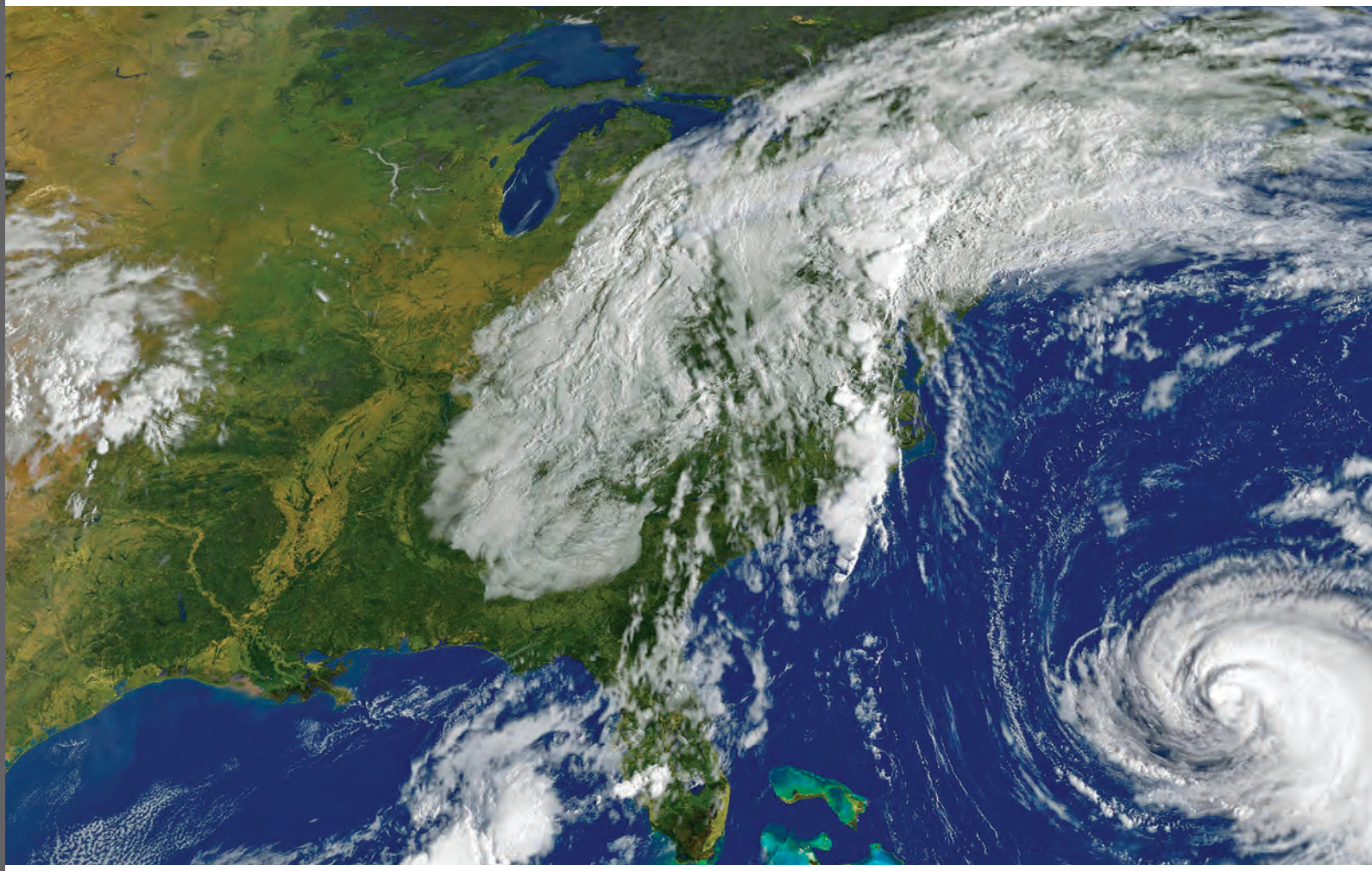
JOURNAL

OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

VOLUME 58 NUMBER 3 / ISSN 1077-3002 **FALL 2024**



WET WEATHER

NEWEA
WORKING FOR WATER QUALITY

weftec
the water quality event

Visit us at
BOOTH #1829
October 7-9, 2024
New Orleans, LA

LOOKING TO REPLACE THOSE AGING, INEFFICIENT PLASTIC DISC OR BRUSH AERATORS? **LAKESIDE REPLACES ALL BRANDS AND TYPES.**

Lakeside's high-performance Magna Rotor Aerators offer the ideal and cost-effective "drop-in" replacement for less efficient and less reliable designs. Improve oxygen transfer performance and reduce maintenance with our superior Magna Rotor Aerators, designed for years of trouble-free operation. Our uniquely designed, high-performance Magna Rotor Aerators with stainless steel blade stars provide efficient oxygen transfer flexibility while minimizing maintenance. Replacements typically require little or no structural modifications. With more than 60 years of experience in oxidation ditch technology and more than 2,000 installations, we're your go-to source for all horizontal aerator brand replacements and upgrades. When performance counts, count on the industry leader for more than 90 years!

REPRESENTED LOCALLY BY:

THE MAHER CORPORATION
WATER & WASTEWATER PROCESSES, PUMPING & VALVE SYSTEMS

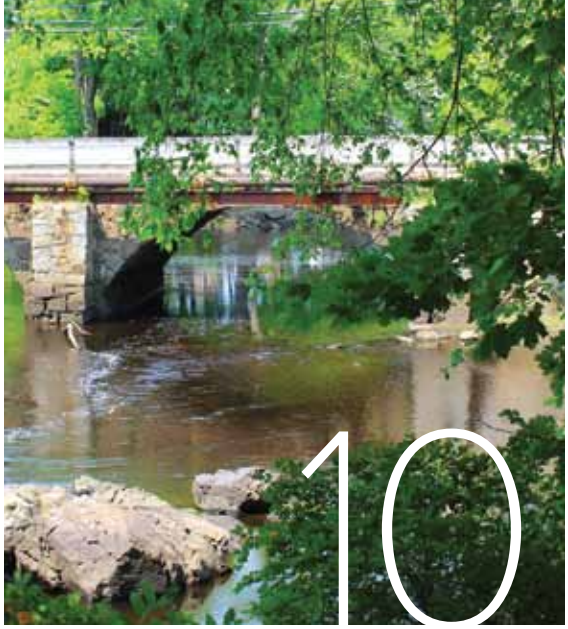
192 Pleasant St. Rockland, MA 02370
T: 800.456.2437 | **F:** 781.878.1219
www.themahercorp.com

LAKESIDE
EQUIPMENT CORPORATION
Water Purification Since 1928

Cleaner Water for a Brighter Future®

Speak to one of our experts at 630.837.5640, email us at sales@lakeside-equipment.com, or visit www.lakeside-equipment.com for more product information.

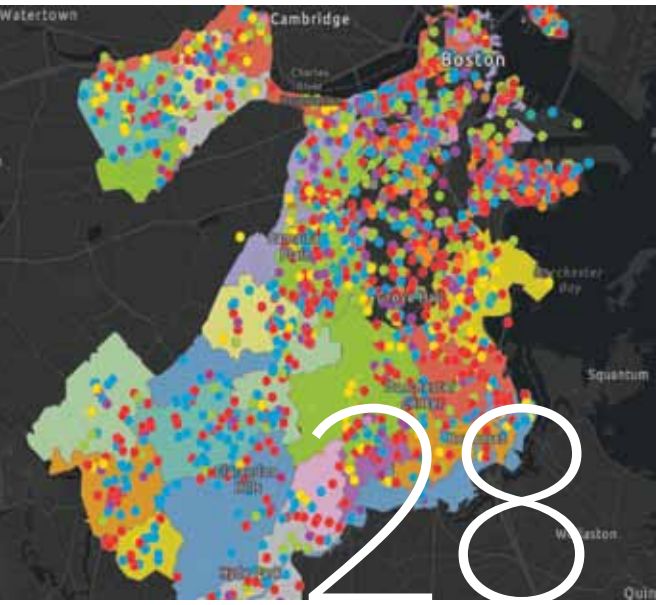
CLR Process Components
- Magna Rotors
- Velocity Control Baffles
- Rotor Covers
- Level Control Weirs
- E.A. Aerotor
- Process Monitoring and Control Systems



JOURNAL OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

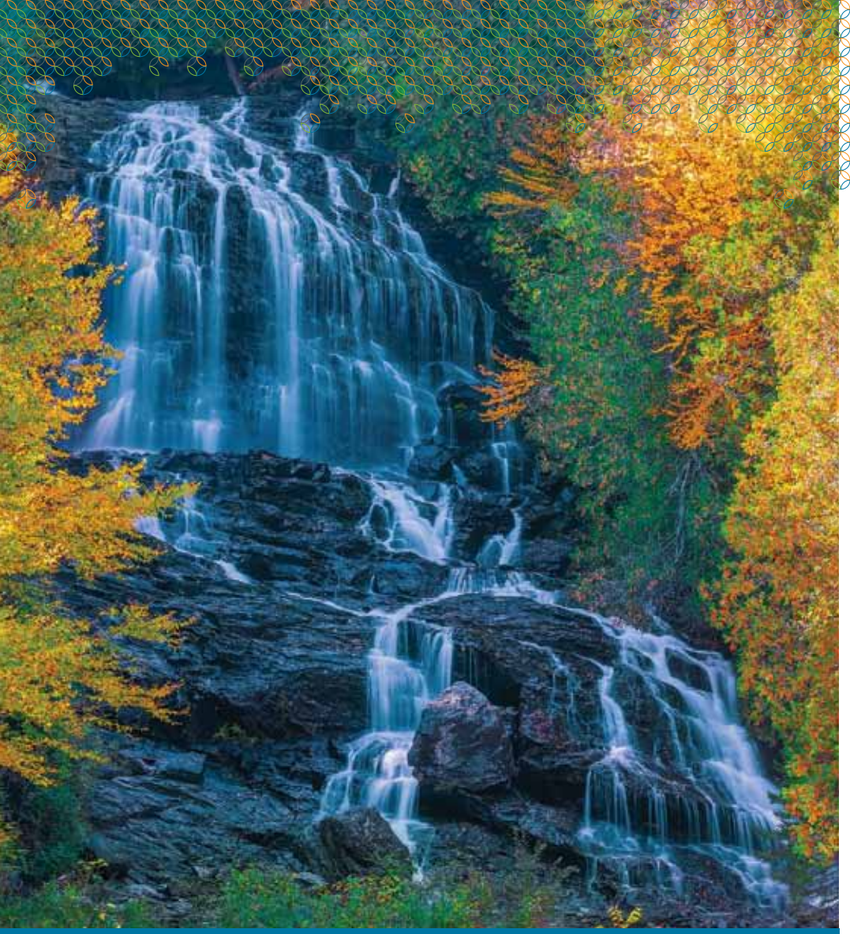
VOLUME 58 NUMBER 3 / ISSN 1077-3002 FALL 2024

Contents



On the cover: Clouds associated with a tropical storm's remnants, and a warm front along the U.S. East Coast. The combination of the two are bringing heavy rainfall from New England to the Appalachian Mountains. Hurricane Katia is seen to the right. *(Satellite image: Rob Gutro—NASA's Goddard Space Flight Center)*

Page 68: Measurement unit conversions and abbreviations



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.

NEWEA Journal ISSN #1077-3002
Published four times annually by New England Water Environment Association, Inc.
This is Volume 58 Number 3
Periodical postage paid at Woburn, MA 01801, and at additional mailing offices

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

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

NEWEA
WORKING FOR WATER QUALITY

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

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

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

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

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

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

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

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

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

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

BECOME A NEWEA MEMBER

- Complete and mail the membership application form on pages 71–72
- Download a membership application from **newea.org** by selecting—*Join Us/Become a NEWEA Member*
- Join online at **wef.org** by selecting—*Become a Member*

2024 RATES ($)

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

Water Environment Federation®
the water quality people®

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

Publication Title	The NEWEA Journal
Publication	#24559
Issue Frequency	Quarterly (four per year)
Annual Subscription Price	$24 (included with membership dues)
Complete Mailing Address, Known Office of Publication, General Business Office, Editors and Owner (non profit organization)	NEWEA, 10 Tower Office Park, Suite 601, Woburn, MA 01801
Contact Person/Managing Editor	Mary Barry, NEWEA Executive Director
Tax Status	No change during the preceding 12 months

Issue date for circulation data below: 09/30/2022

Publication title: The NEWEA Journal	Extent and nature of circulation: Technical/ Educational/ Environmental	Average no. copies each issue during preceding 12 months	No. copies of single issue published nearest to filing date
Total number of copies		1,984	1,935
Legitimate paid and/or requested distribution	Outside country paid/requested mail subscriptions	0	0
	In-country paid/ requested mail subscriptions	1,898	1,870
	Sales through dealers & carriers	5	5
	Requested copies distributed by other mail classes	0	0
Total paid and/or requested circulation		1,903	1,875
Total nonrequested distribution		0	0
Total distribution		1,903	1,875
Copies not distributed		81	60
Total		1,984	1,935
Percent paid and/or requested circulation		100	100

Scott C. Goodinson
Wastewater Superintendent
Town of Narragansett, Rhode Island
sgoodinson@narragasettri.gov

President's Message

Work for Water—we all have a story to tell.

In keeping with my presidential theme, "work for water," it seems fair to share some real-world "water stories," illustrating challenges that come along with the rewards in this field. Although I have a few more years before considering retirement, I sometimes reminisce about the "good (and sometimes not so good) ole" days, and how the personal rewards often make up for the day-to-day struggles.

As I have said before, I strongly feel that as we continue to work in our industry, we somehow become part of something much bigger than ourselves. We become part of a family, a water-family, a big, inclusive, innovative, all-in Water Family, and to me that is very cool!

Just as in every family, there will be good days and bad days. Sometimes a disagreement with a sibling (read co-worker) shadows a day, but we work it out and march on. Some days things may not always go the way you planned, but as we find ways to meet the challenges, things usually seem to work out in the end.

For what most of us do, we need endurance, a good attitude, tolerance, and several other positive attributes. For those who possess these virtues, the occasional ruts in the road seem less daunting at times. As Dori said so many times in Disney's "Finding Nemo," the best solution is often to "Just keep swimming!"

As I am sure is the case with many of you, early in my career there were days when I wished I had stayed in bed. I recall one day, while assisting at the septage receiving area, a tanker truck had issues dumping its entire load of septage wastes, so that the tank's back swing gate had to be opened to discharge the remaining load. The line of other trucks waiting to unload was piling up, so (having once driven a tanker myself) I thought I'd keep things moving and help the driver out. The stuck rear hatch just needed help from my crowbar to open, and—swish—the swinging hatch door just missed my head; however, the product didn't! I was covered head to toe in septage waste. An *ugh-ly* experience, but two things were accomplished: The day for the drivers was saved, as the truck line kept moving; and I learned an important safety lesson or two from the near miss.

I also remember working one Saturday when there was a sump station alarm from a lower area of the plant. A co-worker and I investigated and found that a main overhead influent line had broken; raw sewage was now pouring down onto the pumps and equipment in the lower level, flowing so fast that the sump pumps could not keep up with the flow. As the first responders, we had no time to waste, and needed to stop that flow. To isolate the leak, we had to close a small handwheel on an overhead valve, so my co-worker and I took turns, jumping up on a ladder one small turn at a time, tightly closing our eyes (and mouths!) as the flow streamed down upon us. After about five of the longest minutes of my life, the valve was finally shut and the flow stopped; wet and cold from head to toe, it was time for us to hit the shower. *Ugh-ly* again, but we went home that day knowing we'd saved countless dollars of equipment damage and averted a much more dangerous and complicated disaster. Our joint feeling of accomplishment is something we still share.

A more routine job (requiring one to volunteer and undergo training for) that I recall was "de-slagging" a multiple hearth sludge incinerator. Slag is a deposit of solidified mineral and metallic wastes baked onto the interior of an incinerator chamber. Confined space permitted, with an air/gas meter in place, in a disposable coverall with full face respirator and wrapped in other personal protective equipment, I crawled in and, with my attendant watching, started my de-slagging job. Using pneumatic tools, I chiseled away all that rock-hard slag; pieces broke off the walls and ceiling in chunks, reminiscent of mining for gold in an ultimate confined space! After a 15- or 20-minute stint and feeling hot and exhausted, I took a break, got some water, changed out respirator cartridges, and then jumped back in for another session, and repeated the routine until the incinerator was cleared of slag and ready for use. Just another day at the grind for an operator! A grueling task, but when I completed it, I felt a certain satisfaction at having performed a critical maintenance task that kept the process functioning eficiently.

As clean water professionals, our jobs and daily tasks may vary from time to time and from facility to facility, but all are equally important. Some of us fix things and make repairs all day; some of us work behind a desk monitoring the process; some work in the laboratory analyzing plant samples; others walk the plant several times a day monitoring and operating equipment. There are countless jobs that make up our industry. The clean water family is BIG, with many relations, some young, others more experienced, some with college degrees and rows of letters after their names, some who barely made it through high school, but together we all add value and work well together for our collective success at our mission.

A main overhead influent line had broken; raw sewage was now pouring down onto the pumps and equipment in the lower level, flowing so fast that the sump pumps could not keep up with the flow.

One thing I know to be true concerning our industry: Our passion and commitment to our work is evident; to us, clean water is not just a job, it is a fulfilling calling. We love what we do, we are good at what we do, and we know how to get it done!

I am so proud to be part of this big, all-in, one water family. I ask each of you also to be proud of what you do and to share your own "water stories" with others. This will help us spread the word and encourage others to join us, as we all work on preserving the world's most precious resource: clean water for our communities, for our environment, and for our future.

From the Editor

Wet weather has an entirely new meaning in New England. In late July, nearly eight inches (20 cm) of rain fell in St. Johnsbury, Vermont, in the span of six hours—a 1-in-1,000-year storm event.[1] In August, a slow-moving front accompanied by training storms dumped over 13 in. (33 cm) of rain in 24 hours near Oxford, Connecticut—another 1-in-1,000 year storm event.[2] Could extreme rainfall events such as these be the "new normal" for us? According to recent climate studies, the answer is yes. Since 1958, the number of days with 2+, 3+, 4+, and 5+ inches of precipitation has increased by 49, 62, 84, and 103 percent, respectively, in the Northeast.[3] These intense storms can unfortunately cause catastrophic damage and claim lives; the articles in this edition of the *Journal* highlight some of the work that folks in our industry are undertaking to help our infrastructure adapt to this "new normal."

Jennifer Lawrence, PhD, PE
Environmental Engineer
CDM Smith
lawrenceje@cdmsmith.com

2024 flooding in the Mad River Valley, Vermont

The first article, by Daniel Thompson, details the results of two advanced primary filtration pilots (cloth media filtration and upflow media filtration) at a wastewater treatment plant in Bridgeport, Connecticut. Spoiler alert: The results were promising! When the selected technology is implemented at full-scale, the plant's wet weather capacity will increase by over 100 percent, and the volume of combined sewer overflow (CSO) discharges across the city will be slashed.

The second article, by Rina Dalal, Jordan Goldstein, and Elisabeth Schreiber, provides a concise overview of the threats that climate change pose for wastewater treatment plants in New England, how these threats can impact plant performance, and the role that National Pollutant Discharge Elimination System (NPDES) permits are playing to better prepare plants for these threats.

The third article, by David Peterson and Sadia Khan, takes a longitudinal look at stormwater quality in Boston, and how best management practices and green infrastructure solutions implemented over the past decade have impacted water quality across the city. Monitoring results (including over 800 water quality samples collected from 34 locations in 2020 and 2021!) were used to calibrate and validate the stormwater model. Second spoiler alert of my column: Conditions have improved!

The final article, by Christopher Mackin and Frank Occhipinti highlights the work that Fitchburg, Massachusetts, has done to meet its CSO discharge requirements outlined in its NPDES Permit, including the development of a Wastewater Management Plan and a CSO Long-Term Control Plan. The city has been performing sewer separation and rehabilitation projects to reduce the number of combined sewers since 1999. To date, Fitchburg has invested $82 million in its wastewater collection system and treatment facility. The city anticipates spending an additional $92 million on infrastructure improvements to close all remaining CSOs and fully separate the sewers by 2030.

As always, I hope you enjoy this edition of the *Journal*! And do your best in this ever-changing world to stay dry out there!

1. "Catastrophic flooding forces water rescues in Vermont after 1-in-1,000-year rainfall event." https://www.cnn.com/2024/07/30/weather/vermont-flooding-rain-climate/index.html

2. "Extreme rainfall brings catastrophic flooding to the Northeast in August 2024." https://www.climate.gov/news-features/event-tracker/extreme-rainfall-brings-catastrophic-flooding-northeast-august-2024#:~:text=The%20highest%2024%2Dhour%20rainfall,state%20rainfall%20record%20for%20Connecticut.

3. "The Fifth National Climate Assessment" https://nca2023.global-change.gov/

Industry News

Ipswich River

EPA to fund four educational organizations for environmental projects in New England

In July, EPA announced that four organizations in New England will receive $380,000 to empower youth to tackle environmental challenges, foster community resilience, and advance environmental justice in underserved communities. The four organizations are among 38 across the country to receive $3.6 million in funding under EPA's Environmental Education Grants Program.

"Environmental education isn't just about learning facts and figures; it's about equipping young people with the skills and knowledge to find solutions to real-world problems and make a real difference in their daily lives and communities," said EPA New England Regional Administrator David Cash. "From students in New Haven tackling environmental justice issues and high schoolers in Massachusetts leading climate resilience projects, to Ipswich River Watershed youth participating in a Floating Classroom and students in the Connecticut River Valley finding nature-based solutions through design and engineering—this year's selectees from New England are bringing the environment to life for our kids, and showing them that they have the power to protect and improve the world around them."

This year's environmental education projects in New England are summarized below.

New Haven Ecology Project – $100,000
Growing Environmental Justice Problem-solvers in New England Public Schools
Common Ground High School, an environmental justice-themed charter high school, part of the nonprofit New Haven Ecology Project, will help New England's youth grow into a new, inclusive generation of environmental justice problem-solvers. This will be achieved through a series of linked experiences, starting with interdisciplinary healthy-communities projects in grades 9 and 10, continuing with courses and internships that deepen students' capacity as environmental justice leaders, and culminating in senior leadership portfolios and capstone projects, 225 Common Ground High School students will participate in environmental justice leadership training and learning while engaging in meaningful environmental stewardship. Community-based nonprofit organizations will play a key role in supporting environmental justice learning and leadership experiences. While building and strengthening a model for teaching environmental justice at Common Ground High School, New Haven Ecology Project will also bring together environmental justice organizations and other public high schools across New England, creating and sharing high-quality teaching resources, model curricula, and educator professional development opportunities, all advancing environmental justice teaching in our region's public high schools.

Massachusetts Audubon Society – $100,000
Climate Democracy Project: Culturally Responsive In-school Climate Change Education Toward Local Civic Action and Resilience
The Climate Democracy Project (CDP) intends for high school students from low-income and environmental justice populations in Massachusetts to be empowered to resolve climate-related issues that affect their local environments. CDP will take place in three Title 1 public schools in Worcester, Springfield, and Attleboro, Massachusetts—all three cities designated as Gateway Cities, meaning that each faces persistent economic and social challenges. CDP brings together classroom teachers and non-formal educators to involve students in grades 8–12 in youth-led, non-partisan civic action projects focused on community-based climate resilience. Massachusetts Audubon Society seeks to pilot this programming in three middle or high schools and to collect data and resources to create a toolkit and training program for educators across Massachusetts. CDP will provide place-based, project-based learning focused on climate resilience and civic engagement, to build a statewide foundation for a more environmentally literate citizenry in Massachusetts, who are aware of the issues behind climate change, and experienced in the civic engagement skills to create just and healthy solutions for their communities. This one-year project will serve three teachers, 120 students, and six non-formal educators, and will advance planning toward production of a "ready to implement" program and toolkit for high school teachers to increase climate literacy in schools. The three partner schools are Doherty Memorial High School in Worcester, Springfield Renaissance School, and Attleboro High School.

Ipswich River Watershed Association – $100,000
Breaking Down Barriers to Place-based Education and Environmental Careers in the Ipswich River Watershed
This project will take place in communities that are part of the Ipswich River watershed or that drink Ipswich River water, and in other nearby communities in Essex and Middlesex counties, including Peabody, Salem, Lynn, Lawrence, and Gloucester, Massachusetts. The Climate and Economic Justice Screening Tool has identified these communities as having environmental justice concerns. The project has three audiences and accompanying programs: underprivileged youth participating in summer enrichment programming; seventh-grade classrooms; and underprivileged high schoolers seeking environmental career paths. This project will support the ongoing Floating Classroom program of the Ipswich River Watershed Association, which brings youth to the river for experiential programming and environmental education. It will provide 600 youth and 60 adult chaperones with experiential learning, kayaking and canoeing, and watershed education on the Ipswich River during the summer of 2025. It will also support a place-based watershed study curriculum reaching 200 Ipswich River middle schoolers and at least 20 seventh-grade teachers and paraprofessionals in the 2024–2025 school year. Eight Title 1 middle schools in Salem, Lynn, North Reading, and Andover will be invited to participate in the seventh-grade program along with other interested middle schools. This project will also support six-week internships for two high school youths in the summer of 2025 that explore environmental careers in monitoring, restoration, and education. Internships will be available to a diverse pool of applicants, allowing young people who may experience barriers to participating in internships the opportunity to explore an environmental career.

