with the greatest impact on increasing or reducing GHG emissions

Further updates were made by BEAM's creators, with version 1.1 the official version since 2011. In the interim, research has advanced and updating and validating the model further has been necessary. Between 2010 and 2021, several major upgrades to the calculator model were created by various users for clients such as the New York City Department of Environmental Protection (NYC DEP) and the San Francisco Public Utilities Commission as these organizations work toward municipal goals of becoming "carbon neutral" or better. There is also a new "module" or spreadsheet tab for a new unit process—pyrolysis with drying. Northwest Biosolids and NEBRA led a scientific review and update of

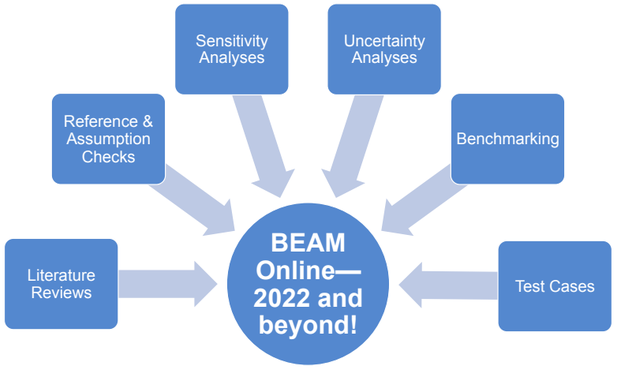


Figure 1. BEAM Evaluation Process

the model and created a website for sharing it. Although CCME was consulted and kept apprised of the current work, NEBRA and Northwest Biosolids assumed responsibility for BEAM*2022.

PLANS FOR KEEPING BEAM*2022 UPDATED

In 2021, NEBRA organized the BEAM*2022 science review team (SRT) consisting of five members—three academics and two PhD consultants. NEBRA created a protocol for annual reviews; the six elements are shown in Figure 1. The SRT conducts reference and assumption checks based on literature reviews. NEBRA performs sensitivity and uncertainty analyses, with SRT input and direction as needed. Benchmarking and test cases are done by BEAM users and will be collected on the new website, where users can share their BEAM spreadsheets and provide feedback for future annual reviews.

For BEAM*2022, the current updated model, the SRT focused on specific assumptions and factors that have a large impact on net GHG emissions from solids management, including, for example, the following:

- Rate of carbon sequestration when biosolids are land applied, varied based on soil type, climate, management practices, and other factors
- Nitrous oxide emissions from sewage sludge incineration and biosolids land application
- Fugitive methane from biosolids management, including in anaerobic digestion (AD) and combined heat and power systems (CHP)
- Default assumptions on percentage volatile solids reduction (VSR) in aerobic digestion and AD systems and similar important information in solids management processes

For this initial BEAM*2022, the SRT peer review process was accompanied by some additional stakeholder review involving an advisory group, which includes NEBRA's Carbon Trading Committee, the WEF GHG subcommittee, and other volunteer stakeholders. The advisory group will continue to help guide development of new modules and uses for BEAM*2022 that will be factored into each annual review.

Results of each annual SRT evaluation of BEAM*2022 will be incorporated by NEBRA into the spreadsheet calculator, with attention to the integrity of all links and references. Results will also be incorporated into the user's manual, including, as needed, changes to any major assumptions, resulting limitations on model uses, and explanations concerning higher sensitivity, uncertainty, and ongoing research. The annual evaluation will likely help further prioritize and inform research and data collection related to understanding, measuring, and modeling GHG emissions associated with biosolids management.

USES OF BEAM*2022

Currently BEAM is a good tool for planning. The model can be used to estimate a program's GHG emissions, including establishing a baseline, comparing different biosolids management scenarios, and estimating impacts from changes in biosolids management. BEAM*2022 can help identify the most impactful actions a utility can take in managing their biosolids.

A long-term goal is to make BEAM acceptable for carbon accounting protocols. We need to demonstrate and validate our practices from a carbon impact standpoint if we want to maximize the benefits of these activities. Biosolids has not yet made it into any carbon accounting for carbon credits, although it does seem likely to fit, with some tweaks, in the climate action reserve's soil enrichment protocol. But the promise for model acceptance is there, and NEBRA's Carbon Trading Committee aims to move that along in collaboration with the rest of the BEAM*2022 advisory group.

HOW BEAM*2022 WORKS

BEAM*2022 calculates GHG emissions and allows the user to compare emissions in carbon dioxide equivalents (CO_2eq) across numerous different unit processes, including the following:

- Storage
- Conditioning/thickening
- Aerobic digestion
- Anaerobic digestion
- Dewatering
- Thermal drying
- Alkaline stabilization
- Composting (two types)
- Landfill disposal (typical, worst-case, aggressive, CA regulatory)
- Combustion
- Pyrolysis
- Land application (two types)
- Transportation

The calculations are based on data entered by the users that in turn are based on local measurements or factors. If no local data are available, the user can enter default emissions factors in the model from the latest peer-reviewed research. Color-coded cells indicate the type of data required, user inputs, default values, interim calculations that feed the default values, and emissions results. A separate tab contains references and assumptions. Emissions are calculated and reported as scope 1 (direct) and scopes 2 and 3 (indirect emissions from operations). BEAM*2022 can analyze numerous different scenarios. Figure 2 shows seven scenarios in which the IPCC standard 100-year timeline is used (but that can also be customized). Negative numbers are reductions in carbon dioxide equivalents—a good thing. Positive numbers show end uses that are increasing carbon emissions—what we want to avoid.

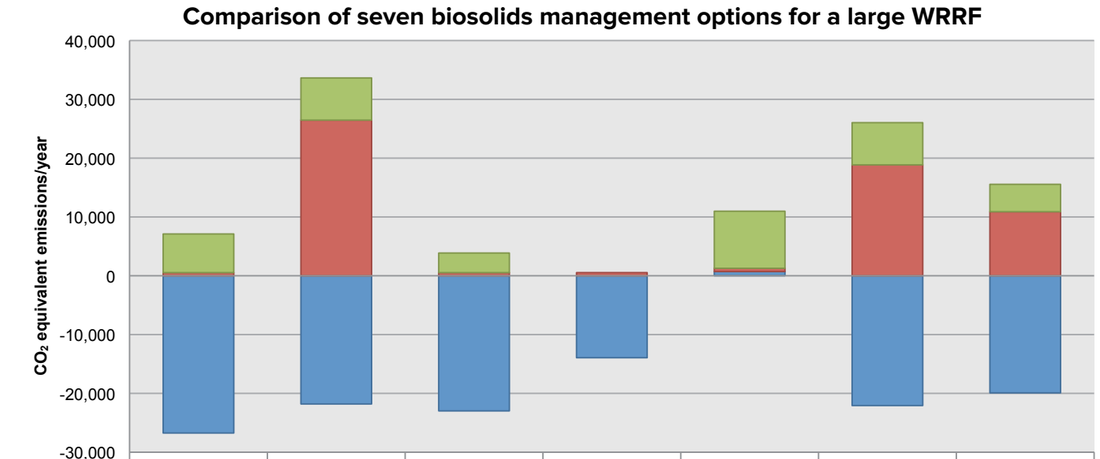
From reviewing research and using this GHG calculator, and seeing the results over the years, NEBRA can conclude that for typical situations landfilling biosolids has the highest emissions and negative impact on climate (based on default factors, typical emissions). BEAM*2022 results show that anaerobic digestion followed by land application or composting is much better in terms of carbon emissions: The decreased carbon resulting from use of these biosolids in lieu of commercial fertilizer and the estimated amount of carbon sequestered through biosolids land application far outweigh any carbon emissions from transportation and storage of the biosolids. Uncertainty remains, however, around nitrous oxide emissions from land application, and that is an active area of research.

BEAM*2022 helps emphasize critically important lessons regarding biosolids management and potential impacts on climate:

- Reducing energy and fossil fuel locally will reduce GHG emissions and save utilities money. Energy efficiency actions should be a priority for all WRRFs.
- Because wastewater and biosolids contain abundant energy—dried biosolids are similar in energy content to lower-grade coal—we can add to renewable energy generation. That is what modern WRRFs are all about.
- Most importantly, we manage organic—carbon-rich—materials that also contain nitrogen. That means there is significant potential for releasing fugitive methane and nitrous oxide. Any significant release of those two gases far outweighs carbon dioxide emissions from fossil fuel use. BEAM*2022 helps focus attention on these high-priority concerns.

MORE TO COME

BEAM*2022 is available online starting this spring at biosolidsghgs.org, a new, dedicated, non-profit website. This is intended not only to provide widespread public access to the updated spreadsheet calculator but also support resources and further share experience and knowledge around estimating, monitoring, and addressing GHG emissions from



	AD Land Ap	Typ Landfill	Composting	Drying Land Ap	Combustion	Aggressive LF	Composite
N_2O (CO_2eq)	6,573	7,171	3,334	0	9,702	7,171	4,658
CH_4 (CO_2eq)	533	26,469	533	533	558	18,863	10,890
CO_2	-26,742	-21,804	-22,981	-13,940	716	-22,070	-19,915

Figure 2. Example of BEAM*2022 output—comparing seven biosolids management options for a large WRRF

biosolids management. We hope it will be a central hub for advancing understanding of GHG emissions related to the management of wastewater solids. A new user's manual is also in the works.

There will be many resources and much anticipated sharing of information by BEAM*2022 users with the goal of continually improving this GHG calculator for biosolids management programs. BEAM*2022 currently estimates GHG emissions from when the wastewater solids are wasted or removed from clarifiers or lagoons. Users have expressed interest in expanding the model upstream to include all WRRF processes, or at least ensuring that its outputs integrate well with large leading carbon accounting protocols, such as the corporate standard (ghgprotocol.org/corporate-standard).

NEBRA plans to review the model annually and update it as needed and as funding is available. Having a formal process to update data and assumptions helps ensure that this calculator is robust and reliable. This is important because voluntary—and in some cases regulatory—programs are increasingly requiring estimates and tracking of GHG emissions with goals of net reductions.

The future of biosolids management will involve carbon accounting. Research continues into the highest and best use of these "waste" materials. Using BEAM*2022 to estimate GHG emissions from various operations will help WRRFs understand the climate impacts from their operation. This could also help them communicate with customers and build support for low-impact, sustainable biosolids management programs. Using BEAM*2022 as a guide, WRRFs can make better long-term decisions, mitigate climate impacts, and become part of the circular economy.

ACKNOWLEDGMENTS

Thanks to Ned Beecher for his work on and contributions to the BEAM*2022 project.

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ABOUT THE AUTHOR

Janine Burke-Wells is the executive director of NEBRA. Ms. Burke-Wells previously was a wastewater utility manager in Rhode Island. She is a former president of NEWEA.

The resilient, adaptive design strategies serve community needs while mitigating anticipated flood paths within the park that could cause extensive future damage to site assets and surrounding areas

Spotlight:

GREEN STEPS AWARD
Langone Park and Puopolo Playground

NEWEA's Sustainability Committee recognized the recent climate-resilient improvements to Langone Park and Puopolo Playground in Boston with the 2021 Green Steps Award during the 2022 Annual Conference. The Green Steps Award celebrates achievements in the wastewater and stormwater industry that demonstrate initiative and leadership in implementing innovative, sustainable practices.

On behalf of Boston Parks and Recreation Department, Brandon Kunkel accepts the Green Steps Award from Courtney Eaton of NEWEA's Sustainability Committee

In presenting the award to the Boston Parks and Recreation Department, NEWEA noted that this is the type of integrated project the organization looks for. The park improvement benefits the community, incorporates innovative and sustainable strategies, involves strategic public outreach and education, and demonstrates collaboration among the stakeholders and the project team.

This project team involved many organizations, including the Boston Parks and Recreation Department, Boston Environment Department, Climate Ready Boston, Boston Planning & Development Authority, Boston Water and Sewer Commission, Public Facilities Department, and other stakeholders. The Boston Centers for Youth & Families, Massachusetts Department of Conservation and Recreation, Eliot School, Boston Harbor Now, Friends of the Boston Harborwalk, and others also supported the project.

PROJECT BACKGROUND

Located along the harbor in the North End neighborhood of Boston, Langone Park and Puopolo Playground is one of the oldest public parks in the city and, most notably, the site of the Great Molasses Flood of January 15, 1919. In March 2018, flooding again inundated the area. This time, however, sea level rise and a Nor'easter were the cause, resulting in the third-highest tide in city history, as the park's seawalls and many other areas in Boston's downtown were breached. This Nor'easter, together with a similar storm only two months prior, pushed climate resilience to the forefront of the city's agenda.

In 2017, redesign of this signature, 4.5 ac (1.8 ha) waterfront park began, with the goals and objectives realigned in 2018 such that resilience and climate adaptation would be at the center of this project. The park would serve as a pilot for the Boston Public Works Department's "Climate-Resilient Design Standards & Guidelines for Protection of Public Rights of Way," demonstrating real-world application of the tools established to protect infrastructure. The design process coincided with the city's development of these climate resilience standards and guidelines.

As planning and design progressed, various solutions were considered that could adapt to and address climate change challenges. Considerations included king tides, incremental sea level rise, increased storm events and intensities, urban heat island effects, and inundation of existing and aging infrastructure. Also considered were increased community access to the waterfront and a revitalized park that would attract multi-generational users, including neighborhood residents, tourists, and international visitors. Incremental and adaptable strategies to evolving climate change data, innovations, and emerging technologies were incorporated as well.

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1. The park redesign serves as a pilot for the Boston Public Works Department's Climate-Resilient Design Standards and Guidelines for Protection of Public Rights of Way 2. Located along the harbor in the North End neighborhood of Boston, the park is one of the oldest in the city 3. Final design solutions include cantilevering the harbor walk edge over the water on stabilized deep-drilled micropiles and a multi-functional secondary seawall integrated within the park confines 4. The accessible, resilient, waterfront park encourages visitors with dramatic water views and opportunities for recreation

Stakeholder inclusion, public participation, and community outreach were integral to the project. Numerous public meetings were held from October 2017 through May 2018 to outline project goals, timelines, and potential issues and challenges; promote anticipated project benefits; and solicit community feedback. These efforts also resulted in developing educational signage displayed on site to inform visitors further.

INNOVATIVE, SUSTAINABLE, AND RESILIENT

Completed in 2021, the redesigned park combines climate mitigation and flood protection with space for recreational facilities. It includes a multi-functional secondary seawall integrated within the park that protects it from damaging storms and provides waterfront seating. The design also elevated important park amenities, cantilevered the harbor walk edge over the water on stabilized deep-drilled micropiles, and raised the utilities at high points onsite to maintain infrastructure resilience during flooding events. In addition, the design does not just divert water through the park and into other areas offsite. Park renewal strategies include grading of certain pedestrian paths, mitigating anticipated flood paths that could cause extensive future damage to site assets and surrounding areas.

With easy access to the North End, Rose F. Kennedy Greenway, New England Aquarium, Faneuil Hall, and beyond, the waterfront park encourages visitors with its dramatic water views and opportunities for active and passive recreation. The increase in visitors to the area will likely improve economic sustainability and increase retail/commercial revenue, drawing people to the area, to the water, and to restaurants, stores, and vendors.