Hitchcock Center for the Environment – $80,000
Schools Exploring Engineering, Design and Sustainability
The Hitchcock Center will enable youth to develop problem-solving skills related to water quality, air quality, and climate change. Students and their teachers will explore the intersections of engineering, technology, and design, and their critical role in meeting many of the environmental challenges that confront society today. This project will use design and engineering challenges to help students understand the idea of nature-based solutions to address environmental challenges, identify new career pathways, be excited and inspired about science and nature, and stay hopeful about climate change solutions. Students can apply the tools and concepts of systems in their present lives and to inform them of the choices that will affect their future. Over two years the Hitchcock Center will work with Title I schools in four districts representing rural underserved communities in the Connecticut River Valley of western Massachusetts, engaging approximately 16 classrooms and 400 students in the fifth grade. Each class will participate in four design challenges—water filtration, stormwater management, erosion control, and air quality—including a field trip to the Hitchcock Center to see nature-based solutions in action. Sub-awards to participating schools will support student transportation, classroom materials, and student action projects. This project will develop, test, and refine the program model with these schools, facilitating sustainable future learning.

EPA awards over $1 million to support water quality monitoring at New England beaches

In June, EPA announced $9.75 million in grant funding to help coastal and Great Lakes communities protect the health of beachgoers. The funding will assist many states, Tribes, and territories with water quality monitoring and public notification programs for their beaches, including five New England states in which the following organizations will receive grants: the Connecticut Department of Public Health, $206,000; the Maine Department of Environmental Protection, $254,000; the Massachusetts Department of Public Health, $254,000; the New Hampshire Department of Environmental Services, $194,000; and the Rhode Island Department of Health, $210,000. The funding will support water quality monitoring and public notification programs for beaches.

"These grants will advance environmental justice in communities vulnerable to and overburdened by water quality impacts by supporting critical monitoring and notification programs," EPA's Cash remarked. "With the Beaches Environmental Assessment and Coastal Health (BEACH) Act funding, New England residents can have the peace of mind that our water quality at beaches is being monitored and protected, and we are all working together to make this summer the best it can be and focus on splashing in the waves and soaking up the sun…with sunscreen, of course."

Under the BEACH Act, EPA awards grants to eligible state, Tribal, and territorial applicants to help them and their local government partners monitor water quality at coastal and Great Lakes beaches. When bacteria levels are too high for safe swimming, these agencies notify the public by posting beach advisories or closings.

Three factors influenced EPA's allocations for the 2024 grant amounts: length of the beach season, number of miles of shoreline, and populations of coastal counties.

To be eligible for BEACH Act grants, states, Tribes, and territories must have coastal and Great Lakes recreational waters adjacent to beaches or similar points of access used by the public. They must also have a water quality standards program and EPA-approved numeric recreational water quality standards for coastal waters. Additionally, eligible entities must meet 11 performance criteria for implementing monitoring, assessment, and notification components of the beach program.

Note: All EPA industry news provided by EPA Press Office

Climate Change Indicators report updated

In July, EPA released the fifth edition of "Climate Change Indicators in the United States." The report highlights new data showing the continuing and far-reaching impacts of climate change on the people and environment of the United States. New to the report this year are an indicator on marine heat waves (showing trends related to multi-day high ocean temperatures) and a feature on heat-related workplace deaths.

"EPA's Climate Change Indicators report is an authoritative resource of how the climate crisis is affecting every American right now and with increasing intensity," said EPA Administrator Michael Regan. "Extreme heat, flooding, and wildfires have become more common, harming human health, threatening livelihoods, and causing costly damage. Regular updates to the data in the Climate Indicators website and report help us track these unprecedented changes so we are better informed in our shared work to confront the crisis."

The fifth edition highlights a subset of EPA's 57 indicators, which include historical data and observed trends related to either the causes or effects of climate change. The report explores the interconnected nature of observed changes in climate with chapters thematically organized around greenhouse gases, heat on the rise, extreme events, water resources at risk, changing seasons, ocean impacts, rising seas, and Alaska's warming climate. Since publishing the first edition in 2010, EPA has maintained an up-to-date online resource of climate change indicators and regularly released updated publications that present the latest data.

EPA partners with more than 50 data contributors from various U.S. and international government agencies, academic institutions, and other organizations to compile these key indicators. The indicators show compelling evidence that climate change is increasingly affecting people's health, society, and ecosystems in numerous ways, for example:

- **Global and U.S. Temperature**. Worldwide, 2023 was the warmest year on record, 2016 was the second warmest, and 2014–2023 was the warmest decade on record since thermometer-based observations began. In the United States, unusually hot summer days have become more common over the last few decades, and unusually hot summer nights have increased at an even faster rate, indicating less "cooling off" at night.
- **Heat Waves in U.S. Cities**. Heat waves are occurring more often in major cities across the United States. Their frequency has steadily increased, from an average of two heat waves per year during the 1960s, to six per year during the 2010s and 2020s. The average length of the heat wave season across U.S. cities is 46 days longer now than it was in the 1960s and, in recent years, the average heat wave in major U.S. urban areas has lasted about four days.
- **A Closer Look—Heat-Related Workplace Deaths**. From 1992 to 2022, 986 workers across all industry sectors in the United States died from exposure to heat, with the construction sector accounting for about 34 percent of all occupational heat-related deaths. During this time, 334 construction workers died due to heat exposure on the job.
- **Sea Surface Temperature**. Over the past century, sea surface temperature has increased and continues to rise. Sea surface temperature has been consistently higher during the past three decades than at any other time since reliable observations began in 1880.
- **Marine Heat Waves.** Between 1982 and 2023, the annual cumulative intensity of marine heat waves has increased in most coastal U.S. waters, with the largest changes in waters off the northeastern United States and Alaskan coasts. When a location sees an increase in annual cumulative intensity over time, it means marine heat waves are either more common, longer, or more intense (hotter), or a combination of the three.
- **Marine Species Distribution**. Along with warming ocean waters, many marine species off U.S. coasts are shifting northward and moving to deeper waters. Since the 1980s, shifts have occurred among several economically important fish and shellfish species. For example, American lobster, black sea bass, and red hake in the Northeast have moved northward an average of 145 mi (230 km).
- **Coastal Flooding**. Tidal flooding is more frequent along the U.S. coastline. Most sites with long-term data have seen an increase in tidal flooding since the 1950s. At most of these sites, floods are now at least 5 times more common than they were in the 1950s. The rate of increase of flood events per year is largest at most locations in Hawaii, and along the East and Gulf coasts.
- **Wildfires**. The extent of area burned by wildfires in the United States has increased since the 1980s, with the largest occurring in the West and Southwest. Of the 10 years with the largest acreage burned, all have occurred since 2004, including peak years in 2015 and 2020. This period coincides with many of the warmest years on record nationwide.
- **Length of the Growing Season**. The average length of the growing season in the contiguous 48 states has increased by more than two weeks since the beginning of the 20th century. A large and steady increase has occurred since the 1970s. States in the West (e.g., Washington and California) have seen the most dramatic increase.
- **Snowpack**. From 1982 to 2023, the snowpack season became shorter at 80 percent of the sites measured. Across all sites, the length of the snowpack season decreased by an average of 15 days, and peak snowpack has shifted earlier by an average of seven days since 1982.
- **Arctic Sea Ice**. The September 2023 sea ice extent was the fifth smallest on record. It was about 789,000 mi^2 (2,000,000 km^2) less than the historical 1981–2010 average for that month—a difference in area almost 3 times the size of Texas. Since 1979, the length of the melt season for Arctic sea ice has grown by 37 days. On average, Arctic sea ice now starts melting seven days earlier and starts refreezing 30 days later than it has historically.

The fifth edition of the "Climate Change Indicators in the United States" as well as more information about climate change indicators can be downloaded at epa.gov.

Contribute to the *Journal*

NEWEA encourages all to submit a paper for publication in the *Journal*

Upcomming *Journal* theme and submission deadline:

Spring 2025
Collection Systems
Articles due
January 1, 2025

For more information visit newea.org/resources/journal-2/

Advanced primary filtration piloting in Bridgeport, Connecticut

DANIEL S. THOMPSON, PE, CDM Smith, East Hartford, Connecticut

ABSTRACT | Two primary filtration technologies were evaluated in a side-by-side pilot study at the Water Pollution Control Authority, City of Bridgeport, Connecticut's West Side Wastewater Treatment Plant (WWTP). Cloth media filtration (CMF) and upflow media filtration (UMF) were evaluated based on various influent and effluent parameters including total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand, ammonia nitrogen, total Kjeldahl nitrogen, total phosphorus, turbidity, and ultraviolet transmittance. Collimated beam testing and bacteria counts were also completed to determine whether the pilot primary effluent would be suitable for ultraviolet (UV) disinfection. Both CMF and UMF achieved high TSS removal and BOD removal during piloting. UV collimated beam testing results of the pilot primary filter effluent revealed complications meeting the WWTP's bacteria permit limits at reasonable UV doses for both technologies.

KEYWORDS | Advanced primary treatment, primary filtration, cloth filtration, UV disinfection, wet weather disinfection, footprint reduction, nutrient removal

The Water Pollution Control Authority (WPCA) City of Bridgeport, Connecticut, is upgrading its West Side Wastewater Treatment Plant (WWTP). The West Side WWTP was last upgraded in the 1990s. The WWTP is aging, and much of the infrastructure has far surpassed its useful life. In 2020 the WPCA completed a Wastewater Facilities Plan, which recommended increasing the wet weather peak flow capacity of the West Side WWTP from 90 mgd (340 ML/d) to 200 mgd (757 ML/d). This increase would provide primary treatment and disinfection to the wet weather flows that reach the WWTP and reduce overall untreated combined sewer overflow volumes upstream in the collection system.

Owing to the constrained footprint of the site, new traditional primary settling tanks to handle the increase in design peak flow were not feasible. Chemically enhanced primary treatment, while reducing footprint requirements, was still too expansive for the site. Instead, advanced dual-use primary filtration technologies were investigated and ultimately recommended for full-scale implementation in final design. Primary filtration offers space savings over traditional primary settling tanks and reduces the load on the downstream biological treatment system and disinfection because of superior solids removal efficency. Figure 1 shows the existing site plan.

As part of the evaluation and selection of a space saving primary treatment, an on-site side-by-side pilot study of primary filtration technologies took place from March to May 2023. The WPCA identified cloth media filtration (CMF) and upflow media filtration (UMF) as two promising technologies for full-scale implementation. The CMF system consists of pile cloth media filter disks, and the UMF system consists of a layer of cross-shaped expanded polypropylene media.

METHODOLOGY

CMF System

The cloth media filter features a disk configuration and an outside-in flow path which allows for three zones of solids removal. The top zone is the "floatable zone" where surface materials such as fats, oils, and grease (FOG) collect on the water surface. The middle zone is the "filtration zone" where solids are removed through filtration. Here, solids deposit on the outside of the cloth media forming a mat as filtrate flows through the media. The bottom or "solids zone" permits heavier solids to settle to the bottom of the tank for intermittent removal.

The CMF pilot trailer unit (Photo 1) has a single cloth filter, which operates completely submerged. Raw primary flow is pumped into the pilot trailer tank where it is filtered by the cloth media and discharged into an effluent center tube. The pilot unit has four modes of operation—filtration, backwash (BW), floatable waste (FW) removal, and settled solids waste (SSW) removal from the bottom of the tank. During a BW cycle, flow through the filter disk is reversed, and a vacuum shoe pulls the effluent water from the center tube through the filter cloth to remove any accumulated solids. Filtration in the disk filter is uninterrupted during BW, FW, and SSW modes. The BW is triggered when the float switch indicates that the level is above a pre-established setpoint. SSW and FW are triggered by either the number of BW cycles or time.

At the WWTP, all functions were automated by the local programmable logic control (PLC) and could be further optimized by the operations team. This equipment and control arrangement mimics full-scale systems.

Figure 1. WWTP site

Photo 1. Cloth media pilot unit

UMF System

In the upflow media technology filters, screened raw influent passes upward through a compacted layer of expanded polypropylene (EPP) beads. The cross-shape of the EPP beads captures solids as they pass through the media layer by trapping particulates in the voids between the beads while allowing clean water to pass through. As filtered water leaves the system, a fixed volume of clean effluent is stored above the media strainer for occasional backwashing. After a large quantity of solids have built up, the system backwashes by gravity, allowing the stored effluent to flow back down through the strainer, unpacking the media and carrying away aggregated solids.

In the UMF pilot system (Photo 2), screened raw water influent passes through a 24 in. diameter by 15 ft tall (60 cm by 4.57 m) column that contains the EPP beads. The cross-shape of the EPP beads captures solids while allowing clean water to pass through. As filtered water leaves the system, a fixed volume of clean effluent is stored for backwashing, which is triggered by a pressure differential or by a preset timed BW. This equipment mimics the full-size installation.

Photo 2. Upflow media pilot unit

Pilot Study

During the side-by-side pilot study, screened raw primary influent flow from the West Side WWTP was pumped

Table 1: Pilot hydraulic loading rates

Trial	Full-scale Equivalent Flow mgd, (ML/d)	Hydraulic Loading Rate gpm/ft^2, (LPM/m^2)	
		CMF Pilot	UMF Pilot
1	15 (57)	0.9 (37)	1.1 (45)
2	40 (151)	2.0 (82)	3.5 (143)
3	90 (340)	3.5 (143)	7.1 (290)
4	120 (454)	4.0 (163)	9.0 (367)
5	200 (757)	5.5 (224)	14.8 (604)

from the primary clarifier influent channel for use as the influent to the pilot units. The combined influent flow to these two pilot units was about 100 gpm (6.3 L/s) at the highest loading rates. Both pilot units were provided with identical influent flow throughout the study. The treatment performance of both technologies was evaluated based on various influent and effluent parameters including total suspended solids (TSS), biochemical oxygen demand (BOD), chemcial oxygend demand, ammonia nitrogen, total Kjeldahl nitrogen, total phosphorous, turbidity, and ultraviolet transmittance (UVT). Collimated beam testing and bacteria counts were also completed to determine whether the pilot effluent would be suitable for ultraviolet (UV) disinfection. Operational parameters were also monitored throughout the study, including BW frequencies, BW volumes, and BW solids settleability, along with FOG and solids generation.

Both pilot units were tested under a range of flows and loads, representative of anticipated full-scale operating conditions. These daily trials corresponded to the expected minimum, average, and maximum month, maximum day, and peak hour flows of the upgraded West Side WWTP. The hydraulic loading rates for each pilot unit are presented in Table 1.

In addition to simulating wet weather hydraulic loading rates by increasing the flow rates to the pilot units, two significant wet weather events were captured during piloting. For some trials additional solids were also spiked into the system to artificially increase the solids loading to the filters and mimic a "first flush" condition. These solids were introduced from WWTP primary sludge pumps with the goal to meet spike conditions of up to 500 mg/L TSS.

Table 2. Influent and effluent TSS, ambient conditions (mg/L)

Trial	Common Influent	CMF Effluent	UMF Effluent
1	174.4 (32.8 – 203.8) [10]	25.6 (2.2 – 64) [10]	34.8 (26 – 61.2) [10]
2	153.1 (84.4 – 220) [4]	24.7 (12.4 – 34) [4]	41.1 (25 – 61.2) [4]
3	155.45 (99.4 – 320) [6]	28.5 (25 – 47.2) [6]	49.5 (41.2 – 77) [6]
4	135 (82.2 – 155.4) [6]	31.6 (18.6 – 39.4) [6]	55 (44 – 73.8) [6]
5	120 (98 – 147.4) [8]	26.6 (21 – 33.2) [8]	43 (17 – 54.6) [8]

Table 3. Influent and effluent BOD, ambient conditions (mg/L)

Trial	Common Influent	CMF Effluent	UMF Effluent
1	120 (28 – 180) [5]	49 (28 – 98) [5]	75 (32 – 110) [5]
2	100 – 150 [2]	36 – 52 [2]	33 – 76 [2]
3	160 (100 – 200) [3]	57 (39 – 63) [3]	60 (41 – 66) [3]
4	110 (89 – 140) [4]	47 (26 – 56) [4]	61 (56 – 70) [4]
5	130 (88 – 150) [3]	39 (23 – 42) [3]	47 (43 – 73) [3]

RESULTS

TSS and BOD Removal

The two piloted primary filtration technologies both met expectations for TSS and BOD removal. During ambient conditions across all flow conditions, CMF averaged 81 percent TSS removal and UMF averaged 71 percent removal. Ambient conditions were defined as incoming screened primary flow without the addition of spiked solids. For BOD removal during ambient conditions, CMF averaged 64 percent removal and UMF averaged 53 percent removal.

Tables 2 and 3 display the pilot data for the influent and effluent composite samples for both TSS and BOD under ambient conditions. The influent and effluent data are reported in this format: *Median value (range from minimum value to maximum value) [Number of values].*

Figures 2 and 3 graphically depict the raw influent and pilot effluent conditions.

Generally, over the range of loading rates tested, CMF TSS removal effectiveness remained consistent between the lowest and highest rates, while UMF saw a decline in TSS removal from the highest to lowest loading rate of about 15 percent. Loading rate had little to no impact on BOD removal effectiveness for either pilot system.

Backwash and Solids Waste Production

For both pilot systems, as hydraulic and solids loading rate increased, the BW frequency and BW volumes increased. The pilot study defined a hydraulic efficiency parameter to measure the impact of BW and solid waste volumes on the overall process efficiency using the following formula:

$$\text{Hydraulic Efficiency} = \frac{\text{Total Effluent Production} - \text{Total Waste Flow}}{\text{Total Effluent Production}}$$

Throughout the pilot, for the CMF system it was observed that an increase in loading rate had little impact on the hydraulic efficiency. Efficiency for the CMF system ranged from 70 percent to nearly 100 percent, with most trials greater than 90 percent. For the UMF system, an increase in loading rate generally led to a decrease in efficiency. Efficiency for the UMF system ranged from 68 to 85 percent. This difference between the two systems was partially attributed to a difference in system operation. CMF continues to filter influent during a BW cycle, while UMF ceases filtration during a BW cycle.

The BW from both CMF and UMF was observed to be much thinner than primary sludge from traditional primary settling tanks. CMF BW averaged about 1,400 mg/L (0.14 percent solids) TSS during ambient conditions, while UMF BW averaged about 700 mg/L (0.07 percent solids).

Disinfection Effectiveness

The facilities plan recommended dual-use advanced primary filtration, with primary effluent flows beyond the secondary capacity of the plant (58 mgd [220 ML/d]) being blended with the secondary effluent and receiving UV disinfection prior to discharge. Given the increased capacity of the plant, the ratio of primary effluent to secondary effluent could be nearly 2.5:1. The current ratio of primary effluent to secondary effluent is approximately 0.55:1. Collimated beam testing was completed about three times per week throughout the study to determine UV disinfection effectiveness on the two pilots' effluent. Early in the pilot study it became obvious that UV alone would not adequately disinfect the primary filter effluent.

The initial collimated beam testing illustrated that it would not be possible to meet the enterococci inactivation required by the disinfection permit limits for the West Side WWTP. Figure 4 shows the collimated beam enterococci results for CMF compared to the West Side WWTP's instantaneous Most Probable Number (MPN) enterococci limit (solid red line, 500 MPN/100mL) and the monthly geomean (dashed red line, 35 MPN/100mL). Even at higher UV doses the enterococci could not be inactivated to the levels required by the existing WWTP permit. The UMF effluent achieved similar results.

Following the initial collimated beam testing of the raw effluent, secondary effluent from the WWTP was "blended" with the primary filter pilot effluent to match a real-world condition, to determine if UV could effectively disinfect the combined WWTP effluent. In this scenario, treated secondary effluent would blend with the primary filter effluent prior to UV disinfection. To investigate this more realistic condition, a 40 percent primary effluent and 60 percent secondary effluent blend was established to represent the projected maximum day flow condition, and a 70 percent primary effluent and 30 percent secondary effluent blend was established to represent the design peak hour flow condition. Figure 5 depicts the enterococci results of the collimated beam testing for CMF

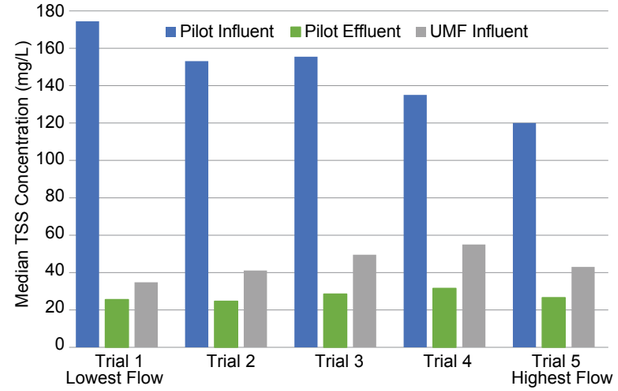


Figure 2. Influent and effluent TSS, ambient conditions

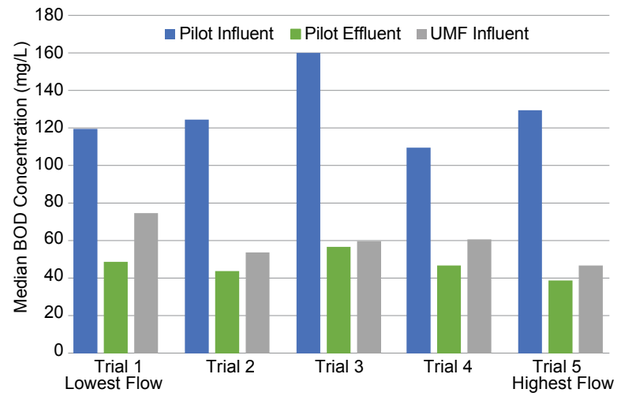


Figure 3. Influent and effluent BOD, ambient conditions

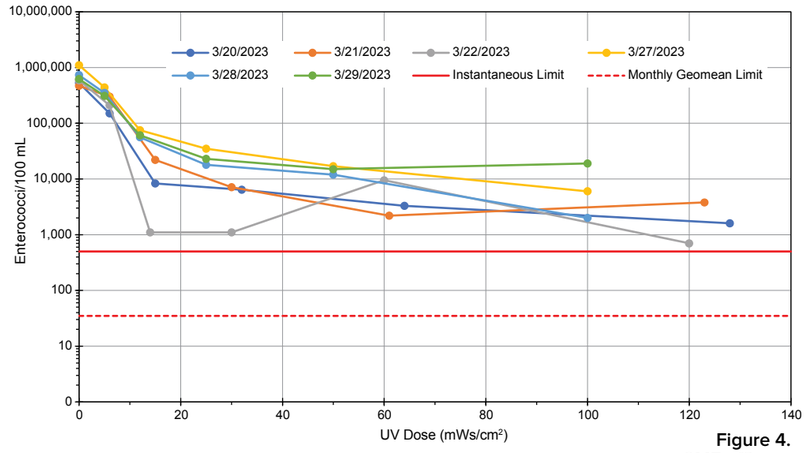


Figure 4. CMF effluent collimated beam testing, primary effluent

primary filter effluent blended with West Side WWTP secondary effluent. Overall, the blended samples had more inactivation, but only a few composite samples reached the instantaneous permit limit at high UV doses. Again, UMF effluent achieved similar results.

It was determined that UV disinfection could not reliably inactivate enterococci in the primary filter effluent, likely due to the particle size in the effluent shielding some bacteria from the UV light. This key finding was not anticipated prior to pilot testing.

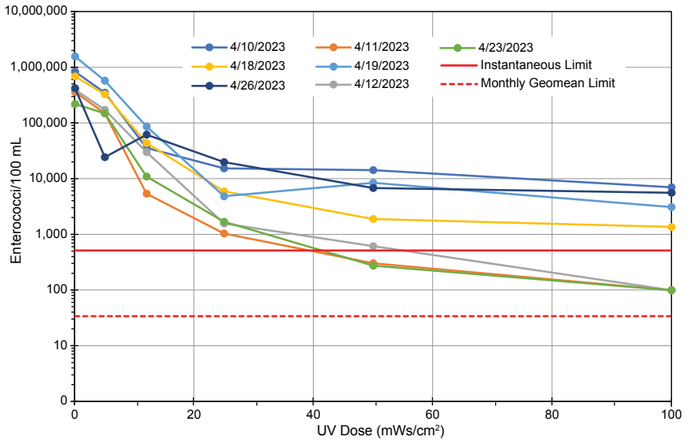


Figure 5. CMF effluent collimated beam testing, primary effluent blended with WWTP secondary effluent

Following the initial piloting period and finding, the WPCA completed hypochlorite dose:response testing on CMF effluent. Effluent from the full-size pilot trailer, as well as from a bench-scale test unit, was collected at loading rates equivalent to the peak flow (aforementioned Trial 5 conditions). This effluent was shipped to an analytical laboratory that completed dose:response testing studies for hypochlorite disinfection effectiveness at chlorine doses of 6, 15, and 50 mg/L. As shown in Figure 6, by 15 minutes of contact with the hypochlorite, all samples reached the West Side WWTP's instantaneous enterococci permit limit.

DISCUSSION AND CONCLUSION

The primary filtration pilot study at the West Side WWTP in Bridgeport demonstrated the potential of two advanced primary filtration technologies. CMF and UMF both performed as anticipated with TSS and BOD removals greater than from traditional primary treatment tanks, with a much smaller footprint and a potential energy savings from a reduced secondary system load.

While these technologies provide cleaner effluent than traditional primary settling tanks do, the primary effluent from both technologies did not meet WWTP disinfection limits when tested via collimated beam testing for UV disinfection. Advanced primary treatment technologies are promising for many facilities, but downstream impacts and specific facility disinfection requirements should be considered before implementation.

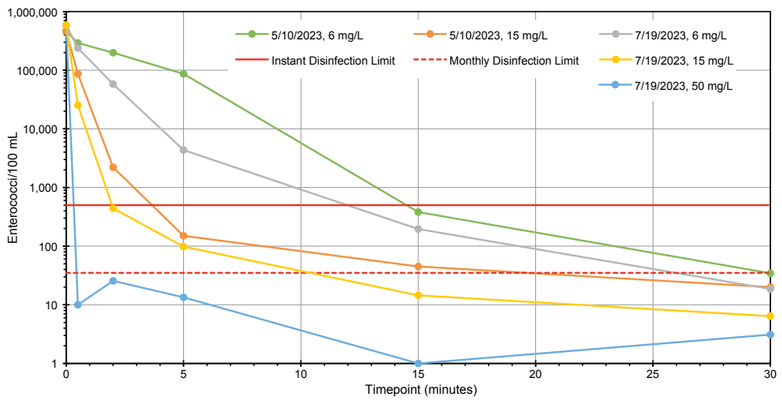


Figure 6. Hypochlorite dose testing of CMF effluent

ACKNOWLEDGMENTS

The author acknowledges and thanks the various parties who made this pilot study possible, including the WPCA, City of Bridgeport, Aqua-Aerobic Systems Inc., Tomorrow Water, and Blueleaf Inc.

ABOUT THE AUTHOR

Daniel Thompson is a project technical leader and environmental engineer with nine years of experience in wastewater conveyance and treatment at CDM Smith in East Hartford, Connecticut. He earned a Bachelor of Science in Environmental Engineering from the University of Connecticut and a Master of Science in Environmental Engineering from the University of New Haven.

NPDES permits as an opportunity for climate change adaptation planning

RINA DALAL, PE, CDM Smith, Edison, New Jersey
JORDAN GOLDSTEIN, CDM Smith, New York, New York
ELISABETH SCHREIBER, EI, CDM Smith, New York, New York

ABSTRACT | Climate change poses significant threats to wastewater treatment plant (WWTP) infrastructure and operations. The threats of climate change in New England include increased rainfall and sea level rise. In some WWTP National Pollutant Discharge Elimination System (NPDES) permits drafted since March 2023, EPA Region 1 has incorporated mandatory requirements for the development of climate adaptation plans (CAPs). CAPs can help WWTPs prepare for changing conditions and enhance the plant's resilience in the face of climate change. An effective CAP contains several steps: understanding regional climate change projections, assessing the vulnerability of critical infrastructure at the WWTP, determining if the vulnerable infrastructure is at risk if a climate change hazard occurs, and developing strategies to enhance resilience. Although these EPA CAP requirements apply only to New England states unauthorized to issue their own permits (Massachusetts and New Hampshire), other states, including New York and New Jersey, are incorporating CAPs into other regulatory frameworks.

KEYWORDS | NPDES Permits, Climate Adaptation Plans, EPA Region 1, climate change, infrastructure vulnerability

Wastewater treatment plants (WWTPs) are indispensable. Climate change poses a threat to wastewater infrastructure's functionality by altering the climatic conditions from those that a WWTP's equipment was designed to withstand. Wastewater systems that do not incorporate projected climate change risks into their planning can pose public health threats, incur expensive repair and maintenance, have long-term financial impacts (EPA, 2024a), and fail altogether.

The increased frequency and intensity of precipitation events and sea level rise (SLR), including the resulting storm surges, pose threats to New England's wastewater infrastructure in varying capacities (EPA, 2017). The climate adaptation plan (CAP), now required within EPA Region 1 National Pollutant Discharge Elimination System (NPDES) permit issuances and renewals, focuses on flooding-related hazards for WWTPs. Preparing a CAP presents an opportunity for WWTPs to prepare for these new and changing climatic conditions by identifying potential risks and measures that improve their infrastructure's resiliency. A typical CAP has four steps (Figure 1).

Adaptation strategies vary in cost and complexity. Strategies include creating emergency response plans, elevating existing infrastructure, and expanding stormwater storage basin capacity (EPA, 2014). The strategies are not limited to addressing only the most severe climatic events (e.g., mega storms). A CAP applies to any scale of climate change-induced event that threatens a WWTP and renders it vulnerable. Table 1 defines key terms in climate change planning.

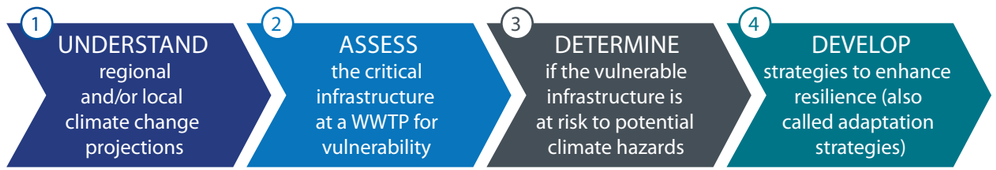


Figure 1. A typical CAP has four steps

New England's policy toward climate change planning is taking shape under the NPDES program. Under NPDES, the EPA issues discharge permits that regulate the volume of effluent that a WWTP can discharge as well as the concentration of specific harmful biological and chemical compounds present in the effluent. WWTPs that are non-compliant can be fined and, in certain cases, have their permits revoked. EPA Region 1 recently promulgated a new NPDES permitting criterion that requires both newly constructed and existing WWTPs to include a CAP in their permit applications. In Region 1, EPA can issue NPDES permits in Massachusetts and New Hampshire, making these two states the first to have mandatory development of CAPs as a part of regulation from a national agency.

Term	Definition
Climate change hazards	The changing climatic conditions due to the increase of greenhouse gas emissions in the atmosphere. In New England, these include extreme precipitation events and sea level rise (and resulting storm surge).
Vulnerability	The degree to which WWTP assets are impacted by a climate change hazard, including the ability to recover from such an event.
Risk	A quantification of the likelihood of a climate change hazard occurring and the consequence of such an event.
Adaptation strategy	Actions that reduce the risk of climate change hazards improve the infrastructure and utility's resilience.

Table 1. Key terms in climate change planning

CLIMATE CHANGE HAZARDS IN NEW ENGLAND AND IMPACTS TO WWTPs

The two primary climate change hazards expected to affect WWTPs in New England are extreme precipitation events and SLR. Table 2 summarizes examples of how these hazards may affect WWTP infrastructure.

DESCRIPTION OF WORK AND METHODOLOGY APPLIED

A systematic review of scientific and regulatory literature identified four primary categories of relevant information to demonstrate that developing a CAP, whether state-required or voluntary, presents an opportunity for utilities. It included literature that evaluated climate change impacts to WWTPs, described the regulatory environment under the new NPDES program requirements in EPA Region 1, described other state-required CAP frameworks comparable to the framework developed by EPA Region 1's NPDES requirements, examined the economic impacts to WWTPs affected by climate change disasters, and further evaluated the mitigation of potential loss by implementing a CAP.

RESULTS

Resources to determine climate change hazards in New England

Understanding the regional projected climate change hazards over a future period (e.g., 2024 to 2100) is critical to knowing the projected impacts to WWTPs. Future climate change hazards are based on general circulation models (GCMs) used to project climate conditions. GCMs are complex numerical models representing physical processes in the atmosphere, ocean, cryosphere, and land surface. They are the most advanced tools available for simulating the response of the global climate system to environmental changes such as increasing greenhouse gas concentrations (Intergovernmental Panel on Climate Change, 2024). The climate projections from GCMs can subsequently be used to understand changes in the future climatic conditions for a given location

Climate change hazard	Impacts to wastewater treatment plant infrastructure
Extreme precipitation events	• Increased volume of wastewater requiring treatment resulting in higher energy consumption and costs for the WWTP • Alteration (major dilution) of the levels of pollutants and organic loads in wastewater, which affects the efficiency of biological treatment in WWTP • Increased rainfall can overwhelm a WWTP's capacity to process the extreme volumes of water entering the WWTP, leading to the discharge of untreated or insufficiently treated wastewater into surrounding environments
Sea level rise (and resulting storm surge)	• SLR poses a signicant threat to WWTPs through increased flooding and inundation • When coupled with intense rainfall and storm surges resulting from severe storms, WWTPs may become completely inundated, which can cause WWTP service interruptions • SLR increases the salinity of influent wastewater in WWTPs adjacent to the ocean, which can result in poor treatment performance, and the discharge of potentially harmful wastewater

Table 2. How climate change hazards may affect WWTP infrastructure in New England (Li et al., 2023)

(e.g., changes in precipitation patterns, seasonal temperatures, and magnitude of SLR).

GCMs can be used to downscale the climate change hazards for a particular location to inform on-the-ground projects. They are also the basis of readily available reports and tools that are the backbone of a CAP. Most New England states have summarized climate change impacts into public facing reports. Table 3 provides a sample of reports by state.

Climate Adaptation Plan Components for NPDES Permits in EPA Region 1

Regarding the new EPA Region 1 NPDES requirements, CAPs must include a vulnerability assessment, an asset vulnerability evaluation, and an alternatives assessment for mitigation strategies (EPA, 2024b) for the threat of current and future flooding at a WWTP. The new NPDES requirements are referred to in the permits as the "Wastewater Treatment Facility Major Storm and Flood Events Plan" and the "Sewer System Major Storm and Flood Events Plan." Under the plans, permittees must develop and submit adaptation plans for their WWTPs and begin implementing them within 12 months of the effective permit date.

In 2024, EPA issued a guidance and recommendation document to accompany permitting requirements: "EPA Region 1 Recommended Procedures and Resources for the Development of Adaptation Plans for Wastewater Treatment Systems and/or Sewer Systems." This document was released to help guide WWTPs in complying with the requirement that a CAP be included in NPDES permits (EPA, 2024b). Since this requirement went into effect, NPDES permits issued by EPA Region 1 have these adaptation plans included in the Operations and Maintenance section of the permit. The adaptation plans are organized into three components:

- **Component 1: Identification of Vulnerable Critical Assets**. By the end of the second year after the permit is granted, the WWTP must identify assets most vulnerable to "baseline conditions" (referring to the 100-year flood based on historical records) and "future" storm events. Permittees must assess the ability of each asset to function during a flood.
- **Component 2: Adaptive Measures Assessment**. By the end of the third year, the WWTP must develop an evaluation of adaptation measures for the WWTP that is to be provided to EPA upon request.
- **Component 3: Implementation and Maintenance Schedule**. By the end of the fourth year, a proposed plan and schedule to implement and monitor adaptation measures must be submitted to EPA.

According to the permit requirements, utilities can use a CAP performed within five years before the permit date (including those underway) and do not need to create a new CAP. Permittees must submit an adaptation plan progress report to EPA in the calendar year following the submission of the adaptation plan and also upon its completion, as well as noting if there are any changes to the WWTP or its assets that would affect the risk assessment (EPA, 2024b).

Climate Adaptation Plan Requirements in Other States

Although the new EPA Region 1 NPDES permit requirements apply only to New Hampshire and Massachusetts, other states are developing a CAP for WWTPs. These states are using various strategies to guide utilities with climate change considerations in planning and design. New York and New Jersey are examples of states that are not regulated under NPDES requirements but have their own regulatory frameworks or statewide guidance to address a CAP. Rhode Island and California are also encouraging climate change considerations into infrastructure planning, though it is not yet required by state law (as of this *Journal* issue's publication).

Table 3. A sample of resources by New England state to determine climate change hazards and climate risks

State	Author	Website(s)
Connecticut	Connecticut Institute for Resilience & Climate Adaptation	circa.uconn.edu/
Maine	Maine Won't Wait	www.maine.gov/climateplan/
Massachusetts	ResilientMass (including the Climate and Hazards Viewer)	resilient.mass.gov/home.html resilientma-mapcenter-mass-eoeea.hub.arcgis.com/
New Hampshire	NH DES climate change website	www.des.nh.gov/climate-and-sustainability/climate-change
Rhode Island	Climate Change Rhode Island	climatechange.ri.gov/climate-science
Vermont	Agency of Natural Resources, Climate Action Office	climatechange.vermont.gov/vermont-today
Northeast	Fourth National Climate Assessment, Chapter 18: Northeast	nca2018.globalchange.gov/chapter/18/

New York

New York's Community Risk and Resilience Act (CRRA) requires permit applicants for certain state-funded programs (e.g. state revolving funds) to consider three main climate risks (flooding, SLR, and storm surge) in their project design (CRRA, 2019). This act was amended in 2019 by the Climate Leadership and Community Protection Act (Climate Act). Under the amendment, applicants for permits issued under the Uniform Procedures Act must submit documentation that demonstrates the consideration of future physical climate risks, including flooding, SLR, and storm surge in their permit applications. This includes the State Pollutant Discharge Elimination System (SPDES) permit applications for "major projects" (CRRA, 2019).

New Jersey

In April 2023, New Jersey Department of Environmental Protection (NJDEP) published the "Climate Change Resilience Guidance for New Jersey's Clean Water and Drinking Water State Revolving Funds." This requires applicants seeking funding under the New Jersey Water Bank (NJWB) to develop a resilience assessment that demonstrates consideration of potential climate impacts and long-term resilience goals in their application. NJWB is a partnership between the NJDEP and the New Jersey Infrastructure Bank to provide low-cost financing for the design, construction, and implementation of water quality infrastructure projects. The requirements include evaluating project alternatives that account for potential impacts from extreme precipitation, flooding, SLR, and storm surge (NJDEP, 2023).

Non-mandatory CAP Actions

Apart from New York and New Jersey, other states have also adopted CAP frameworks for WWTPs and other utilities (waterboards.gov.ca, 2022). In California, the Water Resources Control Board, which governs NPDES permitting, has made coordinated efforts to embed climate change resilience across its programs (waterboards.gov.ca/programs). Although the board has not instated any permit or funding requirements, it clearly encourages CAPs to be embedded across all utility sectors.

Rhode Island's Department of Environmental Management, Office of Water Resources released the "Guidance for the Consideration of Climate Change Impacts in the Planning and Design of Municipal Wastewater Collection and Treatment Infrastructure," intended for the planning and design of any new construction or improvements to municipal wastewater collection and treatment infrastructure systems. It outlines considerations of base flood elevations and SLR under future conditions, a cost-benefit analysis of upgrades, and an operations and maintenance plan. In addition, Rhode Island offers a Municipal Resilience Program (MRP), which enables the municipality to apply for special grants upon completion of CAP-focused training (MRP, 2024).

DISCUSSION AND CONCLUSION

Preparing a CAP prepares WWTPs for the potential impacts of future climate conditions, which can enable faster recovery times from extreme climate change events, decrease rehabilitation costs, and enhance the protection of human and environmental health (Balci and Cohn, 2014). By implementing the CAP's adaptation strategies, a WWTP can improve resilience through the following:

- Reducing the chance of flood water intrusion, thus protecting critical assets and operations, and ensuring operational reliability in the face of climate impacts (EPA, 2014)
- Reducing the chance of planned and/or unplanned sewage discharges into the environment
- Improving the ability of treatment systems to adapt to changing contaminant loads
- Protecting workers and/or nearby communities by securing potentially hazardous electrical and mechanical equipment (EPA, 2014)

Implementing a CAP's adaptation strategies is economically beneficial because most strategies cost significantly less than rehabilitation (Balci and Cohn, 2014). Increased upfront costs that incorporate long-term planning may be more cost-effective than continuous, minor improvements, saving the utility money over time. In addition, a CAP benefits a WWTP as it may reduce future costs associated with asset losses, and socioeconomic and environmental damages (e.g., degradation of public health, natural resources, and ecosystem services). In a study on wastewater resiliency in New York City, estimates showed that current critical infrastructure is valued at $1 billion, with projected cumulative damages from flooding over 50 years exceeding $2 billion if no planning measures are implemented. The proposed protective measures, on the other hand, were estimated to cost $315 million and would reduce the system's flood risk by 85 percent (Balci and Cohn, 2014).

The CAP required by the NPDES permits and other regulatory frameworks can be viewed as an opportunity for utilities to improve. By incorporating robust planning and adaptation strategies, utilities may have greater operational resilience, protect public health, and achieve long-term cost savings. As climate change continues to pose new challenges, proactive adaptation planning will be critical for maintaining the functionality and reliability of wastewater infrastructure. A comprehensive CAP can also provide assurance to financial institutions and decrease the cost of capital and/or the cost of insurance policy premiums. Incorporating CAPs into future WWTP improvement plans is efficient and can add benefits with high returns to improve resilience.

Resilient infrastructure may also have other positive financial impacts on WWTPs. Financial institutions and insurance agencies are increasingly considering exposure to climate risks when determining capital lending interest rates, cost of insurance premiums, and credit scores. Climate change impacts can affect a WWTP's financial performance, affordability, and insurance coverage costs. Therefore, risk management of climate impacts is important in a credit issuer's credit rating. For insurance agencies, an increase in climate-related policy payouts and litigation costs associated with utility service failures has led insurers to focus on the utility's risk management strategies when issuing a policy and determining its premium (EPA, 2024a). By preparing for climate risks, WWTPs could maintain and improve their credit ratings and make capital projects more affordable.

ACKNOWLEDGMENTS

A special thank you to Lauren Miller, CC-P, for her technical expertise and support in writing this manuscript. Thank you also to Quentin Smith at CDM Smith for developing the graphics for the article.

REFERENCES

- (2023, August). ArcGIS Web Application - RAINE Database. epa.maps.arcgis.com/apps/webappviewer/index.html?id=976e44abbdd041d4ae98bb622017f1b1. Accessed 25 June 2024.
- Balci, Pinar, and Alan Cohn. (2014). "NYC Wastewater Resiliency Plan: Climate Risk Assessment and Adaptation," *American Society of Civil Engineers ICSI 2014: Creating Infrastructure for a Sustainable World*, pp. 246–56. https://doi.org/10.1061/9780784478745.021.
- (2023, April). "Building Resilient Water Infrastructure: Climate Change Resilience Guidance for New Jersey's Clean Water & Drinking Water State Revolving Funds," building-resilient-water-infrastructure-climate-change-resilience-guidance.pdf (nj.gov). Accessed July 16, 2024.
- United States. Environmental Protection Agency. "Climate Change in the Drinking Water and Wastewater Sectors and the Impact on Financial Resilience, Insurability, and Credit and Investment Quality: March, 2024(a), Web. 25 June 2024.
- United States. Environmental Protection Agency. "EPA Region 1 Recommended Procedures and Resources for the Development of Adaptation Plans for Wastewater Treatment Systems and/or Sewer Systems: March 5, 2024(b)," Web. 25 June 2024.
- (2014). Community Risk and Resilience Act (CRRA). Community Risk And Resiliency Act (CRRA) - NYSDEC. Accessed July 16, 2024.
- United States. Environmental Protection Agency. "Climate Impacts in the Northeast. 17 Jan. 2019," Web. 25 June 2024. 201919january2017snapshot.epa.gov/climate-impacts/climate-impacts-northeast_.html.
- United States. Environmental Protection Agency. "Climate Change: Resilience and Adaptation in New England (RAINE). August 2023," Web. 25 June 2024. Climate Change: Resilience and Adaptation in New England (RAINE) | US EPA.
- Crutchfield, Lia and Silton, Drew. (2023, Oct. 1). "EPA Issues Clean Water Act Permits Requiring Climate Change Adaptation," www.bdlaw.com/publications/epa-issues-clean-water-act-permits-requiring-climate-change-adaptation. Accessed June 25, 2024.
- (2023, May 17). "EPA Region 1 Proposing Burdensome Climate Resiliency Requirements as Part of NPDES Permit Program," www.nacwa.org/news-publications/news-detail/2023/05/17/epa-region-1-proposing-burdensome-climate-resiliency-requirements-as-part-of-npdes-permit-program. Accessed June 25, 2024.
- United States. Environmental Protection Agency. Authorization to Discharge Under the National Pollutant Discharge Elimination System. Town of Palmer, Massachusetts: Permit No. MA0101168, Sept. 2023. Web. 25 June 2024. Palmer Water Pollution Control Facility; Final Permit; MA0101168 (epa.gov).
- United States. Environmental Protection Agency. Authorization to Discharge Under the National Pollutant Discharge Elimination System. City of Northampton, Massachusetts: Permit No. MA0101818, Sept. 2023. 25 June 2024. Northampton Wastewater Treatment Plant; Final Permit; MA0101818 (epa.gov).
- United States. Environmental Protection Agency. Authorization to Discharge Under the National Pollutant Discharge Elimination System. City of Westfield, Massachusetts: Permit No. MA0101800, Sept. 2023. Web. 25 June 2024. Westfield Water Pollution Control Plant; Final Permit; MA0101800 (epa.gov).
- (2019, October 19). Executive Order 89. https://d31hzlhk6di2h5.cloudfront.net/20191029/cf/2b/2a/32/342d08e5884363d706d6aee7/EO-89.pdf. Accessed June 25, 2024.
- United States. Environmental Protection Agency. "Flood Resilience: A Basic Guide for Water and Wastewater Utilities. Sept. 2014," Web. 25 June 2024. https://www.epa.gov/sites/default/files/2015-08/documents/flood_resilience_guide.pdf.
- Li, Jibin, et al. (2023, August). *Climate Change Impacts on Wastewater Infrastructure: A Systematic Review and Typological Adaptation Strategy. Water Research*, vol. 242, Aug. 2023, pp. 120-282. https://doi.org/10.1016/j.watres.2023.120282.
- (2023, December 7). State of New Jersey. Department of Environmental Protection. "Financial Assistance Programs for Environmental Facilities (N.J.A.C. 7:22)," dep.nj.gov/dwq/all-division-rules-and-regulations/assistance/. Accessed June 25, 2024.
- (2021, October 12). "Murphy Administration Releases Final Climate Change Resiliency Strategy to Protect New Jersey's Communities, Environment, and Infrastructure from Climate Change," Office of the Governor | Murphy Administration Releases Final Climate Change Resiliency Strategy to Protect New Jersey's Communities, Environment, and Infrastructure from Climate Change (nj.gov) Accessed June 25, 2024.
- Permits, Application Forms, and Checklists. dep.nj.gov/dwq/permitting_information/permits_application_forms_and_checklists/. Accessed June 25, 2024.
- (2024). Municipal Resilience Program. https://www.riib.org/solutions/programs/municipal-resilience-program/. Accessed June 25, 2024.
- "What Is a GCM?" www.ipcc-data.org/guidelines/pages/gcm_guide.html. Accessed June 25, 2024.v
- (2022, April 4). "California Launches Updated Climate Adaptation Strategy to Protect Communities from Accelerating Impacts," www.gov.ca.gov/2022/04/04/california-launches-updated-climate-adaptation-strategy-to-protect-communities-from-accelerating-impacts/. Accessed June 25, 2024.
- (2024, April 24). "National Pollutant Discharge Elimination System (NPDES) – Wastewater," www.waterboards.ca.gov/water_issues/programs/npdes/. Accessed June 25, 2024.

ABOUT THE AUTHORS

- Rina Dalal, PE, is an environmental engineer and the Climate Resiliency Discipline Leader at CDM Smith. She holds dual masters degrees in sustainability management and sustainable design and has extensive experience in water and wastewater infrastructure improvement projects, risk assessments, and climate change studies.
- Jordan Goldstein is an environmental scientist and sustainability specialist at CDM Smith. He holds a Master of Science in sustainability science and has over 12 years of experience consulting with a focus on climate change resiliency and sustainable development policy.
- Elisabeth Schreiber is an environmental engineer intern at CDM Smith with experience in water resources engineering, civil infrastructure, and sustainability science. She is currently pursuing her master's degree in environmental management.