This project is believed to be the first in the city with climate-resilient features embedded throughout to protect a park's shoreline, the neighborhood, and other public assets from projected sea level rise and an increase in storm events. Every element was designed both for functionality and resilience, not just for now but for well into the future. While the traditional lifespan of a major park improvement project is roughly 30 years (i.e., 2050), this site is expected to protect assets through at least 2070. The result offers not only a lasting community resource but also a blueprint for the adoption of design standards and guidelines that will benefit the city for years to come.

ABOUT THE AUTHOR

Brandon Kunkel, RLA, is landscape architecture practice leader with Weston & Sampson. He managed the revitalization of the Langone Park and Puopolo Playground.

NEBRA Highlights

EPA National Biosolids Stakeholder Meeting

EPA's biosolids program hosted a three-day (November 2–4) virtual meeting for stakeholders nationwide. The North East Biosolids & Residuals

Association (NEBRA) and other regional biosolids associations were included, along with state "co-regulators" and select utilities. This year's meeting also included Canadian regulators. In total 240 registrants attended.

Welcome and opening remarks were provided by Elizabeth (Betsy) Behl, director of EPA's Health and Ecological Criteria Division in the Office of Science and Technology (OST), and Radhika Fox, assistant administrator for the Office of Water. Participating EPA officials all repeatedly said that "biosolids are back" as a top priority for the Office of Water. The three days of meetings comprised various panel and plenary sessions, with topics from the risk assessment for per- and polyfluoroalkyl substances (PFAS) in biosolids, new analytical methods, research, and state and federal programs. Check out EPA's Biosolids Program Strategy for fiscal year 2020–2025 on NEBRA's website.

NEBRA participated in a panel discussion, "Biosolids for Climate Change Mitigation and Adaptation," to kick off Day 3 of the meeting. The discussion, which included NEBRA's Janine Burke-Wells, Ben Axt (biosolids forestry project manager for King County Wastewater), and Karri Ving (business strategy and performance manager with the San Francisco Public Utilities Commission), generated much conversation. The recordings from the panel discussions are available on the EPA YouTube channel as part of its effort to build a library of resources for biosolids practitioners.

The EPA biosolids team plans to continue these annual meetings with state co-regulators, their biosolids webinar series, and other activities to engage with all its biosolids partners. In addition to its regular work and the risk assessments for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) in biosolids, the team will focus on expanded resource recovery and reuse options and continued engagement with co-regulators, biosolids generators, and other partners.

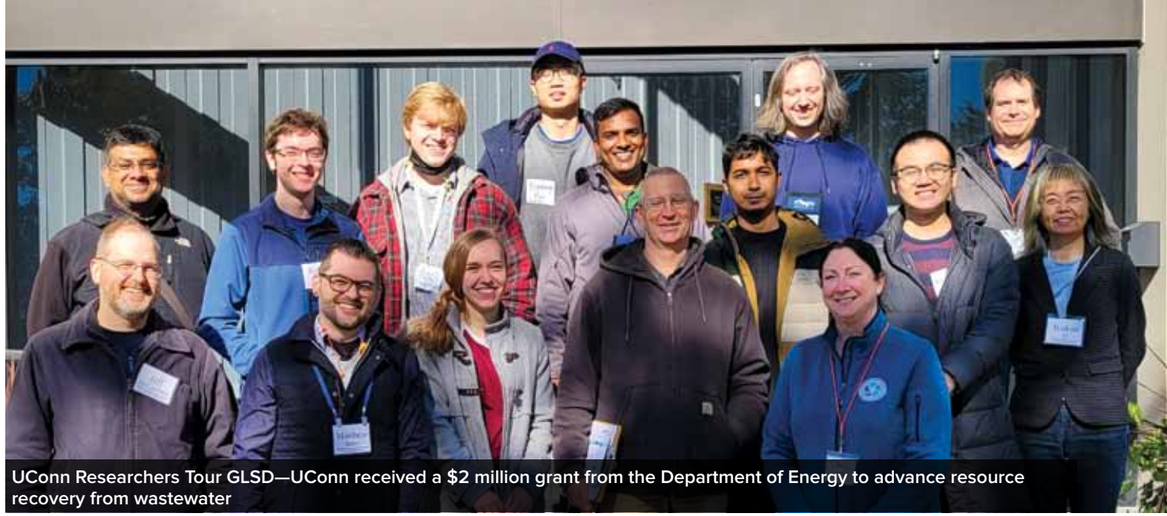
UConn Researchers Tour GLSD in Quest to Optimize Anaerobic Digestion

University of Connecticut (UConn) researchers took a tour on November 5 of the Greater Lawrence Sanitary District (GLSD) in North Andover, Massachusetts, to see operating anaerobic digesters up close and learn more about operations and maintenance issues. The tour was organized by NEBRA, which is assisting UConn researchers in improving anaerobic digestion operations and optimizing biogas production at facilities performing co-digestion with food waste. UConn received a $2 million grant from the Department of Energy to advance resource recovery from wastewater. The research project, "A Digitalization, Automation, and Optimization Platform for Improved Resiliency and Consistency of Distributed Anaerobic Digestion for Wastewater Resource Recovery," is being led by Dr. Jeffrey McCutcheon in the Department of Chemical and Biomolecular Engineering.

The UConn researchers hope to learn even more about what is going on inside the digesters by inserting special millimeter-scale electrode array sensors to collect real-time operating data inside the anaerobic digestion units at GLSD. The project team plans to use those data in artificial intelligence and machine learning programs to improve anaerobic digester operations and biogas production. GLSD has operated digesters for 20 years and is sharing the information gathered with the research team, making for a productive collaboration of the theoretical and academic with practical operations.

Maine Continues to Address Legacy PFAS Pollution Linked to Biosolids and Residuals

On November 23, the State of Maine Department of Inland Fisheries and Wildlife (DIFW) and the Maine Center for Disease Control and Prevention (Maine CDC) issued a Do Not Eat advisory for deer harvested in the area in and around the

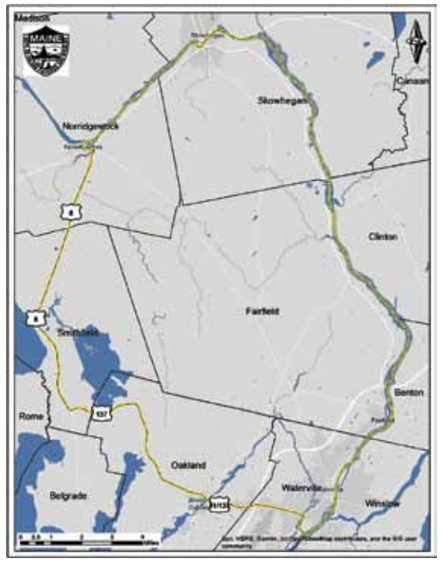


UConn Researchers Tour GLSD—UConn received a $2 million grant from the Department of Energy to advance resource recovery from wastewater

central Maine town of Fairfield, out of caution. The advisory was due to the discovery of relatively high levels (~40 ng/g or parts per billion [ppb] in 5 of 8 deer) of PFOS, one of the most common of the PFAS, measured in the meat and liver of deer that had foraged near farm fields where soil and surface water is known to have high PFOS levels.

Elevated levels of PFAS were first discovered in the Fairfield area during statewide sampling of milk after concerns were raised by the elevated levels of PFOS at the Stoneridge dairy farm in the southern Maine town of Arundel. The Arundel and Fairfield farms had both used biosolids and other residuals as soil amendments in the past, provided by wastewater treatment facilities not designed to remove these chemicals back when

Fairfield Do Not Eat Deer Advisory Area



no one had heard of PFAS and that had received discharges from some major industrial PFAS user(s) that caused very high concentrations of PFAS in their land-applied residuals.

Following the discovery of PFAS at the Stoneridge farm in late 2018, the State of Maine issued a moratorium on land application of biosolids until test results could show that products would not cause increases in levels of PFOA, PFOS, and/or perfluorobutane sulfonic acid (PFBS) above Maine's soil screening values of 2.5, 5.2, and 1,900 ppb. These are the only formal biosolids/residuals screening levels in the nation. Typical levels of the PFAS most focused on—PFOA and PFOS—are in the low 10s of ppb.

Maine is moving ahead with testing of all farms where biosolids and other residuals have been applied in the past—some 500 in all. The legislature appropriated $30 million in funding for PFAS mitigation work, which includes 19 new staff hired to do just this. The state has identified 33 sites in addition to Fairfield as potential hot spots for PFAS. These "Tier 1" sites will be tested first. Much has already been spent on installing filters for the nearly 200 private drinking wells that were affected in the Fairfield area. Maine has also been out in front with recent legislation to reduce the sources of PFAS, but these laws come too late for biosolids and other residuals that were processed and land applied in the past.

To help pay to address PFAS concerns, one part of the Maine Legislature's 2021 PFAS action is a $10/ton ($11.02/tonne) fee for "handling" of sludge or septage. The new law, which became effective October 18, 2021, requires Maine Department of Environmental Protection to create a Land Application Contaminant Monitoring Fund. Read the full news article on NEBRA's website. As of this writing, the Maine Legislature is poised to effectively ban biosolids being recycled to the soil.

Biosolids Coalition Formally Responds to "Sludge in the Garden" Report

On January 10, Greg Kester, the director of Renewable Resources Programs for the California Association of Sanitation Agencies (CASA), emailed to the acting director at the Sierra Club headquarters a scientific rebuttal to the Sierra Club report "Sludge in the Garden: Toxic PFAS in Home Fertilizers Made from Sewage Sludge" issued last May (see the response to the Sierra Club report on NEBRA's website).

The rebuttal was prepared by Rob Scofield of GSI Environmental. NEBRA contributed to that effort and signed the letter to the Sierra Club along with the Mid-Atlantic and Northwest Biosolids associations, WEF, the National Association of Clean Water Agencies, and several major water utilities and biosolids management companies. The coalition hopes to open a dialogue with the Sierra Club and its chapters about ways to mitigate PFAS while preserving the value and benefits of recycling wastewater solids.

Update on National Biosolids Regulation, Quality, End Use, and Disposal Survey

The National Biosolids Data Project (NBDP) is nearly completed, having compiled data from every state and territory in the union. During this work key information about each state is published on a state page at the NBDP website (biosolidsdata.org). The project has found a lot of variation in how biosolids are managed from state to state—from Georgia's long (but changing) reliance on landfill disposal (see the Georgia report), to Connecticut's nearly 100 percent reliance on incineration (report coming soon), to the high levels of biosolids recycling to soils in Florida, the Midwest, California, and the Northwest. In Washington State, which has more agriculture and a lower population density, state support for land application is remarkable, including clear and lasting support from the legislature, the Department of Ecology, researchers at both major state universities, agricultural advisors, farming cooperatives, farmers, urban gardening groups, and environmental organizations.

NEBRA's leadership role in the NBDP is supported by numerous partners, including NEIWPCC, which has helped with data compilation in New England and New York. The project took longer than expected, because state agencies are strapped and biosolids data collection has not been a priority for many years. Thus, the project team is doing the legwork done in the past by state biosolids coordinators. Supplemental funding is still needed to complete the national report. If you would like your company's logo forever showing on what will become a vital resource for the biosolids profession, now is the time to act. Contact NEBRA for details.

University of Arizona to Study PFAS Threats to Land Application

Dr. Ian Pepper, director of Water & Energy Sustainable Technology (WEST) Center at the University of Arizona, is spearheading a new study, "Evaluation of Fate and Transport of PFAS Following Long-Term Land Application of Biosolids: A Collaborative National Study." The project scales up Dr. Pepper's local research on behalf of Pima County, Arizona, following a land-application ban there (see NEBRA News article, December 14, 2020). The research questions are as follows:

1. Does land application of biosolids result in significantly increased human exposure to PFAS?
2. Will it lead to a national ban on land application?

In the first year of the study, the researchers will evaluate the incidence and mobility of PFAS in soil following long-term land application of Class B and/or Class A biosolids. The national study will focus on numerous sites across the country with good records on land application of biosolids to evaluate whether or not such land application is a significant public health route of exposure. The following year, researchers will evaluate the potential for crop uptake of PFAS following land application. The estimated project cost is about $1 million and fundraising recently began, with $110,000 already pledged. The work is being coordinated with researchers working on similar studies. If you are interested in donating, please email ipepper@arizona.edu.

Major Wastewater Utilities Team Up on Biosolids Management Study

Biosolids processing and disposal capacity are limited in the Northeast. Recognizing this trend, three large regional utilities—Narragansett Bay Commission (NBC), Springfield Water and Sewer Commission, and Upper Blackstone Clean Water—banded together and issued a request for qualifications/proposals (RFQ/P) to study the feasibility of regional biosolids processing. The RFQ/P acknowledges the region's capacity issues to manage wastewater solids as a driver for the project.

Phase I of the RFQ/P will be "determining the value proposition" of a regional facility, examining numerous aspects of the issue, and providing the project partners with enough information to decide if further investment is justified. Phase 2 of the study will depend on the results of Phase 1. If the project partners move forward, Phase 2 will determine the economic viability of and any legal, regulatory, or other roadblocks for such a project. With four facilities, three entities with governing boards, and two states involved, it promises to be complicated. Together, the project partners serve a population of about 860,000, with total annual solids production for the four facilities (NBC has two) being nearly 40,000 dry tons (36,000 dry tonnes) annually.

PBS Viewpoint Special Feature on Biosolids

VIEWPOINT WITH DENNIS QUAID

WEF has secured a special feature spot with the Public Broadcasting Service (PBS) to present a brief (3 to 5 minutes) biosolids story segment as part of its Viewpoint program hosted by Dennis Quaid. Given the viewing audience—the public—the segment will convey the biosolids journey rather than focus on one organization or company. The story will follow ordinary people doing extraordinary things every day (plant operators, farmers, community gardeners, scientists, etc.). Particular attention will focus on raising awareness around biosolids production, product stewardship, and the role biosolids play in mitigating climate change.

Production began in February with a filming date in late April. This Viewpoint segment will be aired at 50 national and 150 regional times over a 120-day airing schedule in addition to a short trailer that will air 400 times. WEF is working directly with the Viewpoint production team to curate the content for the story that will be shared with the PBS audience. In addition to bringing the idea to WEF, NEBRA helped with the fundraising for the feature.

Committee Meeting Schedule

- Carbon & Nutrient Trading: 4th Tuesday of the month at 1 PM
- Reg-Leg: 3rd Tuesday of the month at 2 PM
- Research: 4th Wednesday of the month at noon
- Residuals: 3rd Tuesday of the month at 10 AM

Upcoming Events

Monthly Lunch & Learn series resumes in 2022—4th Friday of the month

Janine Burke-Wells, Executive Director
603-323-7654 / info@nebiosolids.org

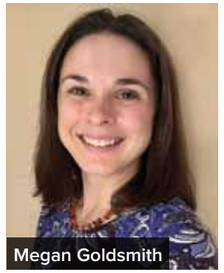
For additional news or to subscribe to NEBRAMail, NEBRA's email newsletter, visit nebiosolids.org

nebra North East Biosolids & Residuals Association

Innovation Highlights

NEWEA Hires Megan Goldsmith as Innovation Council Intern

In May 2021, NEWEA hired Megan Goldsmith as an Innovation Council intern to map New England's water innovation ecosystem. Megan's primary charge is to identify and label the multitude of entities in this ecosystem and identify ways to connect these entities through partnerships and collaboration. Megan will also be working on cataloging innovation resources for NEWEA members, including funding opportunities, start-up and established company innovations, pilot/testing sites, and university water-related research. Welcome, Megan!

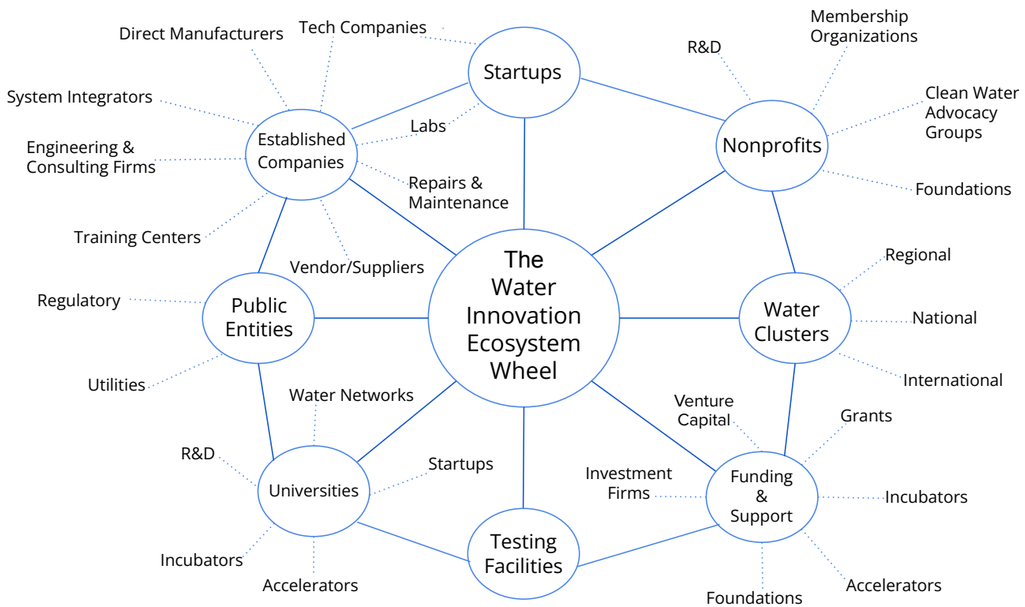

Megan Goldsmith

Prior to joining NEWEA, Megan worked for a decade in the supply chain field before returning to school to study geosciences at Wellesley College in Massachusetts. Her undergraduate research projects focused on analyzing the viability of mycoremediation and tracing legacy metals in spent mushroom compost, soil, and water. Her professional interests include carbon sequestration, bioremediation, hydrology/hydrogeology, GIS applications, water quality, geohealth, and geoscience research, as well as education and outreach. She would like to continue her education at the graduate level to increase her scientific knowledge, communication, and research skills, and to add value to her future workplace.

Turning the Water Wheel: Identifying Key Players in the Water Innovation Ecosystem

For too long, the water industry has been segmented and siloed. Yet professionals, researchers, and developers working in different branches of the water industry—drinking water, wastewater, water reuse—are all working to achieve the same goal: to improve water quality.

As one of Ms. Goldsmith's first assignments with the Innovation Council, she designed a water innovation ecosystem wheel to label and visualize the connections among organizations within the water innovation sphere. With this data, the goal is for NEWEA to act as a matchmaker for customers who have a problem and innovators who may have a solution. These valuable network connections will ultimately create a web of innovation within the NEWEA membership family.



The water innovation ecosystem is a vast network of different entities, from start-ups and established companies, to utilities and consultants, to support groups such as incubators and accelerators. Identifying key players in this ecosystem is essential to increase communication and foster collaboration.

Creating the Water Wheel

Approaching this work systematically was essential to staying focused and filtering through the hundreds of thousands of different entities in the water sector. To conduct this extensive scan of the water innovation ecosystem, specific sources were used, including the following:

- Interviewing professionals in the field
- Accessing the NEWEA membership database
- Searching resources such as water support group cohorts, water cluster membership databases, government sites, and other internet sources
- Reaching out to academics who are conducting water-related research
- Reaching out to water sector accelerators and incubators

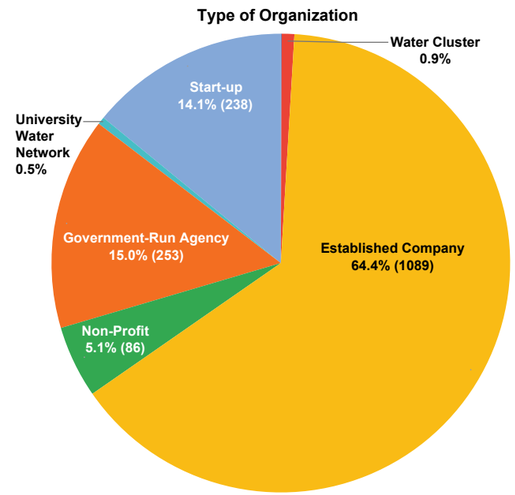
The results were placed into a spreadsheet-supported database for NEWEA staff to share with members who want to connect to a specific type of organization. To organize the data, the players in the water innovation ecosystem were cataloged according to the type of organization, followed by the sub-type of organization, and finally the organization's water-quality focus.

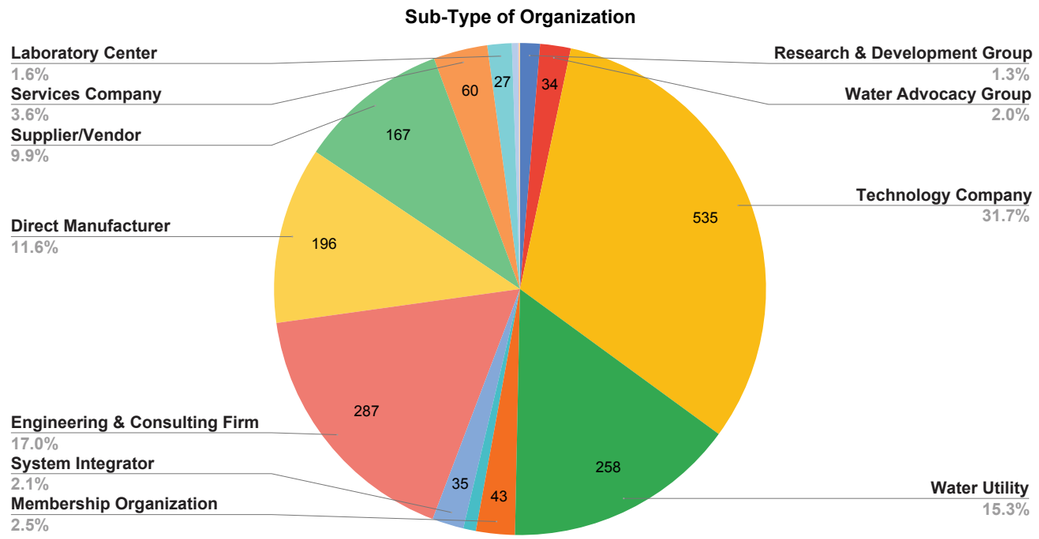
Next Steps

Increasing connection and communication is critical for innovation within the water industry. The water wheel is just one step toward this goal. The Innovation Council will continue to work toward this goal by doing the following:

- Increasing the amount of information on the innovation page of NEWEA's website, including opportunities, events, updates, and resources
- Cataloging international organizations in the water innovation ecosystem and reaching out to form global partnerships
- Locating more pilot and/or testing site opportunities for water innovators
- Increasing the amount of water innovation business partnerships with the Innovation Council
- Continuing to reach out to support groups such as water incubators, accelerators, and research organizations to form partnerships and foster collaboration
- Continuing to reach out to academic professionals to ask them to become a water innovation collaborator within NEWEA
- Reaching out to and collaborating with other sectors of water to adopt a "one water" concept and decrease the current siloed ecosystem
- Continuing to publish innovation updates in the *Journal* to keep members informed about progress

Are you looking to connect through NEWEA's water wheel? Please email Ms. Goldsmith at mgoldsmith@newea.org.





Student Innovation Shark Tank

The 2022 NEWEA Annual Conference held yet another successful jointly sponsored event between the Student Activities Committee and the Innovation Council. The student "Shark Tank" competition, held at the Innovation Pavilion, drew in a large crowd to hear two students, each of whom was selected to provide a five-minute presentation about their research project in a pitch-format to a panel of judges. This year's judges were Dr. Christobel Ferguson from the Water Research Foundation, Dr. Jeffery McCutcheon from the University of Connecticut, and Amy Corriveau from CDM Smith. The session was moderated by Dr. Marianne Langridge from Sustainable Synthesis and current director of the Innovation Council.

The two projects selected, although different in subject matter, both demonstrate water innovation and water quality improvement. After each of the two informative pitches from the students, the judges asked a flurry of questions. Both students answered the challenging questions well. Choosing the winner was not easy for the judges, but they selected Kamruzzaman Khan, a PhD candidate from the University of Vermont, as the winner, with his project on phosphorus recovery from wastewater. Kitty Lovell, an undergraduate from the University of Massachusetts, was awarded second place, with her project on artificial floating wetlands on the Charles River.

Oscillating Electric Field-Assisted Phosphorus Recovery as Struvite from Wastewater

by Kamruzzaman Khan, James Jutras, Appala Raju Badireddy, Univ. of Vermont

Kamruzzaman Khan

Phosphorus removal is critical in wastewater treatment. However, conventional phosphorus recovery techniques at the treatment facilities require further treatment for field application. Consequently, we propose a novel technology featuring an oscillating electric field with chemically modified wastewater, recovering phosphorus as struvite ($MgNH_4PO_4.6H_2O$)—a fertilizer. A pulsed electric field (±3V at ±150kHz), applied to samples with a wide range of relative supersaturation with the target chemicals, was used to precipitate struvite from the wastewater. The results show that this technique can recover up to 84±1%, 11±2%, and 67±2% dissolved phosphorus, NH_4^+-N, and Mg^{2+}, respectively, as struvite from wastewater without pH regulation. In addition, electric-field-exposed samples had 60 percent to 70 percent faster crystal nucleation and accumulated 30 percent to 70 percent more crystal. Morphological analysis also confirmed that the crystals are pure struvite with an orthorhombic structure. Therefore, this study has demonstrated that oscillating electric fields and modified water chemistry can accelerate and form high-quality struvite without pH administration, making this process potentially viable for phosphorus recovery from wastewater.

Charles River Artificial Floating Wetland

by Kitty Lovell, University of Massachusetts

Despite improvements made by *E. coli*-based standards for a swimmable river, cyanobacteria blooms plague the Charles River every year, making the river unusable for recreation. Over the past two summers, researchers at Northeastern have studied the impact of an artificial floating wetland on the Charles River. The first artificial floating wetland, located during the summers in the Charles River's lower basin, is a pilot to study the native wetland plants and their role in improving the river ecology. To discern the wetland's effect on the river ecology, zooplankton abundance and body size along with cyanobacteria concentration measurements are monitored every summer.

Connecticut State Director Report

by Vanessa McPherson
vanessa.mcpherson@arcadis.com

Significant progress has been made in Connecticut in merging our two state organizations, Connecticut Water Pollution Abatement Association (CWPAA) and Connecticut Association of Water Pollution Control Authorities (CAWPCA). Joining forces brings experience and enthusiasm from both entities toward achieving a common goal of improving the water quality and environment within the state. The hard work and commitment of the merger committee are appreciated by all of us.

CAWPCA + CLEAN WATERS = CTWEA
CONNECTICUT WATER ENVIRONMENT ASSOCIATION

It truly is an honor to be stepping into the state director role as the merger nears completion. As an engineer focused on water quality in Connecticut throughout my career, being a part of this unified organization brings a renewed purpose and excitement. While still in our minds, the pandemic cannot stand in the way of the fantastic progress we have made and our plans for this year.

Merger Updates

NEWEA has been extremely supportive of the merger committee in navigating the logistics of this process. One recent milestone was finalizing the board of directors for the new organization—the Connecticut Water Environment Association (CTWEA). We encourage you to check out our website for information on the board, upcoming events, options for membership, and grant opportunities.

Government Affairs and Legislative Outreach

Awareness of and engagement in legislative affairs has been a focus for Connecticut, and with the help of our counsel, Melissa Biggs, we have been at the forefront of identifying areas where input from our organization is needed for perspective in the decision-making process. Wastewater professionals have always been essential, but particularly so in recent times. While we wait for the agency proposals for this legislative session to be published, we have been brainstorming priority topics from our perspective. Workforce development including operator certifications as well as feedback on the state's updated reporting platform are two such areas.

We are planning a series of small group meetings with legislators to focus on the issues important to preserving and maintaining clean water, as well as the funding critical to supporting this work. We also look forward to the Legislative Fly-In in Washington, D.C., and how we can advocate nationally for clean water.

Connecticut has also shown its support of legislation for proper labeling of wipes to mitigate the issue that products labeled as "flushable" have on our infrastructure and with the goal of keeping these plastic products out of our sewers.

NEWEA and WEF Award Recipients

While much uncertainty surrounded the weeks leading up to this year's NEWEA Annual Conference due to the rise in Covid-19 cases and a surge of the Omicron variant, one sure statement is that the measures taken by NEWEA to make the event a success are appreciated. The CTWEA booth at the conference was staffed by Megan Ambrose, Tracy Santoro, and Serdar Umur. We appreciate their time and hope that many of you had a chance to meet with them.

Connecticut was represented in the Regulatory Roundtable session was by Nisha Patel of the Municipal Wastewater section of the Department of Energy and Environmental Protection. Many thanks to Ms. Patel for her time and participation.

A heartfelt congratulations to Connecticut's own Virgil Lloyd on an exceptional NEWEA presidency. We are all grateful for your leadership and the dedication you have shown to the organization.

We are proud of the other notable recognitions of Connecticut wastewater professionals in 2021, including the following:

- EPA Region 1 Wastewater Treatment Plant Operator of the Year Excellence Award – Jeff Lemay (South Windsor, CT)
- Alfred E. Peloquin Award – Sally Keating (Hartford, CT)
- Energy Management Achievement Award – Jennifer Muir (Durham, CT)
- Operator Award – Gregory Quink (Waterbury, CT)
- Operations Challenge Competition Division II, 2nd Place – RI-CONN United: Jason Nenninger, Ryan Harold (New Haven, CT)
- Quarter Century Operators' Club – Carl Veilleux (Enfield, CT)
- WEF Outstanding Young Water Environment Professional – Vanessa Borkowski (Hartford, CT)
- George W. Burke, Jr. Award – Woodard & Curran (North Haven, CT Wastewater Treatment Facility)
- Stockholm Junior Water Prize – Elizabeth Wallace (Greenwich, CT)

Events and Happenings

A Trade Show was held on September 9. Although the participation was limited, those who attended benefited from the networking and interaction that the event provided.