Dynamic integration of a green infrastructure database into modeling to track stormwater quality improvements

DAVID PETERSON, PE, Kleinfelder, Boston, Massachusetts
SADIA KHAN, PhD, Kleinfelder, Boston, Massachusetts

ABSTRACT | The Boston Water and Sewer Commission has been addressing pollutants from runoff and illicit discharges to its separate stormwater system by implementing structural best management practices (BMP) and green infrastructure (GI) solutions since the early 2000s. The Commission has installed over 6,300 BMP/GIs and rectified 700 illicit discharges, significantly improving stormwater runoff quality and reducing discharge volumes. To quantitatively measure the improvements in water quality from 1998, in 2012 the Commission developed a stormwater quality model. Recently, the Commission completed a detailed sampling and flow metering program, collecting data during wet and dry conditions in the fall of 2020 and the spring of 2021 from 34 locations. This data validated the stormwater model for assessing the reductions in phosphorus and bacteria. Additionally, the Commission streamlined an internal workflow process to directly connect its green infrastructure database and its stormwater model, with pre- and post-model execution Python scripting, to calculate phosphorous and bacteria pollutant loading and display the results on a custom online pollutant data visualization tool.

KEYWORDS | Green infrastructure, stormwater model, online water quality monitoring, pollutant data visualization tool, database integration in model

The growing concern over urban stormwater pollution and its impact on water bodies has led to stringent regulatory measures and innovative solutions to mitigate these effects. Recognizing the adverse impact of stormwater pollutants, in 2007 the Massachusetts Department of Environmental Protection (MassDEP) established a total maximum daily load (TMDL) for phosphorus in the Lower Charles River. This initiative underscored the necessity for rigorous control of phosphorus, a key pollutant contributing to eutrophication and the degradation of water bodies.

The Boston Water and Sewer Commission has been at the forefront of addressing these environmental challenges, particularly in managing phosphorus loadings from its municipal separate storm sewer systems (MS4). In 2012, the Commission developed a stormwater model using stormwater sampling data collected in 2011 and 2012 from 20 locations. For detailed analysis, the city's MS4 area was divided into approximately 3,600 subbasins, with land use characteristics in Boston used to develop phosphorus loading assignments. The Commission's stormwater model report highlighted the substantial influence of the base flow in the storm drain system on phosphorus levels in the Lower Charles River.

Following this, the Commission developed a Stormwater Best Management Practices Recommendations Plan (BMP Plan). This plan aimed to identify the most cost-effective green infrastructure (GI) strategies to mitigate phosphorus loadings. The BMP Plan not only focused on immediate interventions but also laid out a phased implementation approach, emphasizing the importance of continuous water quality sampling and model updates in 10-year intervals.

In 2020, the Commission embarked on the stormwater monitoring and model validation project with a goal to update the 2012 stormwater model through the following:

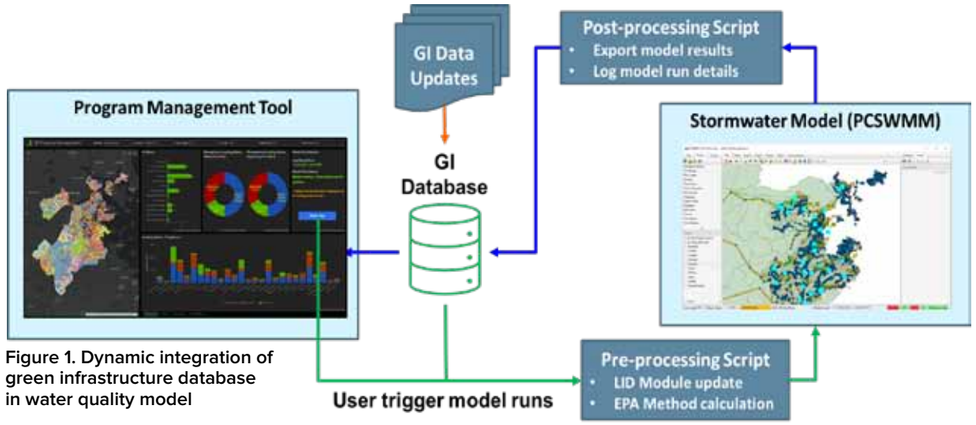


Figure 1. Dynamic integration of green infrastructure database in water quality model

- Incorporating the characteristics of BMP/GI installations completed from 2012 through the end of 2022
- Eliminating flow associated with illicit sanitary sewer connections to the MS4, as documented in the Commission's database (these connections were found and removed through the Commission's illicit discharge detection and elimination [IDDE] program from January 2012 through December 2022)

With these goals in mind, a comprehensive field program was designed to accurately capture the variability of dry and wet weather scenarios, establish the baseline loading through weekly sampling, and assess the quality of the receiving water. The study also evaluated the feasibility of continuous water quality monitoring by installing an online water quality monitoring (OWQM) station at a monitoring location on Stony Brook. Additionally, a dynamic workflow was developed to link the Commission's GI database and the stormwater model, facilitating the tracking of new BMPs and GI and automating model updates.

In this article, the four components of the stormwater monitoring and model validation project are discussed:

1. Water quality monitoring program
2. OWQM station
3. Validation of stormwater model
4. Dynamic integration of GI database to stormwater model

WATER QUALITY MONITORING PROGRAM

A field program was designed to collect sufficient flow and pollutant data from within the Commission's MS4 to develop a basis for a long-term stormwater quality monitoring program; determine the impact to water quality due to GI installations made throughout the MS4 since 2012; determine the influence of the removal of illicit sanitary connections to the MS4 through the Commission's IDDE program; and render an opinion if the current stormwater model is adequately valid, or if it must be recalibrated.

The stormwater monitoring plan evaluated flow and water quality at 30 locations within the MS4, and water quality at four locations in the Lower Charles River (34 monitoring locations in total) during the fall of 2020 (Phase 1 program) and the spring of 2021 (Phase 2 program). Over this time, approximately 800 water quality samples were obtained from these 34 sampling locations. Precipitation data was obtained from the Commission's network of rainfall gauges and analyzed in 5-minute increments. Figure 2 (next page) shows a map of the sampling and the rain gauge locations.

Weather conditions were continuously monitored during the sampling program to identify preferred weather conditions, meeting dry and wet weather definitions, and prepare for mobilization. For dry weather, at least three days of antecedent precipitation less than 0.1 in. (0.254 cm) was targeted. For wet weather events, rain events forecasted to produce greater than 0.5 in. (1.27 cm) of rain were targeted. Samples were collected in the field through one of the three methods including composite, first flush, and grab. Automatic samplers were used for composite and first flush sampling.

The 34 locations were divided into four categories (D1 through D4) based on the different purposes:

D1 sites. The purpose was to obtain updated water quality and flow data for the 17 sites previously sampled in 2011–2012, provide the necessary data to validate the stormwater model, and produce a water quality dataset to assist with future stormwater model calibration. Six dry weather and six wet weather samples were collected at these 17 sampling sites.

D2 sites. Similar to D1 sites, the category D2 ones were also previously sampled in 2011–2012. However, these sites had particular interest for developing a robust sample dataset to compute pollutant loads, and therefore, continuous flow data and weekly water quality data were collected for 86 consecutive weeks at

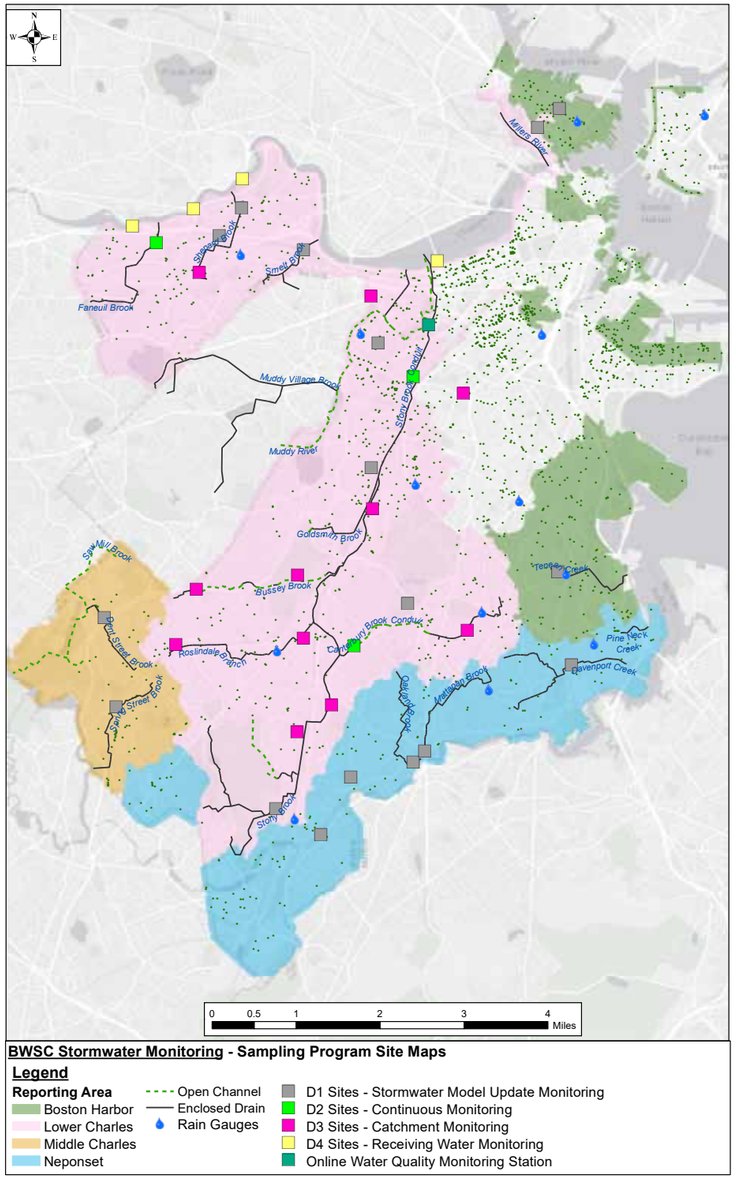


Figure 2. Monitoring program overview map

key findings from sampling data

these locations. The three priority locations chosen are all tributaries that drain to the Lower Charles River and represent water quality conditions within Faneuil Brook, Canterbury Brook, and Stony Brook—all priority locations.

D3 sites. Ten new sampling locations were added during this project to supplement the previously collected sampling data and produce a more robust dataset. All 10 sites were located in tributary areas to the Lower Charles River. These 10 additional sites were chosen considering the following:

- Catchments with a significant amount of GI
- Catchments where GI is planned soon based on known developments in the pipeline
- Areas with common land use types where overland pollutant loading rates and system performance may vary significantly
- Areas with potential illicit connections based on pathogen sampling
- Areas considered potential "hot spots" for pollutant loading

D4 sites. Four D4 sampling locations were chosen in the Lower Charles River and helped to characterize water quality within the receiving water. The sample locations were chosen to complement water quality datasets from the Massachusetts Water Resources Authority (MWRA) and the Charles River Watershed Association (CRWA). The four locations included the North Beacon Street Bridge (Route 20); the Arsenal Street Bridge; the Christian Herter Park Boardwalk; and the Massachusetts Avenue Bridge.

Category D4 sampling consisted of monthly grab samples taken during the growing season. After large rain events (approximately 1 in. [2.54 cm] or more), the team mobilized to collect additional post-storm recovery grab sampling for as many as five days following the rain event at the most upgradient and most downgradient sample location. The post-storm recovery sampling was to document how quickly the Lower Charles River water quality returned to pre-storm conditions after the storm event. Four monthly samples were obtained between August 2020 and November 2020, and eight monthly samples were obtained between April 2021 and November 2021.

All the collected samples were analyzed for physical parameters (pH, temperature, conductivity, and dissolved oxygen), bacterial parameters (fecal coliform, *E. coli*, and enterococci based on the receiving water body as illustrated in Table 1), nutrient parameters (total phosphorus, ortho-phosphorus, total nitrogen, nitrate/nitrite, and ammonia), biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), metal (total copper and total zinc), hardness, and total suspended solids.

Table 1. Bacteria parameters by receiving water

Receiving water	Fecal coliform	Enterococci	*E. coli*
Upper/Mid and Lower Charles River		✓	✓
Boston Harbor	✓	✓	
Neponset River	✓	✓	✓

Key Findings from Sampling Data

Although this project's primary aim was not to make conclusions solely based on the sample data, two observations were notable:

- **Comparison of Median Dry Weather Pollutant Concentrations.** Based on a comparison of the median dry weather concentrations, pathogens (e.g., fecal coliform, enterococci, *E. coli*) and ammonia concentrations were lower in the 2020–2021 sampling compared to those from the Commission's 2011–2012 sampling program. Total phosphorous was not considered significantly lower, and when comparing site-by-site data results, the variability in the data suggested the overall median of sample results does not suggest a reduction in total phosphorous concentration. Table 2 shows the change in median dry weather concentrations for these parameters between the two sampling programs.

Table 2. Dry weather water quality change

	2011–2012	2020–2021
Total phosphorous (mg/L)	0.13	0.08
Fecal coliform (MPN/100 mL)	5,600	2,450
Enterococci (MPN/100 mL)	1,300	430
E. coli (MPN/100 mL)	5,200	1,542
Ammonia (mg/L)	0.48	0.17

This comparison suggests that the Commission's efforts, particularly its IDDE program, have positively affected dry weather baseline stormwater pollutants.

- **Lower Charles River Water Quality**. In most samples (dry and wet) total phosphorous in the Lower Charles River was less than 0.1 mg/L. Also, after a significant rain event, the pollutant concentrations monitored returned to pre-storm conditions within 48 hours. These results are critical to understanding the impact of wet weather on the Charles River. The total phosphorous concentration in the Lower Charles River is consistently lower than 0.1 mg/L (EPA, 1986), even during wet weather, underscoring the river's ability to buffer incoming pollutants.

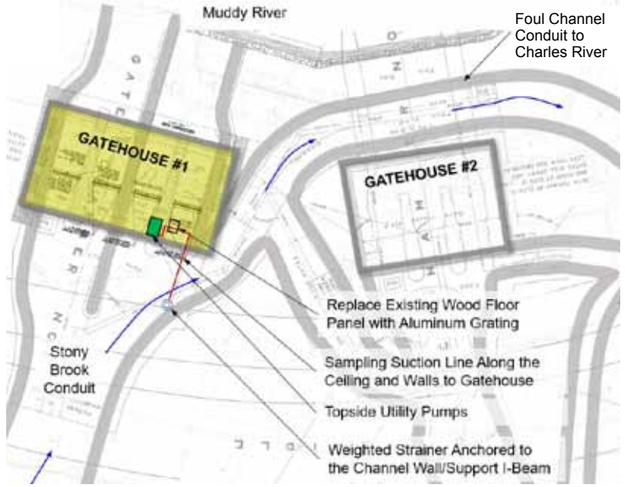


Figure 3. Fens Gatehouse #1 location plan

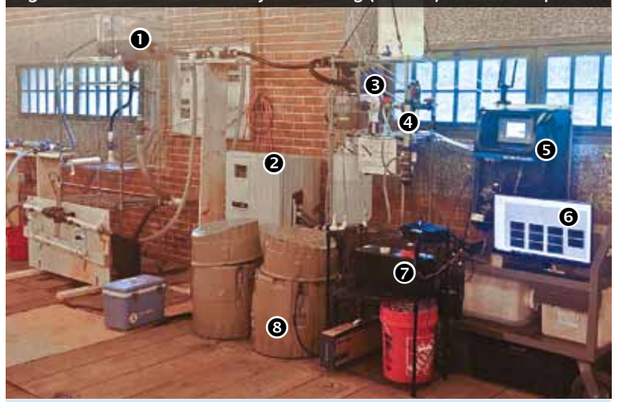
ONLINE WATER QUALITY MONITORING STATION

The sampling program included an OWQM station in the Fens Gatehouse #1, which is a slide gate structure that allows flow from Stony Brook to enter the Muddy River during heavy flows (Figure 3). The purpose of the OWQM station was to obtain continuous water quality data to establish a baseline at, or better than, an hourly resolution. The OWQM aims to illustrate water quality characteristics of wet weather events more meaningfully than autosamplers could.

Design of OWQM

The OWQM system included a flow metering module to monitor flow and level at the sampling site and an automatic sampling analysis system (Figure 4, next page). The OWQM sampling setup consisted of two sample pumps that continuously pumped 5 to 10 gpm (19 to 38 L/min) of stormwater flow from the Stony Brook conduit to an equalization flow-through tank, then looped through online sensors to analyze pH, temperature, conductivity, and dissolved oxygen (DO). Samples were also measured for nitrite/nitrate, ammonia as (N), total phosphorous, total inorganic nitrogen (TIN), and orthophosphate (ortho-P) using an automated online nutrient analyzer system. The analyzer took a stream of samples to an in situ digester that was automatically dosed with acidic reagents to convert insoluble and organic phosphorus to orthophosphate. Following digestion, the sample was dosed with ammonium molybdate and antimony potassium tartrate (colorimetric reagent) and then was measured by a spectrophotometer for total phosphorus. Digestion requires 40 to 50 minutes, per EPA standard method 365.3; thus, the total phosphorus measurements were recorded every 60 minutes.

Figure 4. Online Water Quality Monitoring (OWQM) station setup



1. Gravity feed of pumped stormwater
2. Total phosphorous-colorimetric autoanalyzer
3. Sensor based nitrite/nitrate autoanalyzer
4. In situ sensor-based analyzer for temperature, pH, DO, conductivity & NO_3-
5. Orthophosphate colorimetric autoanalyzer
6. Data logging (to cloud)
7. UPS (backup power)
8. Autosamplers (24 bottles x 2)

Ion-selective electrodes or optic probes were used directly to measure the concentration of other nutrients in the flow-through stream at 15-minute intervals. Table 3 includes the parameters recorded online.

The stormwater project's target parameters were measured in physical samples collected from the OWQM site through weekly sampling and autosamplers during wet weather events occurring between May and November 2021. Timestamps on physical sample collection were aligned with timestamps on sensor/analyzer data to provide ground-truth references for measurements from the OWQM equipment.

Table 3. OWQM station sampling parameters

Target Analytes	Measurement Method	Measurement Frequency	Accuracy	Interferences	Cost[1]
PO_4^{3-} (Ortho-P)	Colorimetric autoanalyzer	~7 min (wet weather)/ 60 minutes (dry weather)	0.03 mg-P/L	Minimal (color)	$$$
Total Phosphorous	Colorimetric autoanalyzer	45–60 min[2]	0.06 mg-P/L	Minimal (color)	$$$$
Temperature, DO, pH, conductivity, NO^{3-}	Multi-parameter sensor	<1 min		Significant (N)	$
NO^{2-}, NO^{3-}	Microfluidic colorimetric autoanalyzer	<1 min		Minimal	$$
NH^{4+}, NO^{2-}, NO^{3-}, Cu^{2+}, Na^{+}, Cl^{-}	Ion selective electrode array	<1 min		Significant (all)	$

[1] $ - <$1,000 / $$ - <$10,000 / $$$ - <$25,000 / $$$$ - >$25,000

[2] Adaptive temporal resolution, for sampling using the instrument, was implemented to compensate for the very high reagent use rate at maximum sampling rate

OWQM Advantages Over Traditional Sampling Methods

One advantage of the OWQM at the Stony Brook gatehouse was the temporal resolution of data recorded in comparison to traditional sampling methods. Another advantage was the ability to compare these high-resolution data with data collected at storm-based and weekly intervals. This comparison helped to establish uncertainty bounds on pollutant loading estimates from traditional grab sampling programs, which are less costly and simpler.

Key Observations

Key observations resulting from this effort include the following:

Identification of chemical differences between baseflow and wet weather waters, including simple-to-measure parameters like conductivity and dissolved oxygen (Figure 5). While current wet weather events are most often detected or monitored using flow meters, these other parameters use simpler, easier-to-maintain sensors, and therefore this may indicate a new way to support real-time monitoring or adaptive management of stormwater infrastructure.

Verification of the total phosphorous analyzer for useful monitoring of stormwater during storms. While the needed digestion step limits temporal resolution of field measurements to 45-minute intervals—possibly considered insufficient to study storms—the data were validated by lab analysis as sufficient for characterizing total phosphorous loading (Figure 6) within reasonable agreement with lab samples (although with high likelihood of missing storm maxima). Reagent consumption and therefore waste generation is minimal and manageable (approximately 1 gal [3.8 L] per month). When combined with the parameter observation above, which can provide precise timing on the hydrograph and therefore mix of baseflow and wet weather flow, estimates of total phosphorous loads can be made using this instrument.

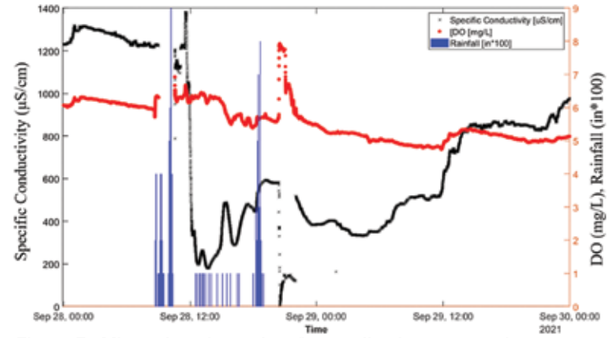


Figure 5. Minute-by-minute data from online instrumentation showing simple-to-measure proxies that can be used to detect wet weather flows

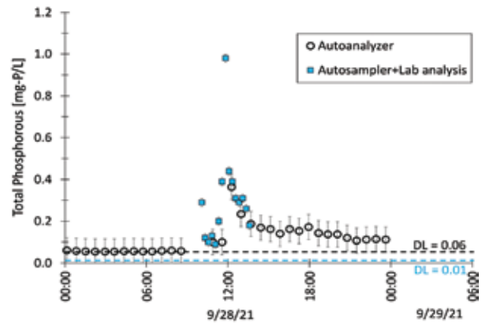


Figure 6. Total phosphorous measured at the OWQM station using the online autoanalyzer and compared to lab analysis on grab samples

Operational Challenges

Operational challenges fell into two categories:

1. Delivery of stormwaters to OWQM instrumentation. Most instruments were not suitable for installation in stormwater sewers. Some instruments, like multisensory setups used to measure the physical parameters (Temperature, DO, pH, conductivity) along with nitrate, were designed flexibly for installation in various locations but required a computer for power and data logging. Other instruments, such as the phosphorus (total-P and ortho-P) autoanalyzers, needed a 120VAC connection and a system to collect the hazardous wastes generated from the automated sample analysis. This necessitated a flow-through loop of stormwater to be pumped from the storm drain to a protected facility where equipment was installed, rather than an in situ installation. This approach was effective during baseflow conditions with lower particle loading and predictable flow regimes. However, maintaining consistent flow during wet weather, especially during the largest events, was a challenge. Downtime of the pumped flow loop, especially during wet weather events, limited the usefulness of collected data for assessing the utility of certain sensors for stormwater monitoring on several occasions.

2. Operational challenges in a field context. Some instruments tested were impractical for stormwater monitoring. One example is the orthophosphate colorimetric analyzer, which was configured by the manufacturer for analyzing the lowest concentration range. Two main challenges were identified:

- At the maximum sampling rate (under 7 minutes per sample), the instrument provided excellent resolution of storm event dynamics but generated hazardous waste at an unacceptable rate (over 5 gal [19 L] per day).
- Although the measurements were accurate compared to lab analyses, the stormwater concentrations of orthophosphate were often near the detection limit of the instrument, making the measurements statistically indistinguishable from one another and from the detection limit itself (Figure 7).

VALIDATION OF STORMWATER MODEL

One outcome of the stormwater monitoring and model validation project was to compare the flow and pollutant loads observed during the sampling program to the stormwater model output for the same observed storm events and determine if the stormwater model was representative of observed conditions.

The observed and modeled peak and total flow were compared at each of the 30 flow metering locations studied during the sampling program. For the model flow output to be considered valid, this project references the Chartered Institute of Water Environmental Management's Integrated Urban

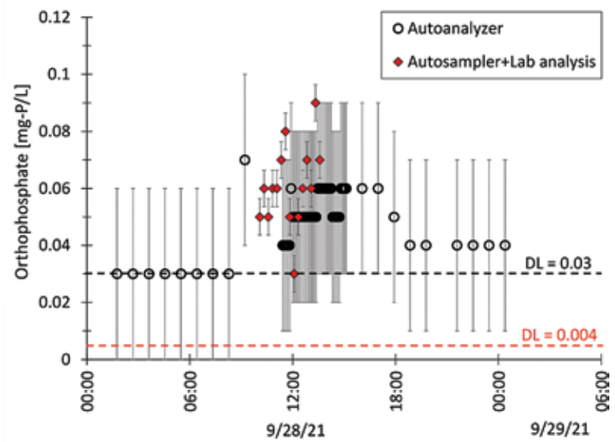


Figure 7. Data collected using the dissolved phosphorous autoanalyzer compared to lab-based analysis results. Although instrument sampling resolution surpasses what is possible using traditional grab sampling, the detection limit (DL) of the system is too close to concentrations measured in stormwaters to provide usefully actionable information.

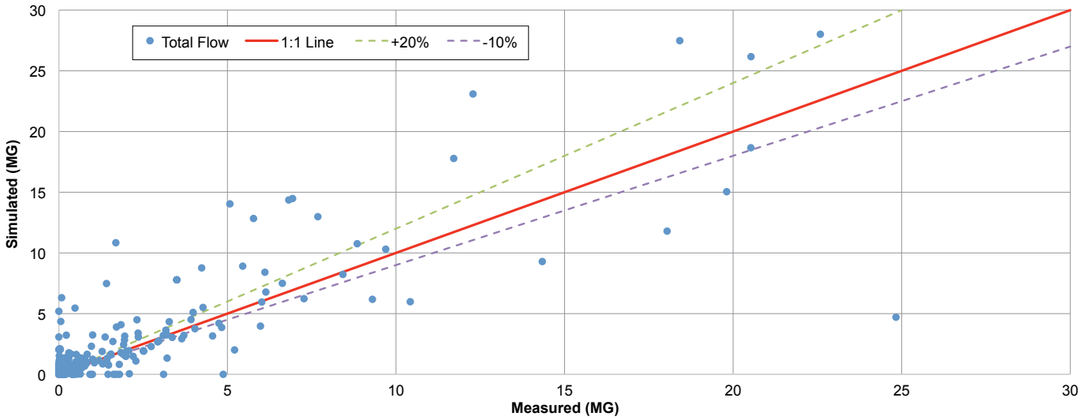


Figure 8. Comparison of simulated and measured wet weather event total flow volume (all events and sites)

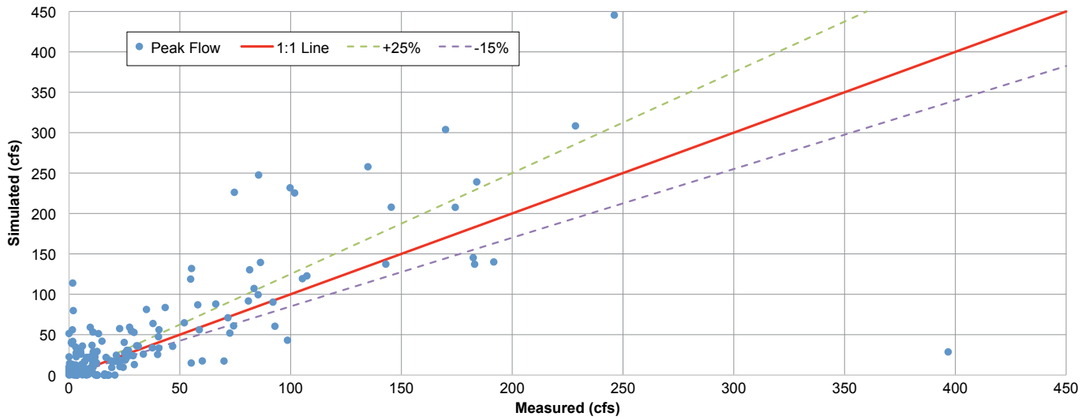


Figure 9. Comparison of simulated and measured wet weather event peak flow volume (all events and sites)

Drainage Modelling Guide (CIWEM 2021), which sets the standard allowable flow variance to be from +20 to -10 percent. The stormwater monitoring and model validation project results indicate that the simulated total flow volumes exceeded observed total flow volumes at 25 out of 30 site locations (Figure 8). Similarly, most of the peak flow values were beyond the suggested validation target (Figure 9). Therefore, it was determined that the model would benefit from recalibration of total and peak flow values from storm events.

The observed and modeled pollutant loading was also compared at each of the 30 sampling locations studied during the sampling program. All the primary sampling parameters were used to compare observed data to modeled pollutant data. For this article, the discussion is limited to total phosphorus only.

The water quality sampling data collected during the selected six wet weather events were used to validate the model results. For validation of pollutant concentration, the concentrations of water quality sampling data were compared to the event mean concentrations (EMC) produced by the stormwater model. For each storm event, a pollutant's EMC was obtained by averaging the pollutant concentration throughout the event period.

For pollutant loading validation, the measured loadings were calculated using the measured concentration and corresponding total flow volume from flow metering data, and were compared to the simulated pollutant loadings, which were calculated based on the sum of loading at each model time step throughout the event.

For total phosphorous, the validation results suggest that the total loadings were overpredicted by 25 to 100 percent at high volume loading sites; however, at other sites, the model underpredicted total phosphorous. Specifically, the model overpredicted total phosphorous loadings by at least 25 percent at 21 sites and underpredicted the loading

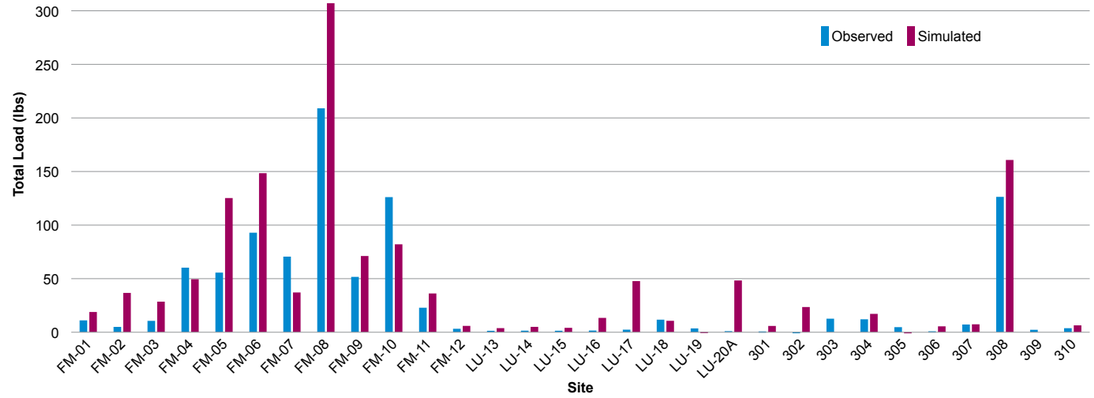


Figure 10. Comparison of simulated and measured wet weather event total phosphorous loading (all events)

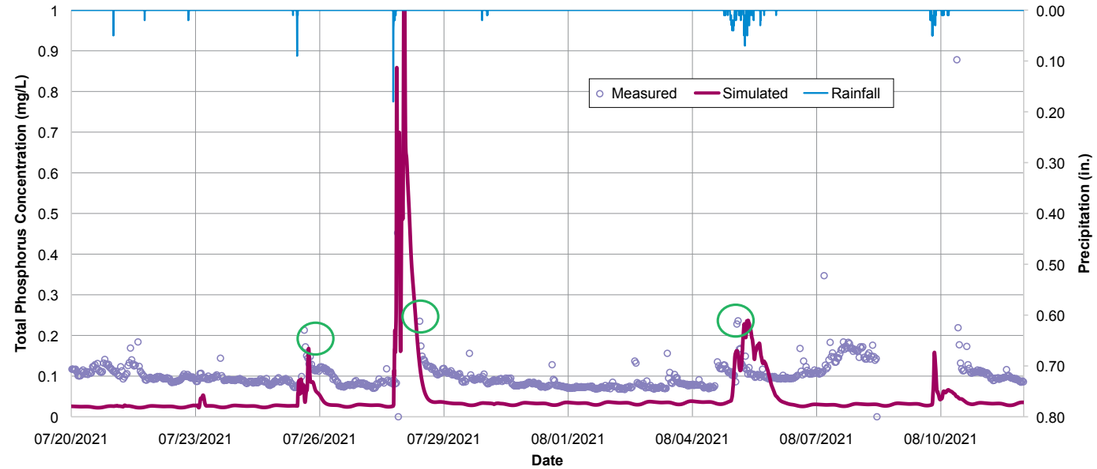


Figure 11. Comparison of simulated and measured total phosphorous concentration (OWQM station)

by at least 25 percent at another five sites. Figure 10 illustrates the inconsistency between observed and modeled total phosphorous loading.

Data from the high-resolution OWQM station at Fens Gatehouse #1 were also used to validate the total phosphorous pollutant from the stormwater model through a comparison of concentration data over a time series. Figure 11 compares simulated and measured total phosphorus concentrations during a sample period of validated data (i.e., July 20, 2021 to August 12, 2021). The stormwater model underestimated the dry weather base flow total phosphorous concentration, but during wet weather events (such as July 28, 2021 and August 5, 2021) the model overpredicted the peak event concentration.

In summary, based on the comparison of observed and modeled flow and pollutant data, it was determined that the stormwater model would benefit from recalibration to improve the Commission's confidence in the model results.

INTEGRATION OF GI DATABASE

Through the stormwater monitoring and model validation project, the Commission identified an opportunity to streamline an internal workflow process used by its engineering customer service (ECS) team, known as the site plan review process. Since the early 2000s, the Commission has been developing a GI database to track the location and type of GI within the city of Boston. A new internal workflow process was developed that synchronized the site plan review process; it is managed by the ECS team, while the stormwater model is managed by the Engineering and Planning Department. The GI database was redesigned to make it compatible with the data scheme that the Commission's stormwater model would use to manage GI information. Then, a series of Python scripts was developed to translate the data from the GI database into the stormwater model, and then to post-process the model output data into an Online Pollutant Data Visualization Tool. By developing

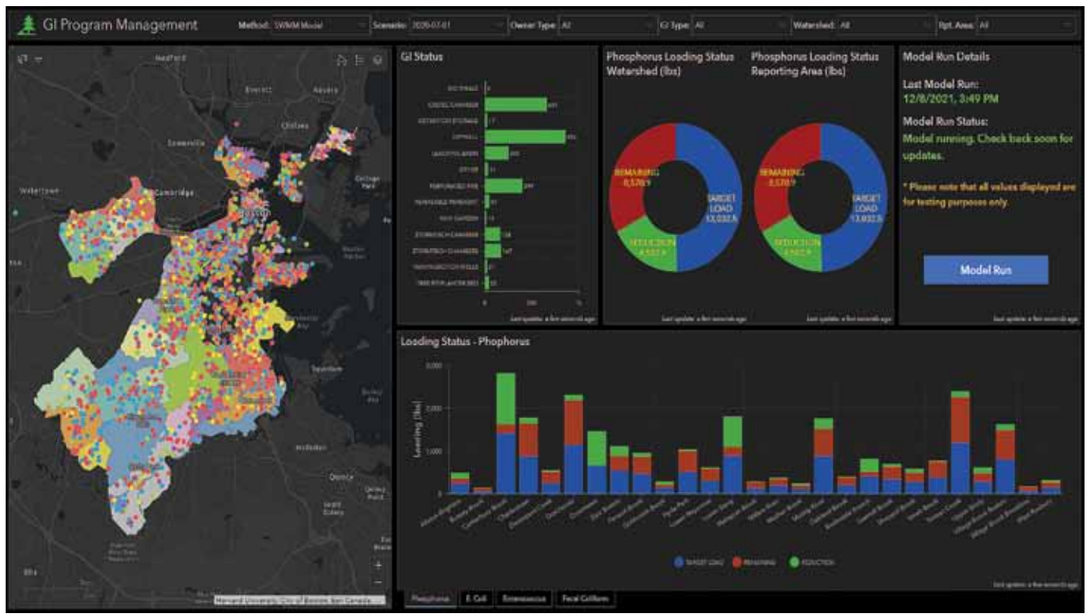


Figure 12. Online pollutant data visualization tool showing total phosphorous results from five selected reporting areas

this improved internal workflow, incorporating the city's GI into the stormwater model was made easier and less time-consuming. The Commission can now make frequent (e.g., quarterly) updates to its understanding of total pollutant loading to the receiving water bodies, and progress more efficiently toward its stormwater pollutant reduction objectives.

Figure 12 illustrates the online pollutant data visualization tool developed for this project. This tool, based on ArcGIS Online, displays GI installation and pollutant information in various ways. The tool includes an interactive GIS map of the city showing each MS4 reporting area and the GI installations constructed within each reporting area. A bar chart shows this same information; however, it also shows the quantity of each type of GI installation. Pollutant data is shown based on the calculated annual pollutant load (in pounds), as well as on the target pollutant load (in pounds), representing the objective the Commission is trying to achieve for each reporting area.

RECOMMENDATIONS AND CONCLUSION

Based on the findings from the stormwater monitoring and model validation project, the following recommendations and conclusions can be drawn:

- The comprehensive field program conducted in 2020 and 2021 has shown a decreasing trend in dry weather pathogens (e.g., fecal coliform, enterococci, *E. coli*) and ammonia concentrations.
- The OWQM station's high-frequency sampling method has demonstrated an advantage in illustrating the first-flush response more accurately than traditional autosamplers. High-resolution monitoring of total phosphorus, using the tested instrument, provides valuable insights into phosphorus loads in stormwater flows, particularly during wet weather events. This approach offers higher reliability and lower costs compared to traditional auto-sampler and laboratory analysis methods.
- The GI program management tool developed under this project has provided the Commission with a mechanism to monitor and track progress toward pollutant load reduction. By regularly updating the GI database and using this tool, the Commission can maintain an up-to-date stormwater model and continuously improve its stormwater management practices.

In conclusion, the stormwater monitoring and model validation project findings underscore the effectiveness of current stormwater management strategies and highlight the benefits of high-resolution monitoring for total phosphorus. By focusing on practical and impactful monitoring approaches and leveraging the GI program management tool, the Commission can continue to make informed decisions and sustain improvements in water quality. These strategies will contribute to healthier ecosystems and communities through better-managed stormwater systems.

ACKNOWLEDGMENTS

The authors acknowledge Charlie Jewell (director of planning, Commission), Amy Schofield (project manager, Commission), Kleinfelder team (Rita Fordiani, Dingfang Liu, Adria Fichter, Jonnas Jacques, Steven Huang, John Rahill), Stacey DePasquale Engineering Inc. (sample collection), PEER Consultants (maintenance hole inspections and dye testing), Flow Assessment Services (flow and level monitoring), and the Northeastern University team (Dr. Amy Mueller and Dr. Edward Beighley) for their support.

REFERENCES

- United States. Environmental Protection Agency. *Quality Criteria for Water*, Washington, DC 20460, EPA 440/5-86-001,1 May. 1986.
- Chartered Institution of Water and Environmental Management (2021, May 1), *Integrated Urban Drainage Modelling Guide v2.01*, https://www.ciwem.org/assets/uploads/IUD_1.pdf. Last Accessed on July 29, 2024.

ABOUT THE AUTHORS

- David Peterson is a senior project manager at Kleinfelder in Boston. He has 22 years of experience as a wastewater engineering consultant for the municipal sector. His experience has focused on water resource management projects including planning, modeling, inspection, design, and construction administration of new or rehabilitated wastewater infrastructure within collection systems and wastewater treatment plants.
- Sadia Khan is a staff engineer at Kleinfelder in Boston. She has experience in stormwater nutrient management, hydrologic and hydraulic modeling, geographical information systems, climate resiliency, and vulnerability and risk assessment.

CSO mitigation, wet weather flows, and regulatory compliance—a look into Fitchburg's collection system separation and rehabilitation plan

CHRISTOPHER MACKIN, PE, Weston & Sampson, Worcester, Massachusetts
FRANK OCCHIPINTI, PE, Weston & Sampson, Worcester, Massachusetts

ABSTRACT | In 2012, Fitchburg, Massachusetts, entered into a consent decree (CD) with the United States Department of Justice, EPA, and the Massachusetts Department of Environmental Protection (MassDEP). This was a result of the city failing to meet the combined sewer overflow (CSO) discharge requirements in its 2010 National Pollutant Discharge Elimination System (NPDES) permit *(United States, Commonwealth of Massachusetts v. City of Fitchburg, 2012).* Under the CD, the city must complete multiple sewer separation projects to eliminate CSO discharges by the end of 2030. Water quality standards for the United States and the MassDEP are regulated under the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq), a.k.a. the Clean Water Act, and the Massachusetts Water Quality Standards (314 CMR 4.00). The CD specifies that the city must submit a Wastewater Management Plan (WMP) and a CSO Long-Term Control Plan (LTCP). The city developed its WMP and LTCP to identify the CSO controls necessary to comply with state and federal water quality standards and its 2010 and subsequent NPDES permits.

KEYWORDS | CSO mitigation, wet weather, regulatory compliance, SRF funding

The city of Fitchburg, one of over 700 combined sewer overflow (CSO) communities in the United States, is approximately 50 mi (80 km) northwest of Boston and has a population of over 40,000 residents (EPA 2024). During wet weather, the combined system experiences highly variable flow rates, significant inflow, debris buildup in the collection system, and untreated combined sewage (combined wastewater and stormwater) discharges to water bodies through relief points, known as CSO regulators, in the collection system. A combined system may also feature combined sewer maintenance holes (MHs) where transference between the wastewater and stormwater systems can occur during wet weather.

Construction of Fitchburg's sewer system (circa 1890)

Before implementing any remedial measures to reduce or eliminate CSO discharges, the city operated an estimated 148 mi (238 km) wastewater collection system that consisted of over 127 mi (204 km) of sanitary sewers, 20 mi (32 km) of combined sewers, and 2.5 mi (4 km) of force mains. It also included 64 CSO regulators, 255 combination MHs, and three publicly owned pump stations. The wastewater collection system was constructed between 1890 and 2015 and includes sewers made of asbestos-cement, brick, cast iron, ductile iron, polyvinyl chloride (PVC), reinforced concrete, and vitrified clay. Wastewater from the entire city, as well as partial flow from the neighboring towns of Westminster and Lunenburg, is treated at the city-owned and operated Easterly Wastewater Treatment Facility (EWWTF), where treated effluent is discharged to the North Nashua River. When the treatment capacity is exceeded during wet weather events, the EWWTF uses a secondary system bypass to redirect flows to the North Nashua River after primary treatment.

One of Fitchburg's CSO regulators

Typical combination MH

Additionally, during wet weather events, the city's CSO regulators discharge untreated combined sewage to the North Nashua River and other tributary water bodies. These discharges to waterbodies are regulated through the city's National Pollutant Discharge Elimination System (NPDES) permit.

NPDES PERMIT

The city's 2010 NPDES permit authorizes discharges from the EWWTF and CSOs to the North Nashua River and other tributary waterbodies. It also sets discharge limits for treated wastewater leaving the EWWTF and reporting requirements for compliance. The permit specifies a monthly average flow limit of 12.4 mgd (46.9 ML/d) that can be discharged into the North Nashua River. Prior to any improvements to the EWWTF, during wet weather events when flow rates exceeded 15 mgd (57 ML/d), the EWWTF activated its secondary system bypass. Historically, flows exceeding the capacity of the treatment facility were not treated to the level that met water quality standards, resulting in NPDES permit violations.

The city's NPDES permit also requires that combination MHs showing signs of transference must have storm and sanitary sewer separation completed within two years of the transference date.

HISTORIC PROJECTS

Fitchburg initially began investigating sewer separation to remove combined sewers in 1995. In 1999, the city reported 20 mi (32.2 km) of combined sewers and 58 CSO regulators. A CSO Master Plan was developed in 1999 to address the collection system, main trunk line, and treatment plants. In 2002, the city created a Combined Sewer System (CSS) Separation Program that prioritized areas for separation based on the largest CSOs. Since 1999, the city has been performing sewer separation and rehabilitation projects to reduce the number of combined sewers.

Between 1999 and 2018, the city completed several sewer system evaluation survey (SSES) and investigation projects, resulting in the successful inspection of 88 percent of the sanitary and combined sewers and 43 percent of the sewer MHs in the city, as summarized in Table 1 (next page). During this time, the city conducted four major sewer separation projects and multiple sewer rehabilitation projects to remove infiltration and inflow (I/I) from the wastewater collection system, as summarized in Table 2 (next page).

Between 1999 and 2018, sewer separation and rehabilitation projects successfully removed over 10 mi (16 km) of combined sewers, closed 47 CSO regulators, and significantly reduced CSO discharge volumes to the North Nashua River.

EWWTF UPGRADES

Owing to violations of the city's 2010 NPDES permit, in 2012 the city entered into a consent decree (CD) with the United States Department of Justice, EPA, and the Massachusetts Department of Environmental Protection (MassDEP) that required the city to conduct upgrades to the EWWTF to increase its capacity. In 2019, the city completed a chemically enhanced primary treatment (CEPT) upgrade to the EWWTF, and in 2020, it completed a secondary system upgrade (SSU) project. These improvements increased facility capacity, as shown in Table 3.

Table 3. Treatment capacity improvements from secondary system upgrades

Seasonal Hourly Capacity	2012 Treatment Capacity	Projected Treatment Capacity with CEPT and SSU
Peak Hourly Capacity (June 1 – October 31)	15 mgd (68.2 ML/d)	32 mgd (145.5 ML/d)
Peak Hourly Capacity (November 1 – April 30)	15 mgd (68.2 ML/d)	40 mgd (181.2 ML/d)
Peak Hourly Capacity (May)	14 mgd (63.6 ML/d)	25 mgd (94.6 ML/d)

Following the SSU, it was estimated the EWWTF could treat up to 40 mgd (151.4 ML/d) of wastewater during the winter, 32 mgd (121.1 ML/d) during the summer, and 20 mgd (75.7 ML/d) in May. Sewer separation is anticipated to reduce peak wet-weather flow rates to a rate that will receive full wastewater treatment.

WASTEWATER MANAGEMENT PLAN

As required by the CD, the city began developing a Wastewater Management Plan (WMP) and CSO Long-Term Control Plan (LTCP) for submittal to EPA and MassDEP. The purpose of the WMP was to develop a plan of projects that would enable the city to comply with state and federal water quality standards by a 2030 deadline. Municipalities with combined sewers must create LTCPs to facilitate the removal of untreated CSO discharges to surface waterbodies. Per the CD, accomplishments needed to meet conditions in the NPDES permit by the deadline include aggressively phased sewer separation, reduction toward elimination of CSO discharges, diligent I/I detection and mitigation, and regular reporting of progress and scheduling adjustments demonstrating effective efforts to meet CD requirements. Additional work required by the CD included investigating and designing combined sewer separation projects and treatment facility upgrades to meet permitted standards.

In addition to the initial WMP submission, the city was required to submit two WMP update reports in December 2020 and December 2023.

The city submitted the WMP Phase I Report to EPA and MassDEP in May 2019. The report discussed improvements to the city's wastewater collection system between 1999 and 2019 and ongoing improvements to the EWWTF. In addition, the WMP included a CSO LTCP that developed a schedule to meet permitted CSO conditions. The LTCP identified the CSO controls necessary to comply with state and federal water quality standards and the city's NPDES permit requirements, establishing the city's plan to mitigate CSO discharges to the North Nashua River and other tributary water bodies. MassDEP requires that municipalities must perform sewer separation as the primary CSO control method, unless proven to have "substantial and widespread social and economic impacts." Following an economic analysis, the city developed an aggressive sewer separation project schedule to complete CSO mitigation.

The WMP Phase II Report was submitted in December 2020. The report discussed infrastructure studies and improvements that the city had completed between 2019 and 2020 and reviewed preliminary performance results from the EWWTF's secondary system upgrade. The Phase II Report also identified the city's anticipated schedule for sewer separation-related projects for the next three years and updated the remaining schedule to meet CSO conditions in the CD.

The WMP Phase III Report was submitted in December 2023. The report discussed studies and improvements completed between 2020 and 2023, listed the work planned for the next three-year period, assessed the abatement anticipated, and again updated the anticipated remaining schedule to meet CSO conditions by the CD deadline. The city is persistently following the combined sewer separation program schedule from the Phase I, Phase II, and Phase III reports.

Because of the anticipated issuance of an updated NPDES permit, the city will provide a Supplemental WMP Phase III Report in December 2024. The supplemental report will describe improvements to the EWWTF, as well as the completion of recent CSO and I/I mitigation projects, and will recommend additional EWWTF upgrades (if needed) to meet the updated NPDES permit.