The Ski Classic took place on February 4 in Mount Snow, Vermont. Icy conditions did not stand in the way of an excellent day on the slopes. This year marked the 10th anniversary of this fantastic event.

A Poo & Brew is planned for April 7 in Suffield that will include a tour of Suffield Water Pollution Control Facility and networking afterward at Broad Brook Brewing.

The Connecticut Clean Water Forum and Expo is scheduled for May 2, with planning underway for this informative and well-attended networking event. Formerly the "Spring Workshop," the Clean Water Forum and Expo will be held at the Aqua Turf in Plantsville. We look forward to seeing everyone there.

Registration is open for the beloved Sewer Open, to be held on Friday, June 17, at the Skungamaug River Golf Club in Coventry. This tournament is a key fundraiser for programs that the CTWEA participates in annually. Tee sponsorships go toward the Scholarship Fund, allocated to students who will be pursuing a college degree in an environmental field. Green sponsorships, meanwhile, support the Connecticut Operations Challenge team. Questions about this event can be directed to the tournament director, Ray Bahr.

AWARD RECIPIENTS

Jeff Lemay – EPA Region 1 Wastewater Treatment Plant Operator of the Year Excellence Award

Vanessa Borkowski – WEF Outstanding Young Water Environment Professional

Vermont State Director Report

by Michael A. Smith
smithm@wseinc.com

Even while continuing to deal with the pandemic challenges that we all face daily, the Green Mountain Water Environment Association (GMWEA) has continued to advance its major activities and programs and recognize accomplishments and milestones within our membership. We discuss and highlight some of this achievement and progress in the summary below.

Collaboration with ANR and VRWA

GMWEA and Vermont Rural Water Association (VRWA) continue to hold quarterly meetings with the Vermont Agency of Natural Resources (ANR) water divisions staff, maintaining that crucial connection between regulators and boots-on-the-ground professionals. GMWEA and VRWA together advocated that more of Vermont's $1 billion in anticipated federal American Rescue Plan Act (ARPA) funds be designated for desperately needed water quality infrastructure upgrades and repairs. GMWEA continues to be at the forefront of local water quality issues including per- and polyfluoroalkyl substances (PFAS) and water and sewer utility bill arrearages, while working to advance water quality projects in disadvantaged communities and to improve the water quality profession through training initiatives.

Operator Continuing Education

GMWEA is continuing our Lunch & Learn program—monthly noon-hour trainings for water quality professionals to provide continuing education for staff with limited availability. In addition, GMWEA and VRWA are once again teaming up to present the eight-week Basic Wastewater Management Course in 2022. Held on Tuesdays and Wednesdays (9 AM to 12:20 PM) from January 18 to March 9, this program provides 48 training contact hours and prepares attendees for the grades 1 and 2 wastewater certification exams. It is also a great refresher for those taking higher-grade exams.

Infrastructure Funding

Foremost in our thoughts in the water quality industry are recent changes in the upcoming federal stimulus funding.

In 2021, because of economic concerns from Covid-19, Vermont received over $1 billion of federal funding from the ARPA. This program made approximately $163 million in grant funds available specifically for water, sewer, and stormwater infrastructure and for economically disadvantaged communities.

In November 2022, the Infrastructure Investment and Jobs Act (IIJA) became federal law. The IIJA provides $347 million in water and sewer infrastructure funding, with a focus on drinking water and no pandemic-related eligibility requirements. Funding will be distributed through the Vermont Clean Water State Revolving Fund (SRF) Loan program. These monies, which are available until spent, will flow from the federal government to the Vermont ANR over five years (2023–2028).

With some of these monies, the Vermont ANR is developing a pretreatment grant program, whereby qualifying private wastewater generators receive grant funds to pretreat their wastewater, thereby reducing loadings on the receiving municipal wastewater facilities and ultimately improving receiving water quality.

With over $350 million in clean water infrastructure needs already identified in Vermont, this funding is most welcome.

Administration

GMWEA has undergone some recent administrative changes. We have recently brought on the New England Water Works Association (NEWWA) to provide our administrative support. This was in response to the recent retirement of Daniel Hecht, our executive director, who served in that position for six years, and the end of our contract with the Vermont League of Cities and Towns (VLCT). VLCT furnished administrative support to GMWEA for 20 years, and for 10 of those years Lisa Goodell from VLCT was our direct support. We will miss working with Mr. Hecht, Ms. Goodell, and VLCT, and thank them for a great job. NEWWA brings us a three-person administrative team who will manage membership tracking, publications, website administration, and events.

GMWEA is also recruiting a new member to join the board of directors as well as members for five standing and ad hoc committees. Our current association president, Mike Barsotti, and other board members can answer questions for interested parties. Their contact information is on the GMWEA website.

People

Congratulations to **Bob Protivansky**, chief operator of the Rutland City Wastewater Treatment Facility (WWTF), who was named Vermont Operator of the Year by NEWEA. Mr. Protivansky has worked for the City of Rutland in its wastewater division for 22 years, and as chief operator of its 29 mgd (110 ML/d) WWTF since 2007. He manages 11 operations staff at the WWTF who service the facility and seven sewage pump stations. He is active in addressing CSO abatement for the city and has been working with a consultant to develop an effective Long-Term Control Plan. Mr. Protivansky helped resurrect Vermont's Water Agency Response Network emergency operator sharing program to help reduce the pressure on communities with Covid-19-related staffing issues. His career focus has been on energy efficiency, saving Rutland over $1 million in energy costs since he took over as chief operator. He has helped to host and organize Efficiency Vermont's Energy Efficiency Cohort, which helps operators statewide to identify and incorporate energy savings at their own facilities. Mr. Protivansky has also been involved in the Vermont Initiative for Biological and Environmental Surveillance (VIBES), tracking Covid-19 in wastewater and correlating it to case volume in the city.


Bob Protivansky

In early February, Vermont lost **G. Lewis (Lew) Hotaling**, the former chief operator of the Rutland City WWTF from 1984 through 2007. Mr. Hotaling took over as chief operator when the facility was being upgraded from primary to secondary treatment and, during his tenure, helped to develop and construct several major upgrades, including adding anaerobic digestion capacity, phosphorus removal, additional CSO treatment, and disinfection improvements. After retiring as chief operator, he stayed on with the Department of Public Works to support the City's CSO monitoring program. Mr. Hotaling contributed greatly to water quality in the state of Vermont. He will be missed.

Late in January, Vermont also lost **Reginald (Tex) LaRosa**. This year marks 50 years of the Clean Water Act, which provided regulations and funding to construct new secondary, and upgrade existing primary, WWTFs around this country. Mr. LaRosa was there for most of that time, serving under eight governors in his 35 years with the Vermont Department of Environmental Conservation. At one point, he was "acting" secretary of ANR, deputy secretary of ANR, and commissioner of the Department of Environmental Conservation—holding all these positions simultaneously for four years! He played a huge part in the SRF funding program during the EPA Construction Grants era. He was instrumental in establishing the Vermont Clean Water SRF allotment percentage that continues decades after his involvement, a legacy that still affects the amount of funding the state receives. Without his influence over the funding allocation method, Vermont and other low-population states would have received a much lower allocation. While Mr. LaRosa was just one of many people supporting these clean water projects, his role was extremely important. Many of us have built careers on what Mr. LaRosa and others helped to start in Vermont in the 1970s and 1980s. Several of Vermont's clean water grant programs, as well as the State Environmental Lab, still carry his name.

Upcoming Events

GMWEA is still coming back up to speed from the pandemic effects, but more and more events are being scheduled. Our fall trade show in Burlington last October was a successful, well-attended in-person event. We expect to be at "full steam" as we approach 2023. Upcoming events include the following:

- GMWEA's 2022 Spring Meeting & Training Conference, May 26 at the Killington Grand (in-person event planned)
- George Dow Golf Tournament (summer date to be determined)
- Fall Trade Show (fall date to be determined)
- Operator training courses and Lunch & Learns (schedule noted earlier)

Our Government Affairs Committee (GAC) unfortunately had to cancel our meet and greet with legislators at the State House due to Covid-19 concerns. The lawmakers are still working mostly remotely. The GMWEA GAC is, however, developing an information package to communicate significant issues to the legislators.

In summary, things continue to look up in Vermont; we sincerely hope the same for our other New England member associations. I am grateful to the GMWEA members who have directly (and indirectly) contributed to this report.

Rhode Island State Director Report

by Eddie Davies
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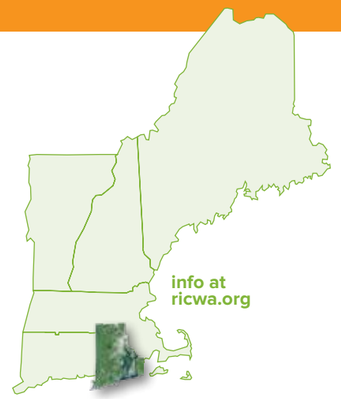

Established in 1952, the Rhode Island Clean Water Association (RICWA) is a non-profit organization created to promote the advancement of knowledge concerning the nature, collection, treatment, and disposal of domestic and industrial wastewaters.

Rhode Island is Sampling Wastewater for Early Warning on Covid-19 Spread

The New Shoreham Sewer Commission began testing the wastewater to help establish public and municipal awareness of Covid-19 infection rates, provide a means for trending analysis, create more visibility to asymptomatic cases, and aid municipal decision-making. Sampling and testing are conducted weekly using 24-hour composite sampling, taken at one-hour intervals. From the pandemic's early months to today, wastewater samples have been shipped to Biobot Analytics for analysis. Funding is federal through Biobot Analytics, relieving the burden on local communities. Biobot, located in Cambridge, Massachusetts, is the first company to commercialize data from sewage. Biobot sees wastewater-based epidemiology as an opportunity both to provide real-time data, an early warning for waves of prevalence, and to evaluate the viral prevalence of the U.S. population.

Wastewater-based epidemiology has confirmed in studies that SARS-CoV-2 measurements in wastewater are higher than clinically confirmed cases. Although estimates of viral shedding in stool from positive cases are still uncertain, data have shown a predictive quality before viral spikes in communities across the country. Furthermore, the data demonstrate the practicality of measuring SARS-CoV-2 in wastewater to determine pockets of viral prevalence rather than tracking covid test results and vaccination rates; the latter method is less reliable due to increasingly unreported at-home testing and decreasing vaccination participation. Moreover, the testing methods have now evolved for variant testing, even finding new strains. The implications are that wastewater treatment facilities can be a trusted source for public health observation to monitor the prevalence of viral activity worldwide.

Operator Certification Update

After years of working with the industry before and during a global pandemic, the board of certification of operators of wastewater treatment facilities has revised its regulations to make some substantial changes, especially who will be allowed to take higher-level exams. Major changes that occurred in 2021 are summarized below:

- Follow past practice for operators in allowing certain maintenance and laboratory staffers in supervisory roles to take the Grade 3 exam on an "if and when" basis
- Reduce the number of supervised staff from two to one to be eligible for Direct Responsible Charge
- Set limits on the number of exam reviews for exam grades 1, 2, and 3 and prohibit reviews for the Grade 4 exam
- Reduce the renewal late fee from $50 to $25

New Board Members

RICWA held its first monthly meeting of 2022 on January 18 to develop committees, discuss the events calendar, and welcome its newest board members. The 2022 board members are as follows:

- President, Peter Connell (Rhode Island Resource Recovery Corporation)
- Past President, Scott Goodinson (Town of Narragansett)
- Vice President, Jeff Chapdelaine (West Warwick Water Pollution Control Facility)
- Treasurer, Nora Lough (Narragansett Bay Commission)
- Secretary, Kim Sandbach (Narragansett Bay Commission)
- Executive Board, Mike Bedard (Warwick Sewer Authority)
- Executive Board, Vinnie Russo (West Warwick Water Pollution Control Facility)
- Executive Board, Craig Danella (Veolia Cranston)
- Executive Board, Dave Perrotta (East Greenwich Wastewater Treatment Facility)
- Directors of Vendor/Consultant Coordination, Kelly Bailey (United Rentals, Fluid Solutions) and Eli Hannon (EJH Professional Services)
- Rhode Island Board of Certifications, Paul Desrosiers (Narragansett Bay Commission)
- NEWEA State Director, Eddie Davies (Quonset Development Corporation)

Congratulations to all as we look forward to another successful year!

Operator Training and Development

In 2021, RICWA continued with its efforts to provide high-level continuing education for operators:

- "Blueprint Reading for Wastewater Collection Systems" – Instructor, Diane Johnson (Atlantic States Rural Water & Wastewater Association)
- "Wastewater Operator Grade 1 Exam Prep Review" – Instructor, Eddie Davies (Quonset Development Corporation)

Please visit ricwa.org for upcoming training opportunities.

Scholarship Winners

RICWA provides scholarships annually to college students sponsored by our members. Scholarships range from $500 to $1,000 depending on the number and quality of applications. Congratulations to our 2021 recipients: Alexandria Lopez, Victoria Lopez, Emily Fasteson, Emma Johnson, Morgan Rojas, and Sean Michael Cheney.

NEWEA Annual Conference

Rhode Island's clean water professionals were well represented at this year's NEWEA Annual Conference as vendors, committee chair, state director, state legislators, and attendees. Several RICWA members participated in the Executive Committee Meeting, Operations Challenge Committee Meeting, Government Affairs New England State Roundtable, and amazing technical sessions and important discussion forums.

Award Winners

The board congratulates the following RICWA members on receiving awards:

NEWEA and WEF Awards

- Scott Goodinson (Narragansett Wastewater Treatment Facility) – NEWEA Operator Award
- Kathy Perez (South Kingstown Wastewater Treatment Facility) – NEWEA Alfred E. Peloquin Award
- Peter Connell – WEF Quarter Century Operator's Club

WEFTEC Operations Challenge

Congratulations to RI-CONN United Operations Challenge team for showcasing its skills in laboratory analysis (first place), process control (first place), collections systems (third place), safety (sixth place), and pump maintenance (eighth place). RI-CONN United's strong performance and second-place finish overall for Division 2 was the best historical finish for both Rhode Island and Connecticut. The nationally celebrated hard work of team members was also recognized at the NEWEA Annual Conference awards luncheon. (photo l to r) Eddie Davies, Ryan Harrold, (team supporter Serdar Umur), Jason Nenninger, Riley Greene, and coach Bradley Vasseur.

Peter Connell, WEF Quarter Century Operator's Club

Kathy Perez, NEWEA Alfred E. Peloquin Award

Rhode Island Awards

- Russell Demeulenaere – Robert J. Markelewicz Award
- Jason Murphy – Collection Systems Operator Award
- Field's Point Operations Staff (Narragansett Bay Commission) – Carmine J. Goneconte Operator of the Year Award
- Glenn Conway – Facility Support Excellence Award

Upcoming 2022 RICWA Event Highlights

- Clean Water Legislative Luncheon (March)
- Annual Awards banquet (May)
- Annual Golf Classic (June)
- Annual Clambake and Exhibition (September)
- Annual Holiday Party, Food Drive, and Elections (December)

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

New Hampshire State Director Report

by Michael Trainque
mtraink75@gmail.com

Greetings from the Granite State. It is a privilege and an honor to start my term as New Hampshire state director for NEWEA. I have been in the engineering industry for 42 years, focusing primarily on wastewater and, more recently, stormwater. Through all those years I have indulged my left brain. As state director, I will be able to give my right brain some exercise. I look forward to addressing the challenges and, more importantly, serving the great people in the Granite State and across NEWEA's organization. I hope by the time you read this we have all emerged from the ice and snow and spring is in full bloom.

COVID-19 has continued to leave its large footprint in New Hampshire. Many meetings of the New Hampshire Water Pollution Control Association (NHWPCA) and the various committees have been and continue to be either fully virtual or a hybrid of virtual and in person. It is our new (though not so new) reality, and it has had some unfortunate consequences. The annual Legislative Breakfast, an enormously popular and successful event, scheduled for March 9, 2022, had to be canceled because the legislators were not allowed to attend in-person events based on Covid-19 restrictions. They have also been meeting in Manchester rather than in Concord, so the event logistics would have been problematic. The Holiday Inn in Concord graciously allowed us to cancel the event without forfeiting the deposit.

Association News

The New Hampshire Department of Environmental Services (NHDES) is rewriting the state's wastewater operator licensing regulations, and it has been diligent in seeking input from our operators including discussion at association events. We look forward to working with NHDES on this important revision.

NHWPCA is updating and reorganizing the website, and suggestions for improvement are always welcome.

Congratulations to Rob Robinson of Manchester, as he takes the reins as president of the NHWPCA. We wish Mr. Robinson much success and look forward to supporting him in moving NHWPCA forward. We also offer thanks and appreciation to NHWPCA's outgoing president, Mike Carle of Hampton. During his term, Mr. Carle had the significant challenge of navigating through the murky, uncharted waters of the pandemic, one he rose to admirably. NHWPCA is in good stead, with 291 members and sound finances despite the pandemic.

I would be remiss not to recognize the rest of the current leaders of the NHWPCA: Ryan Peebles (vice president), Patty Chesebrough (secretary), Mario Leclerc (treasurer), Michael Theriault (first director), Aaron Costa (second director), Nate Brown (third director), Peter Conroy (first director-at-large), and Rebecca Elwood (second director-at-large). We applaud their commitment and talents. Kudos also to the various committee chairs and members who graciously contribute their time and abilities.

The Annual Trade Fair, originally scheduled for April 8 at the Nashua Sheraton, was rescheduled because of construction delays in renovation work at the hotel. For those involved in construction projects this should have a very familiar ring to it! I am pleased to report that the Annual Trade Fair was rescheduled to May 20 at the Radisson Hotel in Nashua.

For this year's operator exchange. New Hampshire is exchanging operators with Maine, so we will coordinate with Maine Water Environment Association through Paula Drouin, the new NEWEA state director for Maine. Ms. Drouin and I are both "newbie" NEWEA state directors, so this should be fun. We are searching for our exchange operator from New Hampshire, as I am sure our friends in Maine are seeking theirs. The exchange will likely take place in the fall. On another NEWEA-related note, Patty Chesebrough is organizing a New Hampshire team to compete in the Operations Challenge competition, which will be held at the NEWEA Spring Meeting in Bretton Woods, New Hampshire, at the end of May.

NHWPCA President Mike Carle (right) passing the gavel to 2022 President Rob Robinson

Laurie Perkins, NEWEA Sawyer Award recipient

Legislation

The New Hampshire House passed bills HB 398 and HB 412, relative to state aid grants for municipal wastewater projects and water system projects, respectively. HB 398 will fund the 11 forgotten wastewater projects that qualified for state funding in the current biennium but were not funded due to the pandemic budget freeze, as well as provide funding for 110 additional qualifying projects that NHDES has identified as eligible for state funding. We are working on legislative approval in the New Hampshire Senate.

Essential Workers—House Bill HB536 has been moving through public hearings. The bill covers death benefits for public works employees killed in the line of duty and workers compensation offsets for certain retirement system benefits. A related billed, SB325, was introduced to the senate to classify public works employees as essential workers.

A legislative study (NH1134) on wipes is moving forward. NHWPCA is working with various groups to propose "DO NOT FLUSH" labeling on wipes similar to legislation signed into law in California last October. This is important, for it has impacts far beyond New Hampshire. If successful in our state, we want to engage all the New England states in moving similar efforts forward. A YouTube video of the recent legislative public hearing can be seen at youtu.be/2ef68aCl3bM?t=3785.

PFAS—Yes, PFAS is a "four-letter word," and it is becoming vastly more prominent in the wastewater and water realm both nationally and locally. Per- and polyfluoroalkyl substances (PFAS) are a very large class of synthetic chemicals with complex chemistry, known as "forever chemicals." They are used to make clothing and furniture fabrics stain-resistant and in cell phones, tablets, telecommunications, aircraft, alternative energy, medical devices, and many other applications. As such, they are pervasive in the environment. Because some PFAS chemicals are known to be PBT (pervasive in the environment, bioaccumulative in organisms, and toxic at relatively low levels), they are now under intense regulatory and political scrutiny. In New Hampshire, several PFAS-related bills are making their way through the legislature, and the NHWPCA Government Affairs Committee is tracking them.

Discover WILD New Hampshire Day

April 16, 2022 (10:00 AM—3:00 PM) New Hampshire Fish & Game, Concord. This event is the Fish & Game Department's biggest community event of the year. Discover WILD New Hampshire Day is a fun way for the family to explore New Hampshire's wildlife resources and legacy of outdoor traditions; browse educational exhibits presented by environmental and conservation organizations from throughout the state; see live animals, big fish, and trained falcons; try your hand at archery, casting, fly-tying, and BB gun shooting; watch retriever dogs in action; encourage kids to be creative with hands-on craft activities; and check out the latest hunting and fishing gear and gadgets. NHWPCA has participated in this event for years and plans to do so again in April.

If you are not already a member of NEWEA or NHWPCA, please consider joining to enhance your growth and development as a water industry professional. As state director, I can be reached at mtraink75@gmail.com or 603-785-3578. Please contact me with any questions. "You become what you believe, so believe in yourself."

Maine
State Director Report

by Paula Drouin
pdrouin@lawpca.org

I am delighted and honored to be the incoming NEWEA state director for Maine. For those who do not know me, allow me to introduce myself. I grew up in Maine where I attended the University of Southern Maine, earning a bachelor's degree in natural and applied sciences and a master's degree in biology. Like many of us, I never planned to work in wastewater treatment, but it found me and has provided an incredibly rewarding career. I am employed at the Lewiston-Auburn Water Pollution Control Authority (LAWPCA) as assistant general manager and was lab supervisor prior to that. (I can definitely still run a biochemical oxygen demand [BOD], blindfolded).

I am fortunate and grateful for LAWPCA's continued support of my working with our state and regional associations. I have been in the industry for nearly 14 years and have served several roles with the Maine Water Environment Association (MEWEA), including founding the Young Professionals Committee and later the New Media Committee (which has since been absorbed into Communications) and serving as Awards Committee past chair, Public Relations past chair, and past president. My volunteer roles now are mostly to oversee the MEWEA website and social media feeds (though I am constantly trying to get a Young Professional to take the latter from me). I am excited to step up and get more involved at the NEWEA level.

MEWEA is an active state association, so I would like to highlight our recent events and a few upcoming ones. Our volunteers are doing great work.

The 13th Annual Legislative Breakfast was held (virtually) on February 16 in collaboration with the Maine Water Utilities Association. Along with leaders in our association, speakers from the Maine Department of Environmental Protection (DEP), Maine Drinking Water Program, and Maine Center for Disease Control and Prevention came together to discuss the state of water, including current challenges. Such collaboration and information sharing is imperative to staying connected to our legislators, so we are grateful we could still hold the event, albeit not in person.

MEWEA once again held our annual Clean Water Week Poster Contest where grades 1–12 students submitted artwork illustrating "Why Water's Worth It to Me." Every year we receive hundreds of submissions and our members love voting on them at the Spring Conference (April 1 this year in Orono) or the North Country Convention in the off year. The top winners from each age group are awarded $100, and we try to plan a celebratory event. (Covid-19 has prevented this the past couple of years, but we are hopeful for 2022.) In the past we have, for example, visited the governor at State House, celebrated near Great Falls in Lewiston-Auburn with the mayors, and met at Brunswick Sewer District with elected officials. The top 12 posters are used to create a calendar for the following year (let me know if you would like one).

Looking a little farther forward, we are planning to have our Fall Convention at Sunday River on September 22–23. Another significant event planned for the fall is a celebration for the anniversary of the Clean Water Act, which turns 50 in 2022. We have come so far and are still on a path of immense progress. Zach Henderson from Woodard & Curran is spearheading the planning of a celebratory event that will bring together water professionals, regulators, elected officials, the public, and the media to recognize the tremendous work that has been done. We will also look at the road ahead and discuss the future of clean water. I will share more event details in the coming months.

Thank you to my predecessor, Jeff McBurnie, who has offered a helping hand; I am sure I will take advantage of your generosity. I hope to offer as much, if not more, than I gain. I am most definitely in good company with the other state directors and the Executive Committee, and that makes my job that much easier (and fun). Be safe and well, and I hope to interact with many of you.

Massachusetts
State Director Report

by Adam Yanulis
fayanulis@tighebond.com

Massachusetts utilities continue to work through Omicron variant issues, and with the Department of Environmental Protection (MassDEP) and local elected officials to serve their communities while protecting our water environment. Massachusetts Water Environment Association (MAWEA) members have several concerns about recent legislation, including SB 2655, "An Act establishing a moratorium on the procurement of structures or activities generating PFAS emissions."

This bill will affect new and existing incineration facilities in the commonwealth. Combined sewer overflow (CSO) notification bill "An Act Promoting Awareness of Sewage in Public Waters" will become a law in July. MassDEP has had three meetings, allowing the opportunity to comment and help develop templates for utilities to use in CSO notification. MassDEP templates will be released in May for CSO and July for sanitary sewer overflow (SSO). A stakeholder meeting was held on March 7 with MassDEP regarding biosolids disposal options for the commonwealth. Other New England states have pending legislation that would eliminate land application of biosolids in their states. With these potential moratoria on incineration and land application, biosolids options may be limited going forward.

MAWEA and Massachusetts Water Works Association (MWWA) have agreed to host a virtual legislative session in May. At this session utility managers and other elected officials will share the challenges they continue to face with more stringent regulation, aging infrastructure repair and replacement, and an aging workforce. The ongoing need for funding infrastructure repair and replacement and the Infrastructure Investment and Jobs Act will be discussed.

MAWEA will host its online Quarterly Meeting on March 22 with a training focus. NEIWPCC continues to provide operator virtual training for all levels. See the NEIWPCC website for courses and schedules. For those looking to improve management skills, personnel are encouraged to look for virtual spring classes and to apply to the year-long management training program that begins in the fall.

Many Massachusetts utility managers, operators, regulators, consultants, and vendors were happy to attend this year's NEWEA Annual Conference in January. The Trade Show and in-person technical sessions were welcomed after several months of virtual gatherings. Massachusetts again was well represented at the Annual Awards Ceremony and Luncheon.

Awardees included the following:

- EPA Award Industrial Pre-Treatment—Sherry Caldiera, Brockton
- NEWEA Operator Award—Ashley Demarey, Suez
- Alfred E. Peolquin Award—Jennifer Lichtensteiger, NEIWPCC
- James J. Courchaine Collection System Award—Louis Mammolette, Chelsea
- Young Professional Award—Colin O'Brien, Brown and Caldwell
- Energy Management Achievement Award—Jason Turgeon, EPA Region 1
- Committee Service Award—Dede Vittori, MWRA
- E. Sherman Chase Award—Michael Williams, Suez
- Elizabeth A. Cutone Executive Leadership Award—Susan Sullivan, NEIWPCC
- Founders Award—Meg Tabasco, MWRA
- Past President's Plaque and Pin—Jennifer Kelly Lachmayr, Arcadis
- William D. Hatfield Award—Cheri Cousens, GLSD
- WEF Delegate-At-Large—Susan Sullivan
- WEF Delegate—Susan Guswa, Woodard & Curran

Congratulations to you all and thank you for your excellent work.

Mark your calendars for the MAWEA Annual Golf Outing, scheduled for June 15 at Heritage Country Club in Charlton.

2022 Annual Conference & Exhibit Proceedings

Boston Marriott Copley Place, Boston, MA • January 23–26

NEWEA's 92nd Annual Conference convened with a meeting of the Executive Committee with all chairs on Sunday, January 23, 2022. More than 1,400 attended this three-day event, which featured over 200 exhibitors and 30 technical sessions. Attendees also joined our virtual event, taking place concurrently on our online event platform.

The Annual Business Meeting was held on Monday, January 24. Nominating Committee Chair Janine Burke-Wells presented the slate of officers for 2022 as follows:

- Vice President – Scott Goodinson
- Deputy Treasurer – David VanHoven
- Council Director: Meeting Management – Amy Anderson George
- Council Director: Treatment System Operations & Management – Marina Fernandes
- WEF Delegate – Janine Burke-Wells
- Maine Director – Paula Drouin
- New Hampshire – Michael Trainque

In accordance with the provisions of Article 9.3.2 of the NEWEA Constitution & Bylaws, these officers will advance to the following positions:

- President – Frederick McNeill
- President-Elect – Robert Fischer
- Past President – Virgil Lloyd
- Treasurer – Clayton (Mac) Richardson/David VanHoven

The remaining incumbents are fulfilling unexpired terms:

- WEF Delegate – James Barsanti (through WEFTEC 2022)
- WEF Delegate – Peter Garvey (through WEFTEC 2023)
- WEF Delegate – Raymond Vermette (through WEFTEC 2024)
- Council Director: Communications – Deborah Mahoney (2nd year)
- Council Director: Outreach – Colin O'Brien (2nd year)
- Council Director: Innovation – Marianne Langridge (3rd year)
- Council Director: Collections Systems and Water Resources – Vonnie Reis (3rd year)
- Connecticut Director – Vanessa McPherson, fulfilling William Norton's 3rd year (3rd year)
- Massachusetts Director – Adam Yanulis (3rd year)
- Rhode Island Director – Edward Davies (2nd year)
- Vermont Director – Michael Smith (2nd year)

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Opposite page: Keynote speaker Dr. Tamika Jacques emphasizes the importance of diversity in workforce development
1. NEWEA president Virgil Lloyd prepares to cut the ribbon officially opening the exhibit halls **2.** A celebratory crowd at the Young Professionals/President's Reception **3.** Philip Pedros and Mike Sparks confer in front of the electronic bulletin board
4. Corey Meyers, Amy Anderson George, and Lucas Chapman at Sunday's reception

30 Technical Sessions

SESSION 1
Innovation:
US EPA Southeast New England Programs (SNEP)
Moderators:
- Marianne Langridge, Sustainable Synthesis
- Bruce Walton, Battalia Winston

There are a number of promising solutions in permitting, but the organizational (Operations, Management & Monitoring—O,M&M), regulatory, and financial systems to support their adoption need development. This was a hands-on design workshop to imagine solutions for funding and O,M&M in a distributed systems approach.