Table 1. Historic sanitary sewer evaluation surveys and investigation projects

Year	Project	Type of System	Description of Work
1999	CSO Master Plan	Combined	Modeling of combined sewer system
2002	CSS 1, 2, and 3	Combined	17,143 LF (5,225 m) of television inspections, 137 MH inspections, and 26,282 LF (8,011 m) of smoke testing
2011	City-Wide Infiltration and Inflow (I/I) Analysis	Sanitary/Combined	City-wide flow metering
2012	John Fitch Highway Investigations	Sanitary	7,725 LF (2,354 m) of television inspections, 30 MH inspections, and 7,725 LF (2,354 m) of smoke testing
2012	CSS 4D	Combined	24,000 LF (7,315 m) of television inspections, 128 MH inspections, and 40,000 LF (12,192 m) of smoke testing
2015	Beech and Hazel Street Separation	Combined	4,880 LF (1,487 m) of television inspection, 37 MH inspections, and 8,000 LF (2,438 m) of smoke testing
2016	SSES Scope of Work	Sanitary	City-wide flow metering
2018	Hydraulic Model	Sanitary/Combined	City-wide modeling for pipes 12 inches (30.5 centimeters) in diameter and larger and 870 MH inspections
2018	SSES Phase I	Sanitary	35,800 LF (10,912 m) of television inspections, 566 MH inspections, 130,000 LF (39,624 m) of smoke testing, 31 dye tests, 184 building inspections, and flow isolation
2018	SSES Phase II	Sanitary	56,520 LF (17,227 m) of television inspections, 399 MH inspections, 28,150 LF (8,580 m) of smoke testing, 6 dye tests, 94 building inspections, and flow isolation
2011-2018	Capacity, Management, Operation and Management (CMOM) Program	Sanitary/Combined	Ongoing CMOM efforts resulted in 661,020 LF (201,479m) (88%) of sewers and 1,546 (43%) of MHs inspected (including above projects)

Table 2. Historic sewer separation and rehabilitation projects

Year	Project	Type of System	Description of Work
2009	CSS-1, 2, and 3	Combined	Construction of new drains and catch basins to separate approximately 12,000 LF (3,658 m) of combined sewers
2012	CSS 2B and 3C	Combined	Installation of 11,780 LF (3,590 m) of storm drains and 115 catch basins/storm inlets to close 10 CSO regulators
2012	Jeffrey Street Extraneous Flow Removal	Sanitary	Removal of sump pumps and a perforated drain to remove 445,000 gallons per day (gpd) (1.7 million liters per day [ML/d]) of I/I
2014	Nashua River MH Rehabilitation	Sanitary	Repair of trunk sewer MHs in the North Nashua River that contributed a combined 17-22 mgd (745-964 ML/d) of inflow after being dislodged
2014	Drury Street Easement Rehabilitation	Sanitary	Rehabilitation of a 300-LF (91-m) pipe that was contributing 25,000 gpd (94,635 L/d) of infiltration
2015	John Fitch Highway Investigations	Sanitary	Sewer replacement on John Fitch Highway to mitigate 942,900 gpd (3.6 ML/d) of I/I
2015	CSS 4D	Combined	25,000 LF (7,620 m) of sewer separation that resulted in the closure of CSO 072, 024, and 033
2017	Beech and Hazel Street Separation	Combined	4,000 LF (1,219 m) of sewer separation

INFRASTRUCTURE IMPROVEMENT PROJECTS (2018 TO PRESENT)

During development of the WMP Phase I and CSO LTCP, the city's remaining combined sewer system was primarily concentrated near the city center. In total, 8.4 mi (13.5 km) of combined sewers and 11 CSO regulators remained active in the city in 2019. After analyzing the WMP and CSO LTCP, the city adjusted its capital improvement plan (CIP) to prioritize sewer separation projects for CSO control.

The sewer separation projects were prioritized based on the number of historical overflow events and volumes and on the locations of the CSO regulators. Since most of the CSO regulators are upstream of the largest regulator (CSO 064) as shown in Figure 1, sewer separation of the entire tributary area is required prior to CSO 064 closure. As a result, that closure was identified as the last of the four sewer separation projects to be conducted, completing closure of all the city's remaining CSO regulators.

While the WMP and CSO LTCP strategically targeted the combined sewer system, the city also conducted investigation and rehabilitation projects in its wastewater collection system.

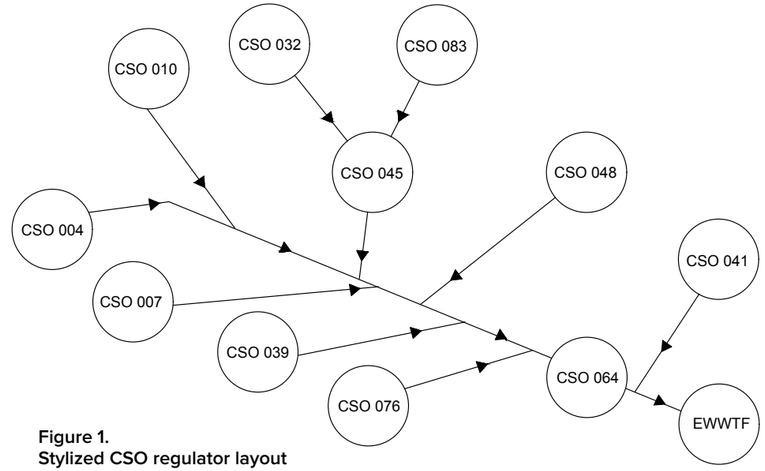


Figure 1.
Stylized CSO regulator layout

One of Fitchburg's CSO regulators

SSES Phase IV Interceptor Evaluation

In 2019, the city conducted the fourth phase of its SSES. This included multi-sensor inspections on approximately 31,144 LF (9,500 m) of interceptor sewers ranging in diameter from 18 in. (46 cm) to 48 in. (122 cm), including the wastewater interceptor. CCTV, laser, sonar, and hydrogen sulfide inspections were part of this work. The city also conducted 138 MH inspections, smoke tested 17,500 LF (5.3 km) of sewers, and inspected 60 buildings, costing $484,000.

Through the inspections and smoke/dye testing, the city identified five sump pumps and five catch basins connected to the sanitary sewer system. It then prioritized rehabilitation based on critical defects identified during these inspections. An estimated $14.7 million in sewer pipe, MH, and inflow rehabilitation was recommended.

Siphon/Various Sewers Heavy Cleaning and Inspection

In June 2020, the city started its siphon and sewer heavy cleaning and inspection project. The goal was to clean and inspect the city's five siphons as well as the sewers upstream and downstream of each siphon, along with sewers previously identified as containing heavy debris. The heavy cleaning and inspections were completed in October 2020.

During the cleaning and inspection, an estimated 284 yd^3 (217 m^3) of debris was removed from the wastewater collection system. A condition assessment was also performed for each siphon barrel and sewer inspected. An estimated $881,000 of high-priority sewer rehabilitation was subsequently recommended. The city spent over $450,000 for the investigation and cleaning performed in this project.

Elm Street Sewer Repair

During the siphon cleaning and inspection project, significant pipe degradation was observed in two 26 by 39 in. (66 by 99 cm) brick sewers on Elm Street. The pipes were missing significant brickwork near the invert and risked collapse. The city replaced the brick sewers with 36 in. (91 cm) PVC pipe. These repairs were completed in September 2020.

CSO 007, 011, 039, 048 Separation and Rehabilitation

In August 2018, the city began investigating and designing the CSO 007, 011, 039, 048 separation and rehabilitation project, aiming to close CSO regulators 007, 039, and 048. The investigation and design phases were completed in July 2020, with construction beginning that November and finishing in July 2023. The post-construction monitoring phase was completed in the summer of 2024. Through this project, the city closed three CSO regulators that had contributed an estimated 20.8 MG (78.7 ML) of CSO discharges to the North Nashua River between 2012 and 2020. The construction separated approximately 4,800 LF (1,463 m) of combined sewers through the installation of 4,850 LF (1,478 m) of new PVC sewers and 2,700 LF (823 m) of new HDPE drains, and separated 19 combination MHs. In addition, approximately 2,100 LF (640 m) of sewers were replaced in areas already separated and 20,000 LF (6,096 m) of sewers were rehabilitated across the project area. The city had previously closed CSO 011, but it still had combined sewers remaining upstream. Fitchburg spent $725,850 on the investigation and design and $9.6 million on construction. Drains in the project area were designed to function during an estimated 2070 10-year, 24-hour storm event.

Combination Maintenance Hole Separation Program

The city's NPDES permit requires that separation of combination MHs is required if there are signs of transference between the wastewater and stormwater collection systems. In 2019, the city began combination MH inspections and designed the separation of 150 combination MHs with known signs of transference. The city allocates funding to perform separations each year until all combination MHs are separated and is actively separating combination MHs throughout the city. Fitchburg also began integrating the combination MH separation program with combined sewer separation projects to achieve an accelerated, cost-effective, and comprehensive separation of combination MHs upstream of combined sewers. From 2016 through December 2023, the city had closed 155 of the 255 combination MHs, with 100 combination MHs remaining. The city will continue to integrate the combination MH separation program with the remaining combined sewer separation projects.

CSO 010, 032, 045, 083 Separation/ Rehabilitation

In July 2021, the city began investigating and designing the CSO 010, 032, 045, 083 separation and rehabilitation project, aiming to close CSO regulators 010, 032, 045, and 083, (photo previous page). The project includes the separation of approximately 27,600 LF (8,230 m) of combined sewers through the installation of 10,850 LF (3,300 m) of new PVC sewers, 1,450 LF (442 m) of new PVC drains, and 42,350 LF (12,900 m) of new HDPE drains. In addition, approximately 48,100 LF (14,660 m) of sewers were recommended for trenchless rehabilitation to repair structural defects and reduce I/I in the project area.

Drains in the project area were designed to function during the 2070 10-year, 24-hour storm event. The city received funding for this in fiscal years 2023 and 2024 through the Massachusetts Municipal Vulnerability Preparedness (MVP) Program to design related green infrastructure improvements within the project area.

The size of the area resulted in three phases of construction for the separation and rehabilitation: CSO 010, CSO 032/045, and CSO 045/083. The CSO 010 construction project was advertised for public bid in March 2023, and construction commenced that June. Construction is estimated to be completed by the end of this year, with post-construction monitoring and sampling concluding about one year later.

The CSO 032/045 construction project was advertised for public bid in June of this year with construction expected to commence in August, and the CSO 045/083 construction project is expected to be advertised for public bid in March 2025 with construction expected to commence that June. Construction of the CSO 032/045 and CSO 045/083 projects is estimated to be completed by the end of 2026 and the end of 2027, respectively, with post-construction monitoring and sampling in each phase concluding one year after construction completion.

Capacity, Management, Operation, and Maintenance Program

By early 2024, the city had inspected about 94 percent of its sewers and 57 percent of its MHs. Since the remaining sewers requiring inspection are beyond in-house capabilities, the city began re-inspecting sewers in the collection system, with about 19 percent now having been inspected. The remaining sewers that have not been inspected will be inspected through future sewer separation and rehabilitation projects.

FUNDING

Fitchburg has invested $82 million in the wastewater collection system and wastewater treatment facility improvements to comply with the CD. The city

Construction of green infrastructure during the CSO 010 project, in this case a bioretention cell

anticipates spending an additional $92 million on infrastructure improvements to close all remaining CSO regulators by 2030 through the separation of all remaining combined sewers, and additional funding sources were considered to help finance the required improvements.

Water and Sewer Rate Study

In 2023, the city performed a water and sewer rate study to determine the required rate structure for funding infrastructure projects enforceable under the city's CD while also considering the affordability of any necessary rate increases. Understanding and implementing the most appropriate rate structure to fund the required improvements was critical to the long-term financial sustainability and viability of the city's water and sewer funds. Workshops were held with the city's DPW and Water, Sewer, and Financial departments to review the financial and billing data for water and sewer services. The city also developed comprehensive water and sewer financial plans and rate structures.

Fitchburg's Easterly wastewater treatment facility

State Revolving Fund Loan Program for Sewer Separation

The city expects most of the funding for the remaining infrastructure improvements will come from the MassDEP's State Revolving Fund (SRF) Loan Program. Many of the previous infrastructure improvement projects required under the CD were also funded through this program, including the city's ongoing CSO 010 separation and rehabilitation construction project. The city has secured SRF funding for the upcoming CSO 032/045 separation and rehabilitation construction project and also intends to fund the future CSO 045/083 project through this program.

Municipal Vulnerability Preparedness Program

The city is committed to increasing the resiliency of its stormwater system for future conditions affected by climate change. As part of MVP funding requirements, stormwater improvements that are part of the city's sewer separation and rehabilitation projects will be designed to function during the projected 2070 10-year, 24-hour storm. MVP funding was targeted as a method of funding for stormwater improvements recommended in the CSO 010, 032, 045, 083 separation and rehabilitation project. The city received MVP funding for this project and has identified five locations for green infrastructure as part of the CSO 010 project. The city also intends to include 12 locations for green infrastructure between the CSO 032/045 and 045/083 projects.

The city is planning to apply for additional MVP funding for future sewer separation projects. This will coincide with its goal of implementing green infrastructure, wherever applicable and feasible, as identified in the CD.

Capital Improvement Plan Update

In the next three years, Fitchburg will have three major combined sewer separation projects underway, each in a different stage. Four additional remaining sewer separation projects will close all the city's remaining CSO regulators. See Figure 2 for the current sewer separation schedule. The city also plans to separate combination MHs as funding becomes available.

CONCLUSION AND SUMMARY

The city continues to address approximately 7.4 mi (11.9 km) of combined sewer, eight CSO regulators, and 100 combination MHs remaining in its wastewater collection system. Most of its upcoming capital improvement projects will focus on CSO mitigation through sewer separation, along with additional I/I mitigation through combination MH separations and sewer rehabilitation. In addition to the elimination of CSOs from the wastewater collection system through the combined sewer separation, and I/I mitigation, the city anticipates a reduction in total and peak wastewater flows conveyed to the EWWTF during storm events. This will also provide significant improvements to water quality in the North Nashua River.

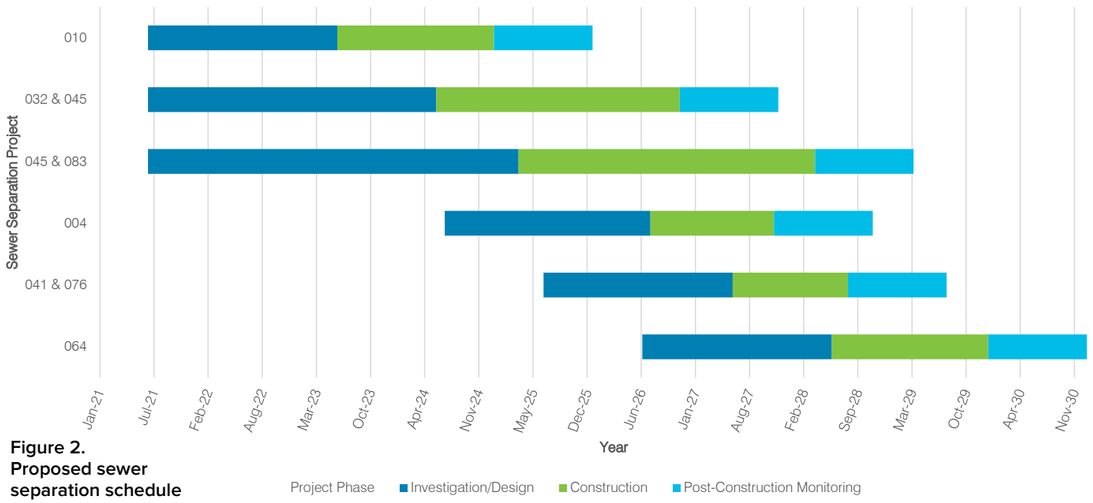


Figure 2. Proposed sewer separation schedule

The city has invested over $82 million in the wastewater collection system and wastewater treatment facility improvements to comply with the CD. It expects to spend an additional $92 million over the next six years to continue with sewer separation and rehabilitation projects to close the remaining eight CSO regulators and meet the CD deadline of 2030.

For communities undertaking a large CSO separation or other project similar to Fitchburg's, the following is recommended:

- **Develop a plan**. Combined sewer systems should be evaluated holistically in the long term, factoring CSO mitigation in with other infrastructure improvements.
- **Assess vulnerable conditions**. CSO communities with highly variable flow rates have different vulnerabilities than other communities and these should be considered when planning long-term improvements.
- **Develop an annual investigation and operation and maintenance (O&M) program**. Combined sewer systems introduce large amounts of grit and debris into the wastewater collection system, requiring a robust investigation and O&M program.
- **Consider your wastewater and stormwater system's resiliency** as part of the proposed improvements.
- **Take it one step at a time.**

ACKNOWLEDGMENTS

The authors acknowledge Nick Erickson, PE (commissioner of public works and city engineer), Mark McNamara (deputy commissioner and acting plant superintendent of wastewater), Ken Dupont (sewer system manager), and Jeff Hillman, PE (superintendent of streets and civil engineer) from the Fitchburg DPW for their support of the ongoing sewer separation projects in the city.

REFERENCES

United States Environmental Protection Agency. Where Combined Sewer Overflow Outfalls Are Located | US EPA. Last updated on June 10, 2024, Accessed July 29, 2024.

ABOUT THE AUTHORS

- Christopher Mackin is a senior project manager at Weston & Sampson in Worcester, Massachusetts. He has over 20 years of experience in wastewater and stormwater collection systems, stormwater design, and site and civil engineering. He earned his Bachelor of Science in Civil Engineering from Worcester Polytechnic Institute (WPI).
- Frank Occhipinti is the Worcester regional manager for Weston & Sampson in Worcester, Massachusetts. He has more than 25 years of experience specializing in the planning, design, and construction of sanitary and storm sewer projects, as well as I/I analysis and sewer rehabilitation. He earned his Bachelor of Science in Civil Engineering Technology from the Wentworth Institute of Technology.

NEBRA Highlights

Connecticut joins Maine in banning biosolids-based products

Connecticut became the second state in the Northeast to ban biosolids-based products. The prohibition is part of a new law that could significantly reduce sources of per- and polyfluoroalkyl substances (PFAS) in the water environment in Connecticut. An Act Concerning the Use of PFAS in Certain Products (PA 24-59) was passed by the Connecticut Legislature and signed into law by Governor Ned Lamont on June 5. NEBRA's Reg-Leg Committee had been watching and supporting the bill for its source reduction potential. However, a late addition to the bill banned the use and sale of biosolids products in the state as of October 2024.

Bagged biosolids products like this that are registered as fertilizer may escape the Connecticut ban that goes into effect October 1

The aim of this legislation was to ban products with intentionally added PFAS—including outdoor apparel, carpeting, and firefighter gear. It is similar to what other states like Maine have proposed for product bans. Like Maine, Connecticut has followed with a biosolids ban.

The original bill, SB-292, was introduced in February and assigned to the legislature's joint Environment Committee. It did not include mention of biosolids or wastewater sludge when it was voted out of committee in March. In addition to NEBRA, the Connecticut Water Environment Association (CTWEA) and NEWEA were also tracking the bill. A subsequent amendment was introduced by Senator Lopes from the 6th District which included definitions for "biosolids" and "wastewater sludge" and the ban on biosolids products. The language reads: "No person shall use, sell or offer for sale in this state as a soil amendment any biosolids or wastewater sludge that contain PFAS."

The section of the law applying to biosolids products is effective October 1, 2024. The timeline for other products varies over the next two to three years.

According to the National Biosolids Data Project (BiosolidsData.org), Connecticut is primarily reliant on incineration as a biosolids end use. Only two water resource recovery facilities (WRRFs) in Connecticut create biosolids products: Stamford and Fairfield. The impacts on biosolid management operations for those two large WRRFs are unknown. However, the ban is expected to affect the region as there are many dried biosolids and compost products being imported and used in Connecticut. A small glimmer of comfort is that bagged biosolids products generally have a fertilizer certification in the states where they are sold, and the Connecticut Department of Agriculture intends to allow biosolids-based fertilizers to continue being used, but probably only if they meet the 1.6 ppb PFAS limit recommended a couple of years ago.

Woonsocket sludge incinerator to phase out acceptance of liquid sludges

Woonsocket, Rhode Island, recently took the first step toward notifying all pertinent parties that it will be phasing out the acceptance of liquid sludges at the municipality's sewage sludge incinerator (SSI). The city council unanimously approved a resolution to that effect at its May 22 meeting. The reasons were set forth in a number of "whereas" clauses, including factors such as liquid tank trucks taxing the city's transportation and wastewater infrastructure and, especially, odors. The resolution also blames the SSI operator for the permit violations at the city's WRRF.

The Woonsocket SSI is co-located on the property with the city's WRRF on Cumberland Hill Road in Woonsocket, on the banks of the Blackstone River. Woonsocket contracts for both WRRF and SSI operations with Jacobs Engineering and Synagro, respectively. All three entities are the subject of legal action by the Rhode Island Attorney General's office taken in March 2023 after a spate of discharge permit violations.

The resolution is considered the initial notice to all impacted communities. The city council pledges a "fair leadup time to allow other communities reasonable notice to find alternative options to dispose of their merchant liquid sludge" and commits to a "formal and viable plan including timeline" for the phase out of acceptance of liquid sludges.

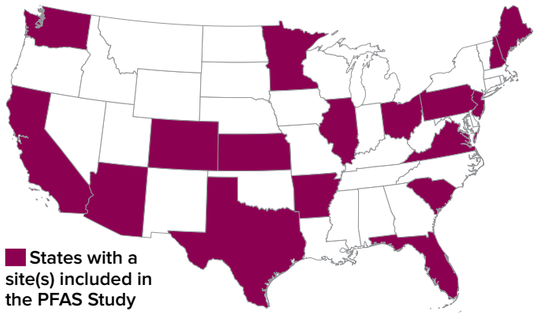
Woonsocket sewage sludge incinerator

The Woonsocket WRRF supplies about 10 percent of the sludge volume coming into the SSI. The remaining capacity is considered available for merchant sludge, mostly trucked in by Synagro under contract with numerous municipalities in the region. The Woonsocket SSI can process about 105 dry tons (95 tonnes) of sludge per day, with about half of that—about 50 dry tons (45 tonnes) per day—currently in the form of liquid, non-dewatered sludge. For perspective, 50 dry tons (45 tonnes) of sludge per day is equivalent to the amount of sludge processed by the Upper Blackstone Clean Water (UBCW) SSIs in nearby Massachusetts, so this action will have a significant impact. Numerous Rhode Island communities will be affected. Connecticut and Massachusetts facilities will be affected too, especially smaller ones that still generate liquid sludge. Dewatering will become even more critical now for these facilities.

Synagro has completed notifying all its customers about the city's plan to phase out liquid sludge; however, there is no phaseout timeline and no plans available yet from Woonsocket.

Phase 1 of National Collaborative PFAS-Biosolids Study nearly complete

The national research project being led by University of Arizona professor Ian Pepper, looking at the fate and transport of PFAS in land-applied biosolids, has made progress. The project team issued a seven-page report in July. It says the project has collected what to date is believed to be the largest U.S. data set on "incidence and distribution of biosolids derived PFAS."



States with a site(s) included in the PFAS Study

The National Collaborative PFAS study includes 23 sites with a documented history of biosolids use spread across 17 states. One site was eliminated from the research because the biosolids used had been industrially impacted. The study is looking at what happens when non-contaminated biosolids are used. At those sites where the past application rate of biosolids is known, the team sampled the soil at 1, 3, and 6 ft (0.3, 0.9, and 1.8 m) intervals. It also sampled groundwater when possible and plans to get groundwater samples at the sites in the future. Twenty-seven soil samples are taken at each site for measuring 25 "representative" PFAS compounds.

Sampling and analysis have been completed at 14 of the 23 sites, and the researchers presented their findings to date in the July report. So far, they haven't found anything alarming at these sites with past histories of land application of biosolids. They noted the highest incidence was for PFOS found in the soils studied. They observed rapid attenuation of PFAS concentrations from 3 to 6 ft (0.9 to 1.8 m) soil depths and noted a greater risk of leaching for the short-chain PFAS compounds studied. Analyses continue.

The researchers are using this large dataset to model PFAS leaching from biosolids to groundwater. They have developed a customized model and hope to test the predicted concentrations in groundwater against the actual concentrations at the sites whenever possible.

Phase 2 of this project, which will require additional funding, will build on the Phase 1 work. The researchers hope to grow crops on these plots—that they now have much data on—to study the potential for crop uptake of PFAS in the biosolids-amended soils. If you would like to pledge a financial commitment to Phase 2, please email Dr. Ian Pepper at ipepper@ag.arizona.edu.

NEBRA gets $25k grant to update the BEAM

NEBRA has received a $25,000 grant from the Northwest Biosolids Association's (NWBA's) annual grant program to update the Biosolids Emissions Assessment Model (BEAM). The BEAM is in spreadsheet format and focuses on the greenhouse gas (GHG) emissions from solids-related processes. It uses emission factors to estimate GHGs from built-in formulas that are transparent. The BEAM calculates Scopes 1, 2, 3, and biogenic emissions. It can and is being used to estimate emissions from biosolids management programs, including establishing a baseline and comparing different biosolids management scenarios (currently up to 10). It can be used to estimate impacts from changes in biosolids management practices as well as to better understand the factors that have the greatest impact on GHG emissions for your program.

The funding from Northwest Biosolids will allow NEBRA to go beyond just reviewing and updating the BEAM to reflect the latest emission factors and science for calculating GHGs from wastewater solids processing and management. The funding will cover structural changes to the spreadsheet tool with an eye toward the future addition of emerging technologies such as hydrothermal carbonization and hydrothermal liquefaction. Increasing outreach and education on the BEAM is also part of the grant project. The website (BiosolidsGHGs.org) will be a big part of that and become a resource for making a copy of the updated BEAM available when it is ready. The website can also be a place to share experiences using BEAM, including data outputs.