SESSION 2
CSO/Wet Weather Issues 1:
Notifications, Applications, Infrastructure Improvements, and High-Rate Treatment
Moderators:
- Joshua Schimmel, Springfield Water & Sewer Commission
- Jim Drake, CDM Smith

WPCA Facilities Planning in Bridgeport: Balancing Critical WWTP Infrastructure Needs & Resolving CSO Discharges
- Alexandra Greenfield, CDM Smith
- Jane Madden, CDM Smith
- Lauren McBennett Mappa, Bridgeport WPCA

Somerville's BRIC Application for Union Square
- David VanHoven, Stantec
- Rich Raiche, City of Somerville, MA

Lebanon's CSO Program—20 Years in the Making
- Ryan Wingard, Wright-Pierce

Development of World's Largest Dual-Use High-Rate Primary & Wet Weather Flow Filtration Process Using Floating Media
- Jonathan Liberzon, Tomorrow Water

SESSION 3
Sustainability:
Integrating Sustainability in Project Planning, Design, and Construction
Moderator:
- Laura Stock, SUEZ

Sustainability Through Innovative Reuse in a Design-Build Wastewater Treatment Plant Upgrade
- John Finnegan, AECOM








1. Garrett Bergey, Tom Hazlitt, Jay Sheehan, Daniel Nason at Monday's coffee bar 2. NEIWPCC's Richard Friesner and Jennifer Lichtensteiger pose during a photo shoot 3. Tracy Wood, Sharon Nall, and Peter Goodwin representing the New Hampshire perspective 4. Erik Saitta and Matt DeLuca on their way to their exhibit floor booth

Langone Park & Puopolo Playground Renewal—A Catalyst for Climate-Resilient Design
- Brandon Kunkel, Weston & Sampson

EPA AAA Process for Facility Upgrade Selection
- Kayla Larson, Tighe & Bond
- Emily Cole-Prescott, City of Saco, ME

Sound the "High Water" Alarm—Effects of Sea Level Rise on Maine's Wastewater Infrastructure
- Maeve Carlson, Wright-Pierce
- Ania Wright, Sierra Club
- Kendra Jo Grindle, Island Institute

Session 4
Residuals 1: Residuals and Biosolids Study and Planning

Moderators:
- Janine Burke-Wells, Northeast Biosolids & Residuals Association
- Justin Motta, Stantec

A Holistic Approach to Struvite Management— Key to Improved Operations and Decreased Operations/ Maintenance Cost
- Varun Srinivasan, Brown and Caldwell

Feasibility and Design of Biosolids Drying at Lewiston-Auburn Water Pollution Control Authority WWTP
- Don Song, Brown and Caldwell
- Paula Drouin, Lewiston-Auburn Water Pollution Control Authority

Results from the Second National Biosolids Regulation, Quality, End Use, and Disposal Survey
- Janine Burke-Wells, Northeast Biosolids & Residuals Association
- Jennifer Lichtensteiger, NEIWPCC
- Ned Beecher, Northeast Biosolids & Residuals Association

Hybrid Biofilter for Biosolids Odor Control
- Carol Zuerndorfer, Brown and Caldwell

Session 5
Government Affairs 1: The Great Bay Total Nitrogen General Permit—Presentation & Panel Discussion

Moderator:
Bill Arcieri, VHB
An opening presentation set the stage for the discussion about Great Bay Estuary regulatory drivers and evolving stormwater point source and non-point nitrogen management programs.

Regulatory Changes, Stormwater and Nutrient Management Practices and Public Concern's Impacts on the Great Bay
- Terry Desmarais, City of Portsmouth, NH
- Gretchen Young, City of Dover, NH

Panel Discussion:
- Samir Bukhari, EPA
- Melissa Paly, Conservation Law Foundation
- Ellen Weitzler, EPA
- Ted Diers, NH DES
- Suzanne Woodland, City of Portsmouth, NH
- James Steinkrauss, Rath Law
- Bill Arcieri, VHB
- Gretchen Young, City of Dover, NH

1. Alexandra Greenfield at the podium 2. William Branton discusses sewer improvements in Scituate
3. Laurie Perkins presents one of her numerous papers 4. Steve Perdios makes a point regarding CSOs and infrastructure
5. Jane Madden speaks on Bridgeport's infrastructure challenges 6. Claudia Buchard enjoying a morning session break

Session 6
Asset Management 1: Case Studies

Moderators:
- Dan Capano, Gannett Fleming Engineers and Architects
- John Sykora, Weston & Sampson

3D GIS and Virtual Reality for Facility and Asset Management
- Zachary Jaffe, LandTech Consultants

Hitting a 20-year Capital Grand Slam in Gloucester
- Karen Chan, Wright-Pierce
- Laurie Perkins, Wright-Pierce

Proactive Asset Management of Newport's Wastewater and Stormwater Systems Contributes to Performance Improvements
- Ed Roworth, Jacobs
- Julia Forgue, City of Newport, RI
- Rob Shultz, City of Newport, RI

Lessons Learned During Evaluation of a Performance Assessment Framework
- Len Sekuler, Arcadis
- Adebola Fashokun, WSSC Water

Session 7
Government Affairs 2: Regulator Roundtable and Regional Updates

Moderator:
- Scott Firmin, Portland Water District

The Regulatory Roundtable Session allowed for discussion of common issues/solutions and facilitated the exchange of information.
Panelists from all six states:
- Joespeh Haberek, RI DEM
- Gregg Wood, ME DEP
- Tracy Wood, NH DES
- Amy Polaczyk, VT DEP
- Kathleen Baskin, MassDEP
- Nisha Patel, CT DEEP

Session 8
Stormwater 1: Stormwater Data, Monitoring, and Compliance—Oh My!

Moderators:
- James Houle, University of New Hampshire
- Andrew Goldberg, Brown and Caldwell

Super High Resolution Multi-Parameter Stormwater Monitoring—Recommendations for Affordable Approaches to Nutrient Monitoring
- Amy Mueller, Northeastern University
- Jonnas Jacques, Kleinfelder
- Charlie Jewell, Boston Water and Sewer Commission
- Amy Schofield, Boston Water and Sewer Commission
- Edward Beighley, Northeastern University

The Great Bay Estuary System Model—A Mechanistic and Quantifiable Framework for the Assessment of Resource Management Decisions
- Andy Thuman, HDR
- Cristhian Mancilla, HDR
- Thomas Gallagher, HDR

Meta-Analysis of Dry Weather Outfall Screening Data
- Emily Scerbo, Tighe & Bond
- Jennifer Lawrence, Tighe & Bond
- Kayla Larson, Tighe & Bond
- Natalie Koncki, Tighe & Bond

1. Edris Taher expounds on microbial communities 2. Christian Pasichny and Shane Hancox discuss Shane's poster about international challenges 3. Kamruzzaman Khan makes his student "Shark Tank" pitch to the Innovation audience

Boston Water and Sewer Commission—Modeling Green Infrastructure Implementation and Tracking Water Quality Improvement in Boston MS4 Reporting Areas
- John Rahill, Kleinfelder
- Amy Schofield, Boston Water and Sewer Commission
- Charlie Jewell, Boston Water and Sewer Commission
- Steven Huang, Kleinfelder

Session 9
Watershed Management: Watershed Resilience—From Adaptation Resources to Watershed Based Solutions

Moderators:
- James Plummer, NEIWPCC
- Jennifer Johnson, Nitsch Engineering

Adaptation For All—How to Build Flood Resilience for Communities of Every Size
- Trevor Johnson, Arcadis

Nitrogen Trading Opportunities Under Massachusetts' First Watershed Permit
- Mike Giggey, Wright-Pierce
- Carole Ridley, Ridley and Associates

Obstacles And Opportunities for Nutrient Trading in The Long Island Sound Study Area
- Rachel Bouvier, R Bouvier Consulting

Manganese Oxide Nanoparticles
- Sadie Lafleur, University of Rhode Island

Session 10
Small Community: Collection, Nutrient & Discharge Solutions

Moderators:
- Megan Trahan, Woodard & Curran
- Ian Catlow, Tighe & Bond

Doing More with Less—A Tale of Enhanced Biological Phosphorous Removal
- David Ford, Town of Wolfeboro, NH
- Jacob Metch, HDR
- Rebecca Elwood, HDR

Innovative Disposal System Performs Well Under Performance-Based Groundwater Discharge Permit
- Adam Higgins, Wright-Pierce

Implementation of an I/I Reduction and Hydraulic Modeling Program to Optimize Collection System Capacity for Future Development
- Anastasia Rudenko, GHD
- Benn Sherman, Town of Uxbridge, MA
- Marc Drainville, GHD

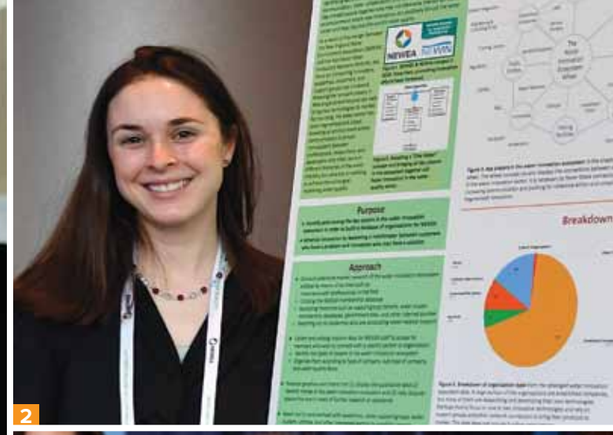
Discharge Won't Do—PDD Opens Up Possibilities in Small Community
- Julianne Page, Woodard & Curran
- Brent Bridges, Woodard & Curran

Session 11
Collection Systems 1: Repairs—Handle the Situation Before the Situation Handles You

Moderators:
- James Barsanti, Mass DEP
- Matthew Corbin, Wright-Pierce

Have You Ever Been Railroaded? Lessons from a Force Main Repair in a Railroad Right-of-Way
- Olivia Lafond, Woodard & Curran
- Jeff Kalmes, Town of Billerica, MA

Targeted Inspections Used to Assess Force Main Condition After Failure
- Allison Zeoli, Arcadis
- Bryce Annino, CPI Engineering



1. Mark Spencer pitches his phone-connected instrumentation at the Innovation Pavilion 2. Megan Goldsmith, NEWEA Innovation intern with her "Turning the Water Wheel" poster 3. Amy Corriveau, a Shark Tank judge, asking the tough questions

Large Diameter Trenchless Rehabilitation by the Holland Tunnel
- Brian Shiels, Mott MacDonald

Removal of Ocean I-I and Restoration of Sewer Capacity—Replacement of the Gravity Sewer System in the Cedar Point Area of Scituate, MA
- Paul Millett, Environmental Partners
- William Branton, Town of Scituate, MA

Session 12
Collection System 2: Floods, Covid, Siphons and GIS—A Basket of Solutions

Moderators:
- Kara Johnston, CDM Smith
- Ryan Wingard, Wright-Pierce

Adapting Collection System Infrastructure to Changing Flood Vulnerabilities—Wareham Massachusetts Case Study
- Lenna Quackenbush, GHD
- Anastasia Rudenko, GHD

How Wastewater Testing Helped to Improve Covid Outcomes in Chelsea, MA
- Peter Garvey, Dewberry
- Barry Keppard, Metropolitan Area Planning Control
- David Bedoya, Dewberry
- Louis Mammolette, City of Chelsea, MA

Grit Traps Reduce Maintenance on Inverted Siphons
- Jack Troidl, Woodard & Curran

Innovative Uses of GIS for Wastewater Collection O&M
- Laurie Perkins, Wright-Pierce
- Kean McDermott, Wright-Pierce

Session 13
Plant Operations 1: Tying Fundamentals to Operations

Moderators:
- Matthew Pitta, CDM Smith
- Adam Higgins, Wright-Pierce

Correlating Operational Conditions to Activated Sludge Microbial Community in One Year of an A2O Process
- Edris Taher, Upper Blackstone Clean Water
- Karla Sangrey, Upper Blackstone Clean Water
- Masha Mehrdad, Environmental Operating Solutions
- Timothy Loftus, Upper Blackstone Clean Water

Increasing Removal Efficiency of Primary Settling Through Influent Solids Characterization and CFD Modeling
- Jacob Metch, HDR
- Hany Gerges, HDR
- Sean McKelvey, City of Philadelphia, PA

Simulating Side-Stream EBPR (S2EBPR) in Full-Scale and Pilot-Scale Demonstration Studies: Modeling Approaches and Challenges
- Varun Srinivasan, Brown and Caldwell

Optimizing Aeration Control to Meet the Needs of Process Intensification
- Paul Dombrowski, Woodard & Curran
- Jonathan Himlan, Woodard & Curran







1. Jennifer Muir touches on Global Climate challenges 2. John Rahill speaks on Green Infrastructure modeling
3. Program Chair Lauren Hertel sips coffee at the start of a busy day

SESSION 14
Contaminants of Emerging Concern: PFAS and PFurious
Moderators:
- Camilla Kuo-Dahab, University of Minnesota
- Janice Weldon, University of Massachusetts Amherst

Destructive Technologies Overview for Complete PFAS Treatment Solutions
- Steve Woodard, ECT2

Holding PFAS Polluters Accountable in New England
- Ken Sansone, SL Environmental Law Group

Electrochemical Destruction of PFAS and 1,4-Dioxane
- Jose Alvarez, Aclarity
- Julie Bliss Mullen, Aclarity

PFAS in Stormwater—Lessons Learned and Where We're Headed
- Renee Bourdeau, Geosyntec Consultants

SESSION 15
Utility Management: Learning from the Past and Planning for the Future
Moderators:
- Kevin Garvey, Wright-Pierce
- Donald Gallucci, Weston & Sampson

10 Years Later—A Renewed Contract, $2.5M Cost Savings, Upgraded Technology—How to Navigate When Your WW Contract Ops Agreement Expires
- Evan Raffi, Arcadis
- Amy Anderson George, Arcadis
- Daniel Borges, City of East Providence, RI

What If Amazon Ran a Treatment Facility—The Future of Wastewater Automation
- Susan Guswa, Woodard & Curran

Federal Funding for Wastewater Infrastructure—What We Know and What to Expect
- Jessica Richard, Woodard & Curran

Infrastructure Planning in Disadvantaged Communities
- Scott Turner, Environmental Partners
- Sara Bucci, Environmental Partners

SESSION 16
Energy: Strategic Energy Management
Moderators:
- Sharon Nall, NH DES
- Tracy Chouinard, Brown and Caldwell

Lessons Learned from Starting a Biosolids Pyrolysis Project During a Pandemic
- Raymond Porter, Porter Odor Science
- Sam Sylvetsky, Biowaste Pyrolysis Solutions

South Essex Sewerage District's Progress Towards a Long Term-Energy Management Strategy
- Michael Wilson, South Essex Sewerage District
- David Michelsen, South Essex Sewerage District
- Peter Pommersheim, South Essex Sewerage District

1. Charlie Tyler and Ben Stoddard discuss awards logistics 2. Ashley Demarey and Mike Williams relax at the awards luncheon
3. Alex and Jennifer Kelly Lachmayr enjoying the awards luncheon 4. Kenneth Wagner makes a point during the Clean Water Act Keynote session

- Richard Delacono, South Essex Sewerage District

The Role of WRRFs in the Global Climate Challenge—Opportunities for Decarbonization Strategies
- Jen Muir, JKMuir
- Molly Keleher, JKMuir

A New Approach to Reducing Energy Consumption Using Artificial Intelligence
- Patrick McCafferty, CDM Smith

SESSION 17
CSO/Wet Weather Issues 2: Analyzing the Data
Moderators:
- Steve Perdios, Dewberry
- Larry Sullivan, Norwich Public Utilities

Quantifying the Accuracy of Various Rainfall Spatial Interpolation Techniques
- Matthew Davis, Brown and Caldwell

Innovative Root Cause Analysis to Identify Chronic Surface Flooding Countermeasures
- Miles Bateman, Dewberry
- David Bedoya, Dewberry

Adaptation of System Monitoring Approaches to Meet Future Challenges
- Karilyn Heisen, CDM Smith
- Justin Chicca, Town of New Bedford, MA
- Scott Craig, CDM Smith
- Shawn Syde, Town of New Bedford, MA

Data Analytics for Wet Weather Solutions, a Sharing Experience in Getting the Most Out of Your Data to Achieve the Best Possible Outcome
- Nicholas Anderson, Stantec

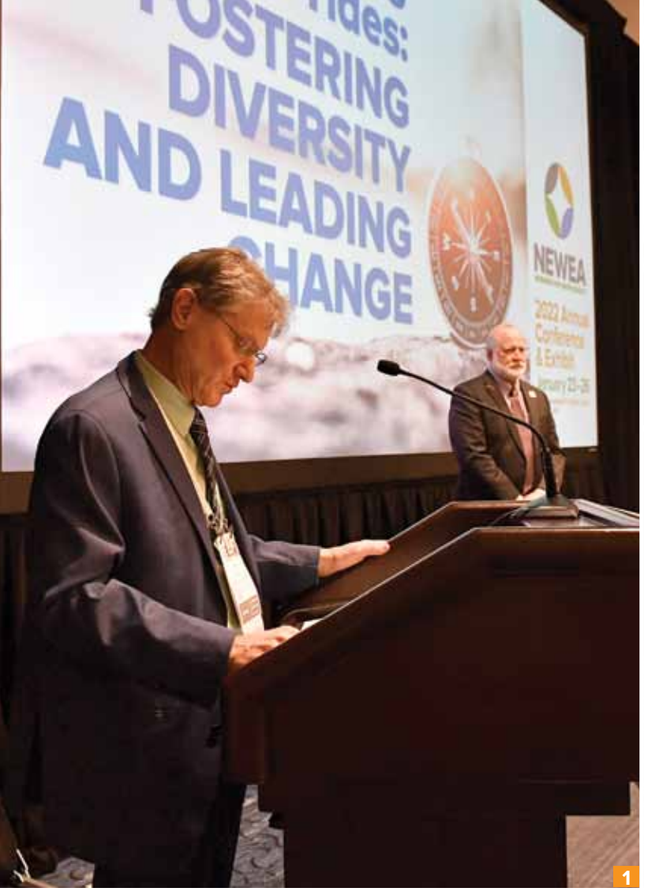
SESSION 18
Stormwater Panel Discussion: The Latest in Stormwater Regulations and Innovative Nutrient Controls
Moderators:
- Zach Henderson, Woodard & Curran
- Lauren Caputo, VHB

This moderated panel discussion provided an update on regulatory obligations for New England's MS4 communities and the private sector with a specific focus on nutrient control initiatives. Additionally, this session provided an update on and introduction to several innovations in stormwater-related nutrient control.

Panelists include
- James Houle, University of New Hampshire
- Theresa McGovern, VHB
- Kenneth Moraff, EPA
- Jim Pease, VT DEC
- Laura Schifman, MassDEP
- Newton Tedder, EPA
- Ken Wagner, Water Resource Services

SESSION 19
Public Awareness: Bringing a Positive Image to The Clean Water Industry
Moderators:
- Faye DeMoura, Wright-Pierce
- Denise Descheneau, Upper Blackstone Clean Water

Gaining Support for Public Works & Infrastructure Through Social Media—The City of Gloucester Spreads the Word
- Conrad Leger, Environmental Partners
- Cassandra Thompson, Environmental Partners
- Michael Hale, City of Gloucester, MA



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1. Jim Barsanti narrating the award presentations **2.** Amy Safford of Maine Manufacturing Partners and Barry Tibbets of Windham, Maine, at the Innovation Pavilion **3.** Russell Macgregor and Larry Sullivan at the Monday coffee bar

Healthy Lake Boon Initiative
- Andrew Goldberg, Brown and Caldwell
- Fiona Worsfold, Brown and Caldwell
- Dan Barstow, Lake Boon Association
- David Gray, Grayscale Solutions

Incorporating Diversity, Equity, & Inclusion in Infrastructure Projects
- John Frey, Weston & Sampson
- Deanna Lambert, Weston & Sampson
- Aaron Clausen, City of Lynn, MA

Flipping the Bird—Rebranding at Upper Blackstone
- Karla Sangrey, Upper Blackstone Clean Water
- Denise Descheneau, Upper Blackstone Clean Water

SESSION 20
Plant Operations 2: Process Intensification

Moderators:
- John Adie, NH DES
- Matt Pitta, CDM Smith

Construction and Performance of North America's Largest CoMag Ballasted Flocculation Process for Phosphorus Removal
- Pamela Westgate, Kleinfelder
- Jose Infante-Corona, Kleinfelder

Startup & Initial Operation of the New Peirce Island WWTF
- Erik Meserve, AECOM
- Jon Pearson, AECOM
- Peter Conroy, City of Portsmouth, NH
- Terry Desmarais, City of Portsmouth, NH

Lessons Learned Installing and Starting-up the CoMag Process for Low Level Phosphorus Removal at the Southington CT WPCP
- Cynthia Castellon, Tighe & Bond
- Fred Mueller, Tighe & Bond

A Phoenix from the Ashes—The Fall and Rise of the Greenfields Wastewater Treatment Plant
- Erin Moore, Tighe & Bond
- David Seche, Tighe & Bond

SESSION 21
Residuals 2: Regulator Roundtable

Moderators:
- Eric Spargimino, CDM Smith
- Natalie Sierra, Brown and Caldwell

There was an opening presentation to set the stage for the discussion about regulatory drivers and evolving residuals management programs.

Regulatory Changes, Nutrient Management Practices and Public Concern's Impact on Biosolids Management, the More Things Change…
- Mark Lang, Black & Veatch

Panel Discussion with:
- Alex Pinto, RIDEM
- Anthony Drouin, NH DES
- Eamon Twohig, VT DEC
- Mike Jakubowski, ME DEP

1. Marianna and Walter Palm unmask for a photo **2.** Janine Burke-Wells and WEF's Steve Dye at the exhibit hall reception **3.** 2022 President Fred McNeill receives the gavel from 2021 President Virgil Lloyd

- Rowland Denny, CT DEEP
- Jennifer Wood, MassDEP

SESSION 22
Collection Systems 3: Sewers are Like Life—It All Depends on What You Put into It

Moderators:
- Scott Lander, Retain-it
- John DiGiacomo, Town of Natick, MA

COVID-19 Modern Trash Loading Proves Sewage Pump Clog Resistance Can Not Be Predicted by Impeller Throughlet Size
- Robert Domkowski, Xylem

Taking Out "Flushable" Wipes—A Case Study on Eliminating Pump Cleanouts
- Mark Wilson, Duperon

Advanced Sewer Process Modeling to Develop Odor and Corrosion Solutions for Managing Sewer Assets
- John Siczka, Jacobs

Some Things Neighbors Should Not Share—The Story of Successfully Separating Shared Sewer Laterals
- Michael Stein, Wright-Pierce
- Laurie Perkins, Wright-Pierce

SESSION 23
Plant Operations 3: Focus on Operations and Startup

Moderators:
- Pamela Westgate, Kleinfelder
- Mickey Nowak, MAWEA

Moving from Reactive to Proactive Operations—Barstow, CA WRRF's Journey to Optimization
- Steve Myers, HACH

An Operator's Tale of Living Through a Facility Upgrade
- Chris Welch, Town of Uxbridge, MA
- Sara Greenberg, GHD

Implementing Cybersecurity and Network Improvements at LRWWU
- Tim Maynard, Woodard & Curran
- Evan Walsh, City of Lowell, MA

Repair, Rehabilitate, or Replace: Approaches to Renewing Wastewater Treatment Clarifiers
- Erik Osborn, Woodard & Curran
- Sean Tarbox, Woodard & Curran

SESSION 24
Stormwater 2: Lessons Learned in Green Infrastructure

Moderators:
- Eric Kelley, Environmental Partners
- David Bedoya, Dewberry

Framework for Managing Stormwater Infrastructure
- Lauren Van Meter, HDR

CSO Reduction and Green Infrastructure—A Happy Marriage
- Kevin Trainor, Woodard & Curran

Successfully Implementing Green Infrastructure to Transform Public Spaces
- Jennifer Johnson, Nitsch Engineering
- Erica DeDonato, Town of Milton, MA
- Marina Fernandes, Town of Milton, MA

Relief Drains and Daylighting to Solve Neighborhood's Street Flooding and Stream Velocities
- Eric Kelley, Environmental Partners
- Ryan Paul, Environmental Partners
- Matthew Weisman, Town of Lexington, MA

SESSION 25
Innovation: Funding Innovation

Moderator:
- Marianne Langridge, Sustainable Synthesis

Funding Innovation—Insights from the Federal Infrastructure Funding Bill
- Adam Krantz, National Association of Clean Water Agencies
- Steve Dye, Water Environment Federation

Funding Innovation Panel Discussion:
- Dr. Christobel Ferguson, Water Research Foundation
- Dr. Jeff McCutcheon, University of Connecticut/ National Alliance for Water Innovation
- Roger Berry, Sudoc

SESSION 26
Water Reuse in Action: Technologies and Operations

Moderators:
- Vanessa Borkowski, Stantec
- David Moering, Woodard & Curran

Pilot-Scale Assessment of Ferrate for Wastewater Recycling
- Charles Spellman, University of Rhode Island

Ceramic Microfiltration Allows Reuse of Challenging Wastewaters at Two U.S. Locations
- Dave Holland, Aqua-Aerobic Systems

Panel Discussion:
- Mark Schemel, Weston & Sampson
- Rob Scott, Woodard & Curran
- Jim Huntington, Natural Systems Utilities
- John Tekula, Natural Systems Utilities
- Jacob Fortin, Woodard & Curran

SESSION 27
Collection Systems 4: In (Verified) Data We Trust

Moderators:
- Peter Garvey, Dewberry
- Tom Loto, AECOM

Gaining on 90%+ Flow Meter Coverage in Study Areas Overrun by Pump Stations
- Laurie Perkins, Wright-Pierce
- Karen Chan, Wright-Pierce
- Meghan Otis, Wright-Pierce

Data Driven Pretreatment & Collection System Management
- Tanner Lauringson, KANDO
- Anne-Li Steutel, KANDO

Prioritizing Sanitary Sewer Collection System Repairs on an Aging System
- Karina Massey, Jacobs

A Drill to Growth and Reliability
- Kevin Garvey, Wright-Pierce

SESSION 28
CSO/Wet Weather Issues 3: Treatment and Storage of CSO Flows

Moderators:
- Jason Kreil, Woodard & Curran
- Larry Murphy, Jacobs

Updating Airflow Design Criteria for a CSO Tunnel Odor Control Facility Using Direct Measurement Techniques
- Robert Baglini, Narragansett Bay Commission
- Derick Hopkins, Wright-Pierce
- Eugene Sorkin, Narragansett Bay Commission

Boston Water and Sewer Commission—Improving System Hydraulics in the Dorchester Interceptor Through Off-line Storage and Inflow Reduction Alternative
- John Rahill, Kleinfelder
- Stephen Shea, Kleinfelder

Utilizing Prestressed Concrete for Cost Effective, Long Term CSO Storage
- Corey Meyers, DN Tanks
- Andy Begin, Greater Augusta Utility District
- Brian Tarbuck, Greater Augusta Utility District
- Kevin Obery, Wright-Pierce

Enhanced Chlorination and Dechlorination for Wet Weather Treatment in Norwalk
- Mary Penny, Arcadis

SESSION 29
Industrial Wastewater: New Innovations and Treatment Solutions

Moderators:
- Sarah White, Unifirst Corp
- Matthew Dickson, MGD Process Technology

Treatment of High Nitrate Industrial Waste
- Jeanette Brown, Manhattan College/ Stevens Institute of Technology
- David Vaccari, Stevens Institute of Technology

Alkaline Hydrolysis of Nitrocellulose (NC) and Comparative Evaluation of End-Pipe Processes for Nitrogen Removal in Hydrolyzed Liquor
- Amalia Terracciano, Stevens Institute of Technology

The Industrial User and POTW Relationship—Working Collaboratively Towards a Permitting a New Pharmaceutical Discharge
- Jocelyn Russell, Dewberry
- Leigh-Ann Dudley, Dewberry

Electrochemical Destruction of Cyanide and other Chelation Agents in Plating Wastewater
- Jose Alvarez, Aclarity

SESSION 30
Asset Management 2: Tools and Resiliency

Moderators:
- Matt Manchisi, Kimley-Horn
- Eliza Morrison, NH DES

Extreme Makeover—Outfall Edition
- Chelsea Waite, Woodard & Curran
- Erik Osborn, Woodard & Curran

How to Build Resiliency and Tap the Funding Pipeline through Master Planning
- Richard Niles, Woodard & Curran
- Marc Strange, City of Agawam, MA
- Scott Medeiros, Woodard & Curran

A Risk-based Approach to Prepare Utility Infrastructure for Storms Ahead—Considerations of a Proactive Utility in Coastal Virginia
- Timothy Adams, CDM Smith
- Lauren Miller, CDM Smith

Smart One Water—Integrating Workforce, Governance, and Technology Innovation
- Kenneth Thompson, Jacobs

Undergraduate Student Poster Board Competition

Continuous Culturing of MnOx Producing Bacteria to Biosynthesize Manganese Oxide Nanoparticles
- Caroline Canales—University of Rhode Island

A Study of Beaded Streams in the Arctic
- Faye Kuszewski, Alanna Joachim, Brady Bell— University of Massachusetts, Amherst

ACTIFLO with Alum: Minimizing Effluent Aluminum
- Nicholas Thompson—University of Rhode Island

Working with International Communities to Implement Projects Remotely
- Liam Amery, Shane Hancox—University of Massachusetts, Amherst

Nitrogen and Phosphorus Concentrations in the Charles River
- Lauren MacDonald—Northeastern University

Graduate Student Poster Board Competition

Nanosheet Toxicity Dependence on Growth Conditions and Bacterial Growth Stage
- Zachary Shepard—University of Rhode Island

The Fate of SARS-CoV-2 Viral RNA in Coastal New England Wastewater Treatment Plants
- Mina Aghababaei—University of New Hampshire

Co-treatment of Acid Mine Drainage in Activated Sludge Sequencing Batch Reactors
- CJ Spellman, Jacira Soares, Aaron Myers, Eloise Davis, Megan Caless—University of Rhode Island

PFAS Occurrence, Distribution and Signature in Drinking Water Sources in Massachusetts
- Christian Pasichny, Janice Weldon—University of Massachusetts, Amherst

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Xylem Water Solutions Inc. - Flygt Products

2022 Awards & Recognitions

U.S. EPA REGION I AWARDS

Wastewater Treatment Plant O&M Excellence
- Stonington Sanitary District, Stonington, Maine
  represented by D. Gay Atkinson, II, Sanitary District Operator
- Exeter Wastewater Treatment Plant, Exeter, New Hampshire
  represented by Joshua Scotton, Wastewater Superintendent

Wastewater Treatment Plant Operator of the Year Excellence
- Jeff Lemay, South Windsor, Connecticut
- Brian Sullivan, Colebrook, New Hampshire
- Louise Grant, Paris Utility District, Paris, Maine

Wastewater Trainer of the Year
- Ryan Peebles, Clean Waters Inc.