Owing to Northwest Biosolids, NEBRA hopes to check off many of the recommended changes in the BEAM*2024 version. The BEAM science review team (comprising five PhDs) recently completed its work reviewing emission factors

and calculations based on the latest science. The BEAM will continue to be a respected source for biosolids-specific emissions, reductions, and sequestration factors (as found in references). The long-term goal is for the BEAM to be helpful in developing protocols and working with registrars to allow for marketable carbon offsets for biosolids practices.

Biosolids workers sought for Johns Hopkins study

The Johns Hopkins University's (JHU's) Department of Environmental Health and Engineering in the Bloomberg School of Public Health needs biosolids workers to participate in a study. Participation includes a one-hour, in-depth interview about your work. The researchers are seeking anyone 18 or older who has transported or applied biosolids products to agricultural lands for at least a year. Participants will be compensated with a $50 gift card. For more information, check out their flyer. Contact JHU's Riley Demo (rdemo2@jh.edu) for further involvement.

VTDEC publishes septage management and capacity study

About 55 percent of Vermont properties use onsite wastewater treatment—or septic systems. The Vermont Department of Environmental Conservation (VTDEC) recently released a contracted study that evaluated the efficiency and capacity for septage management statewide over the next 20 years. The 32-page report, followed by 20 pages of references and addenda, concludes that the capacity is there for septage; it's just not in the right places. The report recommends several alternatives for improving septage management in Vermont. The project included geographic models of septage hauling alternatives. For a copy of the report, go to vermont.gov.

NATIONAL BIOSOLIDS DATA PROJECT

New summary report posted on National Biosolids Data Project

The final report on the National Biosolids Data Project is now available on its website. NEBRA led the project to collect and compile data on biosolids end-use practices for 2018, selected as a pre-PFAS-impacts look at biosolids management in the United States. Thanks to former NEBRA Executive Director Ned Beecher for following through on the report writing on behalf of the research team. The final report compiles and analyzes all the project's 2018 data, with dozens of tables, figures, graphs, and assessments of data quality. It includes survey responses about regulatory oversight, energy and economic aspects of biosolids management, barriers to anaerobic digestion and biogas use, trends, and selected quotes from respondents. It includes extensive references and the full literature review along with survey methods in Appendix 1.

NHDES proposing soil cleanup standards for PFAS

Although the New Hampshire Department of Environmental Services (NHDES) residuals program has been studying the fate and transport of PFAS in biosolids into the soil with the U.S. Geological Survey (USGS), another arm of the NHDES proposes to set standards for soil cleanup that are below background levels found by the USGS. The background levels were not considered based on the reasoning that "PFAS are manmade, therefore no natural background concentrations are proposed." This is of concern for biosolids beneficial use programs. NHDES was required by the legislature to initiate rulemaking for soil remediation standards for PFAS by November 1, 2023. The rules are being proposed as a revision to Chapter EnvOr 600. The New Hampshire Water Pollution Control Association, NEBRA, and others have submitted comments on the proposal, expressing concerns about impacts on groundwater discharge permits, the potential to impact soil excavated from construction projects, the use of an inappropriate regulatory framework intended for oil and hydrocarbon cleanup, and the lack of a cost–benefit analysis as required by law.

Mark your calendars

The joint NEWEA and NEBRA annual Northeast Residuals & Biosolids Conference event is scheduled for November 13–15 at the Graduate Hotel in Providence, Rhode Island.

NORTHEAST RESIDUALS & BIOSOLIDS CONFERENCE

NOVEMBER 13–14, 2024 / Providence, RI

Read more on these topics and stay abreast of the latest biosolids/residuals news and events at nebiosolids.org/news.

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

Committee Focus

Watershed Management

Swales & Ales nature-based resiliency project tour in Exeter, Rhode Island

Who better to ask about wet weather than the Watershed Management Committee? The *Journal* reached out to Steve Wolosoff, current committee chair, to learn more about the committee and the challenges that wet weather poses for watershed management in New England.

Journal *Can you tell us about the Watershed Management Committee and its goals?*

The Watershed Management Committee aims to promote an understanding of water quality regulations, generate enthusiasm for complex watershed-scale analysis, and collaborate with professionals and other NEWEA committees with a broad range of scientific knowledge. The committee comprises friendly, fun-loving individuals from the public and private sectors who share a passion for watershed management issues, both in their day-to-day work and recreationally. We are always open to new members and encourage anyone who might be interested in joining our committee to reach out to us.

■ *What has the Watershed Management Committee been up to lately?*

The Watershed Management Committee recently hosted our 5th Annual Source Water Homebrewers Competition at Tilted Barn Brewery in Exeter, Rhode Island. Joe Zaleski was victorious for a third consecutive year, and we are hoping for some new brewers to challenge his reign in 2025. Each brewer creates an original beer using local source water, and attendees sample each beer and vote for their favorite. The idea behind the event is to increase public awareness about water quality while also creating a fun networking opportunity that supports the local businesses that work with us to host the competition each year. For the past two years, the competition has been preceded by a Swales & Ales tour that highlights local nature-based resiliency projects. Past Swales & Ales events have included a tour of the town brook dam removal, led by David Gould of the Plymouth Department of Environmental Affairs in Plymouth, Massachusetts, and a tour of a floating wetland installation, led by a University of Rhode Island graduate student in Exeter, Rhode Island.

In addition to the 6th Annual Homebrewer Competition (and beyond!), the Watershed Management Committee also plans to host additional Swales and Ales tours, and develop a forum article about the challenges to addressing fecal bacteria impairments. Also be on the lookout for a specialty conference in coordination with other NEWEA committees.

Joe Zaleski celebrates with a glass of his winning Berliner Weisse

■ *What are the biggest challenges for watershed management in New England?*

Watershed management is a muti-disciplinary field, and challenges are widespread. Our committee members often speak of various challenges to many aspects of Clean Water Act regulation and scientific and technological advancements that we are using to address them in the long-term. Several challenges that were shared with Watershed Management Committee members are discussed below.

Lack of coordination between watershed stakeholders and regulators

In New England, National Pollutant Discharge Elimination System (NPDES) discharge regulations have focused on point sources including wastewater treatment plant (WWTP) effluent and combined sewer overflows (CSOs). Management of stormwater sources is inefficient, with Municipal Separate Storm Sewer Systems (MS4s) disjointed into many individual towns and cities, most of which have no dedicated funding stream for stormwater program implementation. Also, there are limited requirements for non-point sources such as agriculture, and in some cases significant voluntary actions are not being tracked and credited. In large watersheds draining to impaired receiving waters with a diverse range of pollution sources, our current regulatory approach and funding streams have been obstacles to rehabilitation efforts that consider a watershed holistically.

For example, if a pond is impaired, a municipality may be required to implement extensive stormwater management under MS4 permits when more effective and lower cost holistic management strategies may be available, including non-point source controls or the use of technologies to reduce nutrients within receiving waters. For wet weather, implementation of latter phases of long-term control plans (LTCPs) may be less effective than a watershed management strategy that allows for other sources that occur more frequently to be prioritized and funded. An alternative watershed management strategy involves creation of multi-agency groups within common watersheds that can pool resources to implement projects to most effectively reduce pollution and improve water quality in receiving waters.

Recognizing the strength in numbers, MS4s have formed several coalitions in Massachusetts organized around watersheds and geography. Similarly, wastewater dischargers have coordinated implementation with common downstream waterbodies such as Connecticut WWTPs in the Long Island Sound watershed. EPA has renewed its commitment to integrated planning with the Water Infrastructure and Improvement Act of 2019. There should be opportunities for holistic groups of stakeholders within common watersheds, including point and non-point sources, to pool resources in collaboration for the most cost-effective and impactful management of water quality.

Impacts of climate change

Weather is getting wetter, and with more intense rain there is more pollution from stormwater runoff. Retrofitting stormwater best management practices in MS4 drainage areas may be needed just to maintain historic levels of pollutant loading and downstream flooding. Stormwater controls to provide a net reduction in loading will need to be larger in the future. Within receiving waters, warmer water creates more favorable conditions for harmful algae bloom species and reduces the assimilative capacity for nutrients due to earlier ice-out, causing longer periods of thermal stratification and associated internal loading from bottom sediment.

Imbalance of time and investment

New England has older infrastructure than most places in the nation and suffers from having combined systems in many communities; thus, we are far behind the starting line compared to many others. Substantial investments have been made to reduce CSOs in the region, but frequent events continue to occur. In areas without centralized sewers, septic systems are aging, and soils that provide important treatment of leachate between the systems and downstream waters are reaching their limit. Controlling spatially diffuse pollution from urban stormwater is a momentous task with the vast geographic extent of urban drainage infrastructure. Repairs are needed to address age, upgrades are needed to address population growth and increased intensity of rain events, and funding is limited to also incorporate pollution reduction controls into projects.

Janelle Bonn, in waders, demonstrates the versatility of a floating wetland

2024 Stockholm Junior Water Prize

Justin Bernstein of Connecticut Wins National Competition

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

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

Justin Bernstein of Connecticut wins national competition

The 27th annual national SJWP event, was held this year at the Colorado School of Mines. The competition is open to projects focused on improving water quality, resource management and protection, and drinking water and wastewater treatment. Thirty-nine states and Puerto Rico were represented by 47 students, with their travel sponsored by their respective WEF member associations. Over 150 volunteer judges chose winners at the state level.

Justin Bernstein of Greenwich, Connecticut, was awarded the U.S. national Stockholm Junior Water Prize for his research on using a genetically engineered cryobacterium to protect glaciers. Bernstein received a $10,000 prize and traveled to Stockholm in August to represent the United States at the international competition. Greenwich High School is on a roll—last year, Greenwich student Naomi Park won the national and the international competition. The international winner receives a $15,000 prize and a crystal trophy presented by HRH Crown Princess Victoria of Sweden.

Other students receiving awards at the SJWP ceremony included two runners-up. Krishnam Goel of Utah conducted research on redefining the paradigm of toxic algal blooms under nutrient-limited conditions. The team from Pennsylvania—Aditya Kothari and Remington Yang—was also named as a runner-up for its prototype using nonthermal plasma coupled with granular activated carbon to degrade short-chain polyfluoroalkyl substances.

Two other awards were also part of the SJWP national event. **Dylan Striek of Massachusetts was awarded the Bjorn von Euler Innovation in Water Scholarship for his project,** "The Electrolytic Extraction of Dawsonite from Ocean Water: Efficient Salt Water Mineral Recovery Through Electrolysis." Mahi Patil of Florida received the James L. Condon Recognition for Environmental Stewardship for her project, "Year 2: A Novel Biodegradable Sorbent for Oil Spills."

Thank you to the state associations for their continued support and our NEWEA judges for volunteering their time and expertise to review papers: Megan Ambrose, Tracy Chouinard, Laura Marcolini, Amy Mueller, John Tillotson, and NEWEA SJWP Coordinator and judge Annalisa Onnis-Hayden. Read the following abstracts to learn more about the winning projects from New England.

Connecticut

Justin Bernstein
Greenwich High School
Greenwich, CT
2024 SJWP U.S. Winner

Genetic engineering of cryobacterium to increase silica content and enhance the glacial albedo of black arctic oceans

Arctic glaciers are rapidly melting due to climate change, leading to dangerous rises in sea levels. This phenomenon is exacerbated by the absorption of incident solar radiation by arctic dark water, which increases sea-temperatures, accelerating the melting process in a negative feedback loop. While the use of silica microbeads on arctic ice was previously proposed, this solution is not easily scalable or plausible. Thus, a novel, environmentally-safe, genetically-engineered strain of Cryobacterium, native to Arctic ice, was developed herein to better reflect solar radiation, and protect glaciers. Cryobacterium were first transformed to express silicatein and sillafin, proteins that facilitate biomineralization, through the use of calcium chloride and heat shocking. Reflectance spectroscopy demonstrated a 2.5x increase in UV and visible light reflectance for the new biomineralized bacteria (versus wild-type), after integration of dissolved silicon. Engineered Cryobacterium also exhibited resistance to thermal changes caused by visible illumination and demonstrated successful formation of protein-glass complexes through fluorescence analyses. Silicon uptake was confirmed through a UV-Vis silicomolybdate colorimetric assay combined with scanning electron microscope and energy dispersive spectroscopy analyses. Finally, the presence of biomineralized Cryobacterium led to a 1.5x increase in UV-visible light reflection of ice, suggesting that biomineralized Cryobacterium could potentially slow or reverse polar ice melting, and disrupt the warming trend and rise in ocean water levels. Notably, the biomineralized Cryobacterium showed 1.16x greater reflectivity than wild-type Cryobacterium, which could increase Arctic ice albedo from 47% to 54%, potentially undoing 30 years of decline in arctic ocean ice coverage and the increase in ocean temperature.

Massachusetts

Dylan Striek
Hopkinton High School,
Hopkinton, MA

The Electrolytic extraction of dawsonite from ocean water: efficient salt water mineral recovery through electrolysis

As global warming worsens, organisms in the ocean experience life-altering adversity. To decrease the significance of emission-formed ocean alteration, a lesser-known method of carbon sequestration, known as electrolysis, was improved. Three variables of time (5-15 min.), distance (1-2 in. [2.5 - 5 cm]), and voltage (1-3 9V batteries), were tested on 100mL of distilled water, 0.2 mol CO_2, and 0.05 mol NaCl and ranked based on dawsonite, a mineral fire retardant, production along with pH change. The study showed that Trial 16 (1 in, 1 battery, 10 min) produced a far larger amount of dawsonite than all trials except for Trial 18 (1 inch, 3 batteries, 10 minutes) through a t-value of 0.11. However, a correlation coefficient (0.03) showed that batteries had minimal effect on results, allowing for Trial 16 to be deemed most efficient due to minimal energy requirements. To further convey that Trial 16 is the most efficient, scalable experiments were performed which showed that when the variables were scaled 2x and 3x, the yield increased accordingly. Recycled aluminum was also tested, and gum wrappers were deemed sufficient.

New Hampshire

Mihir Garimella
Nashua High School South
Nashua, NH

Low-cost autonomous surface vehicle for water monitoring

Water bodies are central to communities, and provide countless societal and ecological benefits. Human harm in the form of pollution and climate change has done nearly permanent damage to these habitats, and a lack of effective monitoring of these water sources has made it challenging to assess the damage done. While methods such as manual water sampling exist, problems arise when considering the ability of these approaches in allowing real-time monitoring and free movement. In this study, through a rigorous build and testing process, we introduce a novel, low-cost Autonomous Surface Vehicle (ASV) with offline waypoint movement and a comprehensive object avoidance system. Utilizing a cost-effective USB camera-based system for perception, the introduced ASV reduces costs by over 80 percent, while effectively maneuvering around obstructions and moving on command. The ASV has the potential to be used in under-resourced communities to understand the health of water bodies, as well as to allow individuals to adapt to changes caused by ecological destruction. The system may aid in enabling widespread environmental monitoring and effective conservation efforts, improving community and ecosystem wellbeing.

Rhode Island

Enyu (Alaina) Zhang
Portsmouth Abbey School
Portsmouth, RI

The application of sugar kelp as a sustainable and economic biofilter for wastewater treatment

Eighty percent of global wastewaters are discharged untreated into the environment, negatively impacting marine biodiversity and human health. This research proposes a sustainable, efficient, and cost-effective solution through sugar kelp (Saccharina latissima) farming in coastal areas for concurrent removal of excess nitrogen (N) and carbon (C) from water environments. A custom kelp farm was established in Portsmouth, Rhode Island, to collect field data from February to April 2024. The monthly samples demonstrated significant nutrient removal rates as the N and C contents were analyzed with dynamic flash combustion based on the Dumas method. The C:N ratio also shows that C removal rate increases over time as N removal rate reaches its peak in April. These data are then integrated into a 1-Dimensional box model to simulate 2.5-acres (1 ha) kelp farm capacity, demonstrating a N removal rate of 43.2 percent and a C removal rate of 0.8 percent while being 99.3 percent cheaper in operational costs. Isotope analysis ($\delta^{15}N$ and $\delta^{13}C$) suggests the nutrient sourcing and metabolic pathways in sugar kelp. While this study highlights the promising potential of sugar kelp farming for wastewater treatment, further investigation regarding scalability and heavy metals accumulation within kelp are recommended. Overall, this research underscores the viability and sustainability of sugar kelp farming as a solution to address wastewater treatment and environmental conservation challenges.

Maine

Clodine (Minchae) Kim
Fryeburg Academy
Fryeburg, ME

Performance of synthesized nanobots on micro and nano plastic adsorption in real-world aquatic environment

Ubiquitous plastic contamination in aquatic environments has posed health risks to humanity through permeation into the food chain, suggesting the imperative of advanced water remediation techniques. This study assesses the real-world applicability of iron-based Prussian Blue (FeHCF)—a synthetic pigment used to dye blue jeans—in micro and nanoplastic agglomeration (MNPA) known to occur through self-propelled fuel-free movement of FeHCF nanobots. To this end, these nanobots were added to water samples obtained from Fryeburg, Maine: landfill effluent—a primary source of micro and nanoplastics (MNPs) in the environment—and bottled water—a primary source of MNPs in human diet. Within all water samples, FeHCF nanobots induced noticeable decline in turbidity and changes in microscopic images, demonstrating a significant role in MNPA. For the first time, this study demonstrates the performance of FeHCF nanobots in real-world aquatic environments and proposes a novel method to quantify MNPs with estimated filtrate mass calculation. The calculated number of MNPs in bottled water (1L) in this study aligns with its recently reported magnitude, showing the promising potential of FeHCF nanobots to remediate global plastic pollution and latent health risks.

New Members May–August 2024

Nicholas Benavides
New York, NY (STU)

Laura Camargo
Boston, MA (YP)

Eric Carty
Town of Hopkinton, MA
Hopkinton, MA (PWO)

Devon Case
NEIWPCC
Lowell, MA (YP)

Christopher Cline
Town of Yarmouth
Yarmouth, ME (PWO)

Ryan Connor
CDM Smith
Boston, MA (YP)

Anthony Corrente
Town of West Warwick
West Warwick, RI (PRO)

Alex Cross
WateReuse Association
Alexandria, VA (YP)

Kaylee Cruz
Waltham, MA (PRO)

Benjamin Davis
Scarborough Sanitary District
Scarborough, ME (STU)

Donatella DeFazio
Canton, CT (STU)

Madelyn Dwyer
Dewberry Engineers Inc.
Boston, MA (PRO)

Drew Gallant
Environmental Partners
Woburn, MA (PRO)

Maria Murillo
Lexington, MA (STU)

Reem Gawish
Northeastern University
Boston, MA (STU)

Matthew Hane
NTM
Pittsfield, MA (PWO)

Emily Heneghan
East Meadow, NY (STU)

Christopher Johnson
Kennebunk Sewer District
Kennebunk, ME (PRO)

Kaylee Jurecka
Infiltrator Water
Old Saybrook, CT (YP)

Audrey Karl
CDM Smith
Bethel, CT (YP)

Julia Kelly
Hazen and Sawyer
Boston, MA (YP)

Stella Klingebiel
Northeastern University
Kent, CT (STU)

Eric Lemoi
Wright-Pierce
Providence, RI (YP)

Rotem Leshed
Boston, MA (STU)

Serge Loubier
Englobe Corp
Sherbrooke, QC (PRO)

Jose Lovell
Kleinfelder
Springfield, MA (PRO)

Philip McHenry
Wright-Pierce
Portsmouth, NH (YP)

Craig Meehan
United Concrete Products
Yalesville, CT (PRO)

Jeffrey Neal
Town of Ipswich
Ipswich, MA (PWO)

Megan Patton
Kleinfelder
Rocky Hill, CT (YP)

Zacariah Perkins
City of Bath WPCF
Bath, ME (PRO)

David Perrotta
The Maher Corporation
Milton, MA PRO)

Alyson Pohlit
Environmental Systems
Chesterbrook, PA (PRO)

Joseph Prata
NBC
Providence, RI (PRO)

Nick Protasowicki
UNH
Littleton, MA (STU)

Ariel Roh
Vanderbilt University
Nashville, TN (STU)

Anna Ropes
CDM Smith
Manchester, NH (YP)

Megan Ruggieri
Woodard & Curran
Providence, RI (STU)

Kirsten Ryzewic
NHDES
Concord, NH (YP)

Arjav Shah
MIT
Cambridge, MA (STU)

Daphne Short
NEIWPCC
Lowell, MA (YP)

Lydia Silber
WateReuse Association
Alexandria, VA (YP)

Joshua Soper
CDM Smith
Boston, MA (YP)

Gordon Starr
Town of Barnstable, MA
Barnstable, MA (ASSOC)

Laurie Stevens
Brookline, NH (PRO)

Rachel Tenney
Tighe & Bond
Amherst, MA (YP)

Tia Trate
Danbury, CT (PRO)

Ross Tsantoulis
Woodard & Curran
Andover, MA (PRO)

Niccolo Valente
Tighe & Bond
Portland, ME (YP)

Kaleigh Walsh
Chelmsford, MA (YP)

Robert Whalen
Woodard & Curran
Tiverton, RI (YP)

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

Connecticut State Director Report

by Vanessa McPherson
vanessa.mcpherson@arcadis.com

I'm pleased to share information about what we are up to in Connecticut. We have been building on the fantastic momentum generated by our organization and the support of our membership.

CTWEA Board of Directors updates

First, we introduce our newest directors for Connecticut Water Environment Association (CTWEA)—Robert Butler, Rick Hartenstein, and Jamie Kreller. We are excited for their added perspectives and participation.

New directors: Robert Butler, Rick Hartenstein, and Jamie Kreller

Rob is in his 10th year at the South Windsor Water Pollution Control Facility (WPCF). He started in an entry-level position and has moved up to lead operator. He is passionate about process control but has also worked a lot in maintenance and the collections system. Rob is the vice-chair of CTWEA's Operations Committee.

Rick has been superintendent of Water Pollution Control in Stafford for over 10 years. He started as a laborer and worked his way up to superintendent, over a 33-year span. He oversaw the upgrade of the town's pump stations, the WPCF upgrade, and an inflow and infiltration study. Rick has been an advocate, judge, and safety event coordinator for Operations Challenge and actively supports that program.

Jamie is the wastewater superintendent in Suffield and has a wealth of knowledge in wastewater process control and facility administration from his years of experience in operations. He received the EPA Region 1 2023 Operator of the Year Award. Jamie is an active member of the CTWEA Government Affairs and Operations committees, and he also takes a lead role facilitating the wastewater management class.

Serdar Umur rejoins the board of directors for a new three-year term, and we are thrilled to have him back. Serdar is the chair of our Networking Events Committee.

The director terms for Ray Bahr and Megan Ambrose ended this year, and we thank both for their dedicated service to our organization and profession. Megan will continue as chair of our Membership, Engagement, and Communications Committee. Jane LaMorte has also ended her term on the board and as our treasurer. We wish Jane all the best in her future endeavors and will miss her leadership and optimism.

2024 Wastewater Forum and Expo

The Wastewater Forum and Expo was held on May 10 at the Aqua Turf Club in Plantsville. This event included our annual business meeting, technical presentations, and exhibitors. As in prior years, the vendors and exhibits were in the same room as the technical presentations, allowing everyone in the industry to come together, learn, network, and see the latest in products, services, and equipment targeted for Connecticut's wastewater industry. Special thanks to guest speakers Michael Kowal and Abad Cabassa from the Department of Homeland Security and Ellen Weitzler from EPA Region 1. A pipe-cutting competition was hosted by our Operations Challenge Committee, and once again we witnessed how experienced professionals make a difficult task look easy. The recipients of five student scholarships were announced during the event, and our inaugural CTWEA awards were presented. Congratulations to the following well-deserving recipients:

- Facility Safety Award – Brian Hutchins, Norfolk Sewer District
- Laboratory Excellence Award – Kimberly Bergeron, East Windsor WPCF
- Operations Leadership Award – Robert Grasis, Vernon Water Pollution Control Authority (WPCA)
- Outstanding Service Award – Tom Sgroi, Greater New Haven WPCA

Ops Challenge

Early this year, things did not look promising for the Connecticut representation in the Ops Challenge. However, in the 11th hour, Committee Chair and Coach Jason Nenninger and Vice-Chair Uday Karra made it happen with help from our friends in Rhode Island (thank you, Eddie Davies!). The RICONN II team was born, and it is certainly making waves. Members Chris Cleaveland (Veolia, East Providence, Rhode Island), Kevin Mauricin (Veolia, Norwalk, Connecticut), Graydon Stewart (Farmington, Connecticut), Kevin Venancio (Newport, Rhode Island), and Nicole Laboy (The Metropolitan District, Hartford, Connecticut) were outstanding at the NEWEA Spring Meeting competition, placing second overall and earning the opportunity to compete nationally. We will be rooting for them at WEFTEC in New Orleans in October.