Industrial Pretreatment Program of the Year
- City of Brockton, Massachusetts
  represented by Sherry Caldiera, Industrial Pretreatment Coordinator
- Town of Milford, New Hampshire
  represented by Jim Pouliot, Director

WEF – MA AWARDS & RECOGNITIONS

George W. Burke, Jr.
- Woodard & Curran, North Haven Facility

Arthur Sidney Bedell
- Amy Anderson George

William D. Hatfield
- Cheri Cousens

Laboratory Analyst Excellence
- Michelle Gaudette

WEF Project Excellence
- Peirce Island Wastewater Treatment Facility

WEF Fellow
- Kristin Morico
- Erin Mosley

WEF Service Delegate
- Susan Sullivan
- Susan Guswa

Operations Challenge Division II: First Place Laboratory, First Place Process Control, Third Place Collections, Second Place Overall
- RI-CONN United

Student Design Competition Wastewater Division Second Place
- Aidan Travers, Emily Eastman, Jeffrey Ling, Taylor Labbe (Northeastern University)

Operator Scholarship
- Riley Cobb

Outstanding Young Water Environment Professional
- Vanessa Borkowski

Quarter Century Operator
- Tim Haskell
- Peter Connell
- Carl Veilleux

Jay Sheehan, Ashley Demarey, Paul Dombrowski, Mickey Nowak, Susan Guswa, and Mike Williams at the awards celebration

NEWEA award recipients: 1. Colin O'Brien, Young Professional Award 2. Dede Vittori, Committee Service Award 3. Louis Mammolette, James J. Courchaine Collection Systems Award 4. Sally Keating, Alfred E. Peloquin Award (CT)

NEWEA RECOGNITIONS

Scholarship Recipients 2021–22

Undergraduate Students
- Courteney Hales
  University of Vermont
- Kathryne Lovell
  University of Massachusetts
- Shawn Shay
  University of Connecticut

Kate Biedron Scholarship
- Ella Quinn
  University of Massachusetts

Student Design Competition
- Jeffery Ling, Aidan Travers, Taylor Labbe, and Emily Eastman
  Northeastern University, Boston, MA

Stockholm Junior Water Prize
- Elizabeth Wallace, Greenwich, CT
- Ginny Hunt, Bangor, ME
- Maxim Attiogbe, Worcester, MA
- Abhinav Avvaru, Nashua, NH
- Hiba Ali, South Burlington, VT

NEWEA acknowledged retiring officers, directors, delegates and committee chairs

OFFICERS

Mac Richardson (Treasurer)

STATE DIRECTORS

Steve Clifton (NH),
Jeff McBurnie (ME),
Bill Norton (CT)

WEF DELEGATES

Susan Guswa, Susan Sullivan

COUNCIL DIRECTOR

Phil Forzley (Treatment, Systems Operations, and Management)

COMMITTEE CHAIRS

Marylee Santoro (Assessment and Development)
Dan Roop (Asset Management)
Jay Sheehan (Awards)
Mike Bonomo (Bylaws)

COMMITTEE CHAIRS (continued)

Janine Burke-Wells (Contaminants of Emerging Concern, Nominating)
Steve Perdios (CSO/Wet Weather Issues)
Marina Fernandes (DE&I*)
Sharon Nall (Energy)
Corey Meyers (Exhibits)
Alexandra Greenfield (Journal)
Walter Palm (Laboratory Practices)
Peter Frick (Membership)
Scott Goodinson (Operation Challenge)
Denise Descheneau (Public Awareness)
David Horowitz (Safety)
Nick Valinski (Scholarships)
Nick Tooker (Student Activities)
Sara Greenberg (Watershed Management)
Lenny Young (Youth Education)
* Ad hoc

NEWEA AWARDS

NEWEA Operator Award

Connecticut
- Gregory Quink, Waterbury, CT

Maine
- Theresa Tucker, York, ME

Massachusetts
- Ashley Demarey, Agawam, MA

New Hampshire
- Dan Driscoll, Concord, NH

Rhode Island
- Scott Goodinson, Narragansett, RI

Vermont
- Robert Protivansky, Rutland, VT

Alfred E. Peloquin Award

Connecticut
- Sally Keating, Hartford, CT

Maine
- Paula Drouin, Lewiston, ME

Massachusetts
- Jennifer Lichtensteiger, Lowell, MA

New Hampshire
- Michael Trainque, Manchester, NH

Rhode Island
- Kathy Perez, South Kingstown, RI

Vermont
- Richard Kenney, Hartford, VT

NEWEA AWARDS

James J. Courchaine Collection Systems Award
- Louis Mammolette, Chelsea, MA

Paul Keough Award
- Alex Kuffner, Providence, RI

Young Professional Award
- Colin O'Brien, Petersham, MA

Youth Educator Award
- Adriana Cillo, Boston, MA

Biosolids Management Award
- James Jutras, Village of Essex Junction, VT

Asset Management Award
- City of Dover WWTF, Dover, NH

Energy Management Achievement Award
- Jennifer Muir, Durham, CT

Energy Management Achievement Award
- Jason Turgeon, Boston, MA

Committee Service Award
- Dede Vittori, Newton, MA

E. Sherman Chase Award
- Michael Williams, Holyoke, MA

Clair N. Sawyer Award
- Laurie Perkins, Manchester, NH

Elizabeth A. Cutone Executive Leadership Award
- Susan Sullivan, Lowell, MA

Founders Award
- Meg Tabacsko Chelsea, MA

Diversity, Equity, and Inclusion Leadership Award
- Oluwole "OJ" McFoy, Buffalo, NY

Past President's Plaque and Pin
- Jennifer Kelly Lachmayr, Wakefield, MA

New Members December 2021–February 2022

Thomas Kapnis
South Essex Sewerage District
Salem, MA (UPP)

Vishal Prakash
ProSoft Technology
Bakersfield, CA (PRO)

Jennifer Norton
Richmond Hills, NY (YP)

Scott Neesen
ADS Environmental
Londonderry, NH (PRO)

Jeff Heroux
Fall River, MA (PWO)

Scott Medeiros
Enfield, CT (PRO)

Stephen Rupar
Shelton, CT (PRO)

Bud Dunbar
Westhampton Beach, NY (PRO)

Hilary Johnson
Cambridge, MA (PRO)

Brian Messner
Wright Pierce Engineers
Middletown, CT (PRO)

McKenzie Banahan
Boston, MA (YP)

Joe Fayan
Old Saybrook, CT (PRO)

Brendan Robertson
Portland, ME (PRO)

Hannah Schulz
Portland, ME (YP)

Weile Yan
Lowell, MA (ACAD)

Joseph Baron
Portland Water District
Portland, ME (UPP)

Matt Clauss
Newington, NH (PRO)

John McGrath
Plaistow, NH (PRO)

Sara Page
Portsmouth, NH (PRO)

Miles Sabine
Portland Water District
Portland, ME (UPP)

Jeffery Stearns
Providence, RI (PRO)

Robert Howard
City of Brewer, Maine
Brewer, ME (PWO)

Richard Kenney
White River Junction, VT (PRO)

Brett Roberts
Seekonk, MA (PRO)

Jeffrey Zdrojewski
Buffalo, NY (PRO)

Areeg Abd-Alla
Somerville, MA (YP)

Courteney Hales
Burlington, VT (STU)

Justin Jobin
Selden, NY (PRO)

Ella Quinn
Northampton, MA (STU)

Tim Wade
Greater Augusta Utility District
Augusta, ME (PWO)

Matthew McKenna
Loureiro Engineering Associates
West Hartford, CT (YP)

Meghan Abbey
Hampton, NH (STU)

Michael Alberice
Oak Bluffs, MA (PWO)

Chloe Blanchette
South Portland, ME (STU)

Alex Katsoulakos
Greater Lawrence Sanitary District
North Andover, MA (PWO)

David Milano
Southington, CT (YP)

Ryan O'Hagan
Woburn, MA (PWO)

Shawn Shay
Meriden, CT (STU)

Kevin Trainor
Woodard & Curran Inc
Portland, ME (PRO)

Tom Ferrero
Ambler, PA (YP)

Stephen Furtkevic
Greendell, NJ (PWO)

John Sherbondy
TIGG LLC
Oakdale, PA (PRO)

Clifton Dassuncao
Eastern Research Group, Inc
New York, NY (YP)

George Heufelder
Falmouth, MA (PWO)

Matthew Serrano
Metropolitan District
Rocky Hill, CT (UPP)

Academic (ACAD)
Affiliate (AFF)
Complimentary (COMP)
Corporate (COR)
Dual (DUAL)
Executive (EXEC)
Honorary (HON)
Life (LIFE)
Public Official (POFF)
Professional (PRO)
Professional WW/OPS (PWO)
Student (STU)
Utility Partnership Program (UPP)
Young Professional (YP)

2022 Spring Meeting and Hotel Room Block

NEWEA is pleased to announce our 2022 Spring Meeting, taking place May 22–25 at the Mount Washington Resort in Bretton Woods, NH.

The hotel room block is now open! Join us at the beautiful Mount Washington Resort, a historic hotel that offers grand amenities and views of the majestic Presidential Range.

For more information visit: **springmeeting.newea.org/hotel-travel-information/**

Upcoming Meetings & Events

OPERATIONS CHALLENGE TRAINING DAY
Springfield W&S, Springfield, MA
April 1, 2022

ENERGY/PLANT OPERATIONS SPECIALTY CONFERENCE
North Essex Community College, Haverhill, MA
April 14–15, 2022

NATIONAL WATER WEEK DC FLY-IN
Washington, DC
April 26–27, 2022

DE&I VIRTUAL PANEL SESSION
Virtual
May 10, 2022

SPRING MEETING
Mt. Washington Resort
Bretton Woods, NH
May 22–25, 2022

EUM WORKSHOP JOINT WITH EPA
Edwards House, Framingham, MA
June 9, 2022

NEWEA GOLF TOURNAMENT
Derryfield Country Club,
Manchester, NH
September 31, 2022

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

MEWEA SPRING MEETING
Black Bear Inn and Conference Center,
Orono, ME
April 1, 2022

NEWWA SPRING CONFERENCE
DCU Center, Worcester, MA
April 6–7, 2022

NEAPWA SPRING CONFERENCE
Rentschler Filed, East Hartford, CT
April 20, 2022

CTWEA SPRING WORKSHOP AND AWARDS
Aqua Turf, Plantsville, CT
May 2, 2022

GMWEA SPRING MEETING
Killington Grand, VT
May 26, 2022

AWWA ACE 2021
San Antonio, TX
June 12–15, 2022

MAWEA GOLF TOURNAMENT
Heritage Country Club in Charlton, MA
June 15, 2022

NEAPWA SUMMER MEETING
Red Jacket, Yarmouth, MA
June 15–17, 2022

CTWEA SEWER OPEN
Skungamaug River Golf Club,
Coventry, CT
June 17, 2022

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 2022 ANNUAL SPONSOR PROGRAM PARTICIPANTS

Platinum
Dewberry
EST Associates, Inc.
Flow Assessment Services, LLC

Gold
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Woodard & Curran

Bronze
Black & Veatch
Hobas Pipe USA
Ti-SALES

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

Join NEWEA's 2023 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 2022 *Journal* Themes

Summer—**Clean Water Act's 50th Anniversary**

Fall—**Instrumentation & Controls**

Winter—**Funding the Work**

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)

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/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) | WEF 22

Membership Categories (select one only)

		Member Benefit Subscription	Dues
☐ **Professional**	Individuals involved in or interested in water quality	■ *Water Environment & Technology* ■ *Water Environment Research* (Online)	$190
☐ **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..	■ *Water Environment & Technology* ■ *Water Environment Research* (Online)	$75
☐ **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 # _____	■ *Water Environment & Technology* ■ *Water Environment Research* (Online)	$110
☐ **Academic**	Instructors/Professors interested in subjects related to water quality.	■ *Water Environment & Technology* ■ *Water Environment Research* (Online)	$190
☐ **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.	■ *Water Environment & Technology* ■ *Water Environment Research* (Online)	$15
☐ **Executive**	Upper level managers interested in an expanded suite of WEF products/services.	■ *Water Environment & Technology* ■ *Water Environment Research* (Online) ■ *WEF SmartBrief* ■ Complimentary WEF Webcasts and more	$360
☐ **Corporate** (member benefits for one person)	Companies engaged in the design, construction, operation or management of water quality systems. Designate one membership contact.	■ *Water Environment & Technology* ■ *Water Environment Research* (Online) ■ *WEF SmartBrief* ■ Complimentary WEF Webcasts and more	$420
☐ **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

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

Payment

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

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☐ 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 ManagementLevel

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

5 Disinfection and Public Health

6 Drinking Water

7 Energy

8 Finance and Investment

9 Industrial

10 Intelligent Water Technology

11 Laboratory Analysis and Practices

12 Nutrients

13 Plant Operations and Maintenance

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

21 Utility Management and Leadership

22 Watershed Management

23 Wastewater Treatment, Design, and Modeling

24 Water Reuse and Reclamation

25 Workforce

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

Gender: ☐ Female ☐ Male

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

Did Anyone Recommend that You Join WEF?

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

Urban Flood Resilience in Plain Sight

Stantec is integrating stormwater, transportation, open space and cultural benefits into a new, vibrant community space in Brickbottom.

Poplar Street
Pump Station & ArtFarm
Somerville, MA

Design with community in mind
stantec.com/water

Stantec