Government affairs and legislative debrief

What seemed like a quiet legislative session took a dramatic turn at the finish with restricting use of biosolids containing PFAS as a soil amendment language added to an impending bill. We initially supported the bill, now Public Act No. 24-59, "An Act Concerning the Use of PFAS in Certain Products," which in its original form was aimed at phasing out PFAS in consumer products, but we are disappointed that the final bill now also targets biosolids management.

A highlight of the Government Affairs Committee's work was participation in the 2024 National Water Policy Fly-In (Water Week) in Washington, D.C. Jeff Lemay represented Connecticut, meeting with four of our legislators.

WEF Collection Systems and Stormwater Specialty Conference

In April, Connecticut hosted the WEF Collection Systems and Stormwater Specialty Conference in Hartford. The conference was well attended and featured three pre-conference workshops, 31 technical sessions, and over 60 exhibitors. Many NEWEA and CTWEA members participated in the local planning group to organize the conference. The welcome reception at the Connecticut Science Center, hosted by NEWEA, was a conference highlight.

The RICONN II team: Graydon Stewart (Farmington, Connecticut), Chris Cleaveland (Veolia, East Providence, Rhode Island), Kevin Mauricin (Veolia, Norwalk, Connecticut), Kevin Venancio (Newport, Rhode Island), and (missing from photo) Nicole Laboy (The Metropolitan District, Hartford, Connecticut)

Sewer Open

CTWEA's annual golf outing, better known as the Sewer Open, was held on June 21 at the Skungamaug River Golf Club in Coventry. Once again, the tournament was sold out, and Director Ray Bahr was incredible in organizing the event with support from his committee. This was Ray's 20th and final year leading the event, and we are grateful to him for the dedication and commitment that has made this an extraordinary networking and fundraising opportunity. This tournament is a key fundraiser event for programs that CTWEA participates in annually, and this year we raised $3,400 for scholarships and $4,150 for Ops Challenge.

Events

- CTWEA Fall Workshop – October 2024
- Operations (formerly known as Managers) Forum, Plantsville – February 12, 2025

In March, plant tours were held at the University of Connecticut and Windham WPCFs.

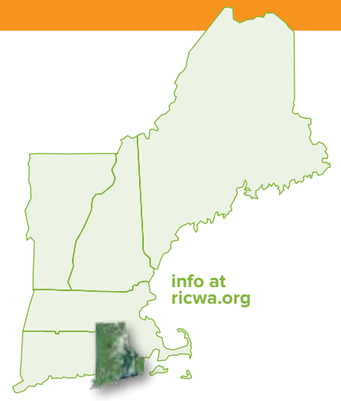
Other highlights

Connecticut is paired with New Hampshire this year for the Operator Exchange, with planned visits occurring in the fall of 2024.

CTWEA congratulates Justin Bernstein, a high school student enrolled at Greenwich High School, who won the U.S. Stockholm Junior Water Prize (SJWP). He was honored for his outstanding project "Genetic Engineering of Cryobacterium to Increase Silica Content and Enhance the Glacial Albedo of Black Arctic Oceans." This marks the second year running that the national SJWP winner has been from Connecticut!

Rhode Island State Director Report

by Amy Anderson George
amy.anderson@arcadis.com



For such a little state, we've been busy! We started the year with a visit to our federal delegation at the D.C. Fly-In, hosted our annual Rhode Island Clean Water Association (RICWA) Awards Ceremony, kicked off the first annual Run for Clean Water 5K at the NEWEA Spring Meeting, hosted an intense RICWA Chowder Cook-off member event at Fort Getty in Jamestown, and are preparing for this year's Rhode Island Operations Challenge team, RIsing Sludge, to compete in Division 1 at WEFTEC in October. It's been an incredible experience to support RICWA as state director, and I'm excited for all the events planned for the rest of this year.

Government affairs – D.C. Fly-In

On April 9, Janine Burke-Wells and I headed to Washington, D.C., to participate in the 2024 National Water Policy Fly-In (Water Week) and meet with Rhode Island's federal delegation. We secured in-person meetings with Senators Jack Reed and Sheldon Whitehouse, and Congressman Gabe Amo. We addressed key issues related to polyfluoroalkyl substances, biosolids, Infrastructure funding and resiliency, the Wastewater Infrastructure Pollution Prevention and Environmental Safety (WIPPES) Act, and cybersecurity. Water advocate Steve Soito from Rhode Island Water Works joined us to show a united "One Water" team from Rhode Island. Highlights of this event included the plenary session, with opening remarks from Howard Carter, and the Water Week Reception on the rooftop of the new DC Water headquarters. Upon returning home we met virtually with Congressman Seth Magaziner to continue to educate and inform our legislators of key water issues important to Rhode Island.

Janine Burke-Wells, Senator Jack Reed, Amy Anderson, and Steve Soito

Run for Clean Water 5K

RICWA hosted the first Annual Run for Clean Water 5K at Fort Adams State Park in Newport on May 19. While the weather did not cooperate the way we had hoped, the event was a success, raising over $3,000 to help offset the increasing costs of participating in Operations Challenge at WEFTEC. We had over 100 participants from all over New England make their way through Fort Adams to help raise money for the NEWEA teams. Many Ops Challenge team members volunteered (in the rain), making this event a great team-building activity prior to competition at the Spring Meeting. Special thanks to our marathon sponsor, Veolia, and our Mile Marker sponsor, Arcadis, for helping make this event a success. Congratulations to New Hampshire's Sam Wood for crossing the finish line first and winning the race! We are looking forward to making this an annual event, so keep an eye out for future information.

Annual golf tournament

RICWA hosted its annual golf tournament on June 16 at Potowomut Country Club in East Greenwich. The sold-out event, with 144 golfers, sponsors, and volunteers raised over $12,000 for the organization and our scholarship fund. Special thanks to our Golf Committee members: Peter J. Connell (chair), Eli Hannon, Paul Desrosiers, Ben Levesque, Janine Burke-Wells, Tracy Santoro, Kim Sandbach, Amy Anderson George, and Bill Wilbur. Our event wouldn't be the success it is without support from our sponsors: SYNAGRO, Hart Companies, CDM Smith, The MAHER Corp, PARE Corporation, NEIWPCC, Beta, Electrical Installations, Jacobs, Wright Pierce, H2O Innovation, Veolia, Wilkem Scientific, Fuss & O'Neill, Carlsen Systems, Flygt, Arcadis, Holland Chemical, Inland Waters, Tighe & Bond, and C3ND.

Water Week Advocates visit the DC Water headquarters rooftop: WEF's Steven Dye, Theresa Tucker, Emily Cole-Prescott, Howard Carter, Peter Garvey, John Digiacomo, Jeff Lemay, Amy Anderson, and Janine Burke-Wells

Earth Day Cleanup

RICWA hosted its annual Earth Day Cleanup on April 21 at Squantum Point in East Providence. Over 30 volunteers participated, helping collect 350 pounds (160 kg) of trash. Thank you to United Rentals and Narragansett Bay Commission for supporting this event and helping to keep Rhode Island's beaches and parks clean.

Awards Banquet

Each year, RICWA recognizes the commitment, innovation, and achievements of facilities and individuals in the Rhode Island Clean Water Community through our Award Programs. RICWA held its annual Awards Banquet on May 10 at Cranston Country Club. Congratulations to our award winners:

Facility Excellence Awards

- Platinum Awards: East Greenwich, Newport, New Shoreham, and Quonset Development
- Gold Awards: Jamestown and Smithfield
- Silver Awards: Narragansett Bay Commission – Bucklin Point, Warren, Warwick, and Westerly

Safety Excellence Awards

- Joseph Mattera Plant Safety Award <5 MGD: Narragansett
- Joseph Mattera Plant Safety Award >5 MGD: Cranston

Individual Service Excellence Awards

- James Marvelle Award: Eli Hannon
- Carmine J. Goneconte Operator Award: Anthony Turchetta
- Bill Wilber Collections System Award: Kyle Phillips
- Robert J. Markelewicz Award: Joe Chapdelaine
- Facility Support Excellence Award: Martha Fuller
- Sponsor Appreciation Award: Seacoast Supply
- Lifetime Member Award: Paul Desrosiers

NEWEA operator awards (Operator of the Year and Alfred E Peloquin) will be awarded and announced at the NEWEA Awards Banquet in January. For more information on the RICWA Awards Program, go to ricwa.org/annual-awards.

Operations Challenge

RICWA wishes Operations Challenge team RIsing Sludge best of luck in Division 1 competition at WEFTEC this coming October. Rhode Island will be cheering you on as you compete in five classic Operations Challenge events, each testing a different aspect of wastewater work: process control, laboratory, safety, collection systems, and pump maintenance. This is the first time in the event's history that a Rhode Island team has qualified for Division 1! The team comprises Dave Bruno (Quonset Development Corporation), Rob Norton (City of Newport), Shaun Collum (Narragansett Bay Commission), Riley Green (Town of East Greenwich), and Eddie Davies (Quonset Development Corporation). The team has been training weekly and is prepared to compete nationally. Best of luck!

Operator Exchange

Rhode Island participated in the annual Operator Exchange with Massachusetts this year. David Pennetti (Veolia East Providence) traveled to Massachusetts on May 13 to participate in the three-day event. Rhode Island hosted a Massachusetts operator this September in a visit that included tours at eight Rhode Island treatment plants and ended with our annual Trade Show.

Scholarship

RICWA provides annual scholarships to college students, sponsored by our members and through fundraising. Scholarships range from $500 to $1,000, depending on the number and quality of applications. Visit ricwa.org/academic for more information on our scholarship program.

Upcoming events and happenings

RICWA has a full slate of events on the calendar throughout 2024 and into 2025. We encourage anyone interested in becoming a member of RICWA or NEWEA to join us at any of these events. We are always looking to welcome new faces to our organization and industry. One recent event and one upcoming of note are:

- September 13 – Annual Trade Show, Crowne Plaza, Warwick
- December 6 – Annual Holiday Party, Food Drive, and Election of Officers

Maine State Director Report

by Paula Drouin
pdrouin@lawpca.org

Greetings, from Maine!

Maine Water Environment Association (MEWEA) once again had a successful "Why Water Is Worth It to ME" annual poster contest, which engages hundreds of students grades K–12 statewide to submit artwork. We are always taken aback by not just the sheer number of submissions (typically over 500!), but the level of talent and variety of media used. Hannah Case continues to be a front-runner in this competition, with this being her fourth year earning first place in her grade group. Nice work to all the student artists!

Maine had excellent representation in Washington, D.C., at the National Water Policy Fly-In in April. Association President Emily Cole Prescott, Vice President Terry Tucker, Second Vice President Rob Pontau, and New Professionals Committee Chair Sierra Kuun all attended and met with our elected officials. Rob Pontau commented, "It was my first trip and I really enjoyed it. I hadn't been to DC since I was a child, and I was impressed at how nice the city was. I thought the networking opportunities at DC Water and with NEWWA were great." They even got a signed group photo with Senator King.

(front) Rob Pontau, Terry Tucker, Emily Cole-Prescott; (back) WEF Scholarship winner Mogambi Osoro and Sierra Kuun

MEWEA and the Maine Water Utilities Association (MWUA) hosted the second annual Water & Wastewater Professionals Day on June 22 at Hadlock Field where the Portland Sea Dogs took on the Richmond Flying Squirrels. Over 300 tickets to the game were sold, and attendees gathered for a beautiful evening in Portland.

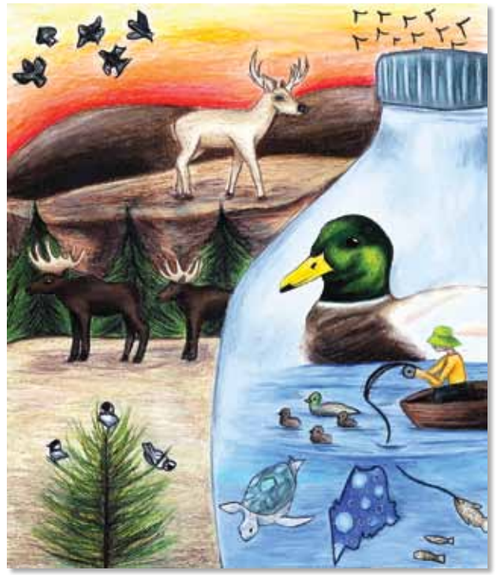
The MEWEA/MWUA Summer Outing was on August 10 at the Cumberland County Fairgrounds. The day started with a two-hour training on Global Positioning System data collection. Unfortunately, the pipe tapping competition was canceled, as only one team signed up to compete, but the cornhole contest and BBQ lunch did not disappoint. Also new this year was a scavenger hunt coordinated by the MWUA Technology Committee where attendees could try their hands at locating items hidden in the area. A fantastic time was had by all who attended.

The Maine Stormwater Conference was held on September 5–6 in Portland. This biennial conference brings together professionals from the Northeast region and fosters connections between technology companies, planners, infrastructure designers, builders, engineers, and state and municipal leaders. This year's conference topics included real-world examples of innovative and collaborative stormwater management and other topics applicable to decision-makers and practitioners.

MEWEA's fall convention was held on September 18–20 at Sunday River in Newry. In lieu of a keynote speaker, Maine Department of Environmental Protection (DEP) highlights were at the top of the agenda. Because of the number of new DEP employees, there was also a meet and greet with DEP representatives and our utility leaders and operators. The golf tournament was well attended as was the cornhole tournament, which grows every year. Both of these social events are excellent networking opportunities and are well received by vendors and operators.

MEWEA leaders Amanda Smith (director of water quality management in Bangor) and Phil Tucker (superintendent of York Sewer District) were recently interviewed by Joe Blackman of the Public Works Podcast. They discussed legislation, politics, and the challenges our industry faces with biosolids disposal. It is worth a listen (visit spreaker.com/episode/phil-tucker-and-amanda-smith-mewea--60930793).

Why Water Is Worth It to ME annual poster contest



Legislative updates

MEWEA is following up on recommendations of the collaborative Biosolids Study, which was published in December (nebiosolids.org/maine-biosolids-study). Association leaders have resumed meetings with Maine DEP to coordinate action items to forge a sustainable path. MEWEA recently provided public comment supporting a state landfill expansion capacity request because of the biosolids management concerns. Also supported was the federal Wastewater Infrastructure Pollution Prevention and Environmental Safety (WIPPES) Act (so named because it concerns control of disposable wipes). We continue to strengthen initiatives this year to align our governmental affairs and public relations messaging.

Looking ahead

Imagine a Day without Water is a national education campaign that brings together diverse stakeholders to highlight how water is essential, invaluable, and in need of investment. This year it will take place on October 17. The event is managed by the U.S. Water Alliance, an organization which works to unite voices across the water sector, fostering collaboration and activating leadership to address current issues the sector faces and advance a One Water future. Key issues are affordability and access, climate change, infrastructure funding and implementation, storytelling and culture, sustainable water management, water equity, water policy, and workforce and capacity building. More information can be found at uswateralliance.org/issues.

New Hampshire State Director Report

by Michael Trainque
mtraink75@gmail.com

Greetings from the tropical Granite State. By the time you read this we should be in more seasonal fall weather, although I, personally, like the warmer weather. As I write this, I can't help but be impressed with the variety of natural features, resources, and attractions that New Hampshire has to offer, from its 13 miles of seacoast (the shortest of any coastal state in the United States) to the summit of Mount Washington, the highest peak in New England, and the almost limitless activities these natural features offer, all within a couple hours of driving time. This unique environment certainly provides inspiration for the work done by everyone in the water industry in keeping our water and natural environment clean and healthy now and into the future.

This year, New Hampshire exchanged operators with Connecticut as part of the annual Operator Exchange event. In New Hampshire, the exchange took place on September 11–13, to coincide with the New Hampshire Water Pollution Control Association (NHWPCA) September 13 Fall Meeting in Newington. The guest operator from Connecticut visited the wastewater treatment facilities (WWTFs) in Concord and Manchester and the Peirce Island plant in Portsmouth.

We are excited to report that New Hampshire fielded an Operations Challenge team for the first time in several years. The team was on a steep learning curve but had fun practicing, working hard, and participating in the challenge at the NEWEA Spring meeting in Newport, Rhode Island in May. Although the team did not place in any of the events there, its hard work and dedication paid off with a very good performance. The team is eagerly looking forward to next year. We express our thanks and appreciation to the operators who participated, and to Patty Chesebrough for chairing the NHWPCA Operations Challenge Committee and providing such great leadership to the team.

The always popular Discover Wild New Hampshire Day was held on April 20 at the New Hampshire Fish & Game Department in Concord. Over 7,000 people attended the family-oriented event. There were fun activities for the entire family as well as opportunities to learn more about New Hampshire's wildlife resources and its rich legacy of outdoor traditions. Activities included educational exhibits presented by environmental and conservation organizations, live animals, fish, trained falcons, archery, casting, fly-tying, B-B gun shooting, retriever dogs in action, hands-on craft activities for the kids, and opportunities to check out the latest hunting and fishing gear and gadgets and, of course, food trucks. The NHWPCA raffled off 23 fishing poles and provided pizza. This event was successful and fun for all who attended!

The NHWPCA Annual Summer Outing took place on June 21 at Ellacoya State Park in Gilford. Despite a stormy forecast, the rain held off for most of the event; the food was fantastic, and everyone had a great time! Ice cream was provided with various toppings to "top off" the edible fare. The feature event was the highly competitive cornhole tournament. Teams of two competed in several challenge rounds to whittle down the contestants. The fearsome twosome of Luis Armas and Nate Young prevailed. Mario Leclerc and Mike Dube took second place. Sorry, Mario! We extend our thanks and appreciation to all the sponsors and hard-working volunteers that made this event a success.

The NHWPCA held its 35th annual Golf Tournament on August 1, at the beautiful Beaver Meadows golf course in Concord. Although the weather was hot and steamy, the 26 teams were not deterred. This event is always an opportunity for colleagues of all ages to gather for fun, relaxation, and friendly competition. All the New England states were represented, and players received Taylor Made hats. Players enjoyed a continental breakfast with early morning beverages, and then hit the driving range and putting green prior to the "serious" competition. At 8:15 AM, over 100 players commenced 18 holes of fun and games followed by a delicious luncheon that included chicken, steak tips, burgers, and hot dogs. Prizes were awarded for longest drive, closest to the pin, and straightest drive for both men and women. Raffle prizes included great golf equipment as well as Red Sox tickets and other prizes.

NHWPCA held its Fall Meeting on September 13 at the Newington WWTF. There were refreshments and tours of the WWTF in the morning followed by lunch and a meeting at Cisco Brewers in Portsmouth.

The Granite State Rural Water Association (GSRWA) held its annual Operator Field Day and Exhibit on September 19 at the Pat's Peak Ski Area in Henniker. It was another great opportunity to join professionals in the water and wastewater industry, check out new products and services, attend continuing education classes, participate in various field day games and activities, and network with others in the water industry.

New Hampshire Construction Career Days will be held on September 26–27, at the Hillsborough County Youth Foundation Fairgrounds in New Boston. This wonderful event enables New Hampshire high school students to explore careers in the construction and transportation industries, with hands-on exhibits and educational resources. Labor unions, construction companies, school districts, state agencies, and trade and professional organizations collaborate to introduce students to various aspects of construction and enable them to see and operate construction equipment and find out more about career opportunities.

The NHWPCA Annual Winter Meeting will be held on December 6, at the Merrimack WWTF with refreshments and plant tours in the morning followed by lunch, a brief business meeting, and the always popular Santa's raffle at the Doubletree hotel in Nashua. Who will be Santa this year? Come and see for yourself!

For more great information on what's happening in the Granite State, check out the Fall 2024 edition of "The Collector," NHWPCA's newsletter, on our website: nhwpca.org.!

The NHWPCA expresses its appreciation and gratitude to all the members, volunteers, committee members, committee chairs and co-chairs, exhibitors, and sponsors that contribute their time, talent, and resources to make the NHWPCA function effectively and make the various training, activities, and events possible for our members. Thank you!

"True human progress will be the result of love, compassion, charity, generosity, patience, kindness, empathy, tolerance, forgiveness, gentleness, discipline, and friendship." Greek philosopher Heraclitus.

Vermont State Director Report

by Jennie E. Auster
jennifer.auster@wright-pierce.com

Vermont unfortunately made national news in July 2024 for flooding events that affected communities across the state. First the remnants of Hurricane Beryl hit the northern half of the state on July 10, remarkably on the anniversary of last year's historic flood event that inundated multiple wastewater treatment facilities. This year's storm again resulted in infrastructure damage and destruction of roads, bridges, culverts, and water and sewer lines. Operations at several of Vermont's wastewater treatment facilities were affected either by high flows at the facilities or flooded areas at pump stations and at some facility sites.

Then on July 29–30, slow-moving storms resulted in 3 to 8 in. (7.6 to 20 cm) of rain in northeastern Vermont resulting in additional flooding and infrastructure damage. The water quality impacts from these storms have resulted in closures of lake and river recreation areas vital to the state's economy and communities. The long-term effects of these major storm events on our lakes and rivers will be understood fully only over time, but we assume that nutrients, sediment, and other pollutants that washed into our receiving streams will continue to affect our watersheds.

Vermont interim strategy for mitigating PFAS risks associated with residuals management

On April 1, the Vermont Agency of Natural Resources of the Department of Environmental Conservation issued the Interim Strategy for Mitigating Polyfluoroalkyl Substances (PFAS) Risks Associated with Residuals Management. The interim strategy applies to any soil amendment containing greater than 1 yd^3 (0.76 m^3) of Exceptional Quality (EQ) biosolids or short paper fiber.

EQ describes a biosolids product that meets Class A pathogen reduction requirements and vector attraction reduction standards, but also meets more stringent metals limits as specified in CFR 40, Part 503. Both EQ and Class A biosolids are tested to demonstrate that they meet lower pathogen limits and are also subject to a process to further reduce pathogens.

The Interim Strategy established that land application of any soil amendment containing EQ biosolids must meet the conditions in the following table:

EQ biosolids land application	
PFAS Compound	**Concentration (µg/kg or ppb)**
Perfluorooctane sulfonic acid (PFOS)	3.40
Perfluorooctanoic acid (PFOA)	1.60
Perfluoroheptanoic acid (PFHpA)	0.84
Perfluorononanoic acid (PFNA)	0.44
Perfluorohexane sulfonate (PFHxS)	0.38

Additionally, soil samples from the application site must be analyzed for PFAS with results obtained prior to land application. If soil PFAS concentrations exceed the table above, the use of residuals is prohibited at that location.

The Interim Strategy stated that at the time of issuance eight certified facilities are producing and distributing EQ biosolids in Vermont and three facilities are approved to import EQ biosolids to Vermont.

The Interim Strategy offered context for PFAS occurrence and sampling, noting that in 2019 Vermont Department of Environmental Conservation studied PFAS occurrence in shallow soils across the state; PFAS were detected in every sample, and PFOS was the dominant compound detected. It also noted that other management options for residual materials, such as landfilling and incineration, may result in transfers of PFAS to the environment and are limited by capacity. The Interim Strategy stated that landfilling sludge is limited by capacity and generates landfill leachate that contains elevated levels of PFAS and that leachate is typically hauled to a wastewater treatment facility for disposal. Regionally, dwindling landfill capacity is a growing concern (NEWMOA 2021). In Vermont, only one active landfill remains, with an estimated capacity of 20 years. In 2022, about 3,300 dry tons (2,994 tonnes), amounting to 27 percent of sludge produced in Vermont, was landfilled.

GMWEA Annual Award Winners

Christine Dougherty (l) and Joe Duncan (r) congratulate Facility Excellence Award winning staff of the Town of Middlebury: Emmalee Cherington, Noah Fleury, Bob Wells, Jeremy Rathbun, Tim Prior, and Dean Rheaume

Spring Meeting

Thank you to everyone who joined us in Killington for our Spring Meeting on May 23. It was a great day of valuable technical sessions on drinking water, wastewater, and stormwater; networking opportunities with peers and vendors; and celebration of our award winners. Special thanks to the Continuing Education Committee for organizing a diverse program. We welcome our newest board members, Josh Kemp and Matthew Moriarty, and we thank departing board member Joanna Bisceglia for her years of service to Green Mountain Water Environment Association (GMWEA).

GMWEA ANNUAL AWARDS

Please join us in congratulating the following award winners, recognized at the 2024 Spring Meeting in Killington:

- *Andrew Fish Laboratory Excellence*
  Jeremy Rathburn, Town of Middlebury
- *Elizabeth Walker Meritorious Service*
  Chris Robinson, Town of Shelburne
- *Facility Excellence for Wastewater, awarded to four facilities*
  Town of Middlebury, Richmond Water Resources, Village of Ludlow, and Village of Johnson
- *Outstanding Service Award*
  Jay Nadeau, Champlain Water District
- *Michael Garofano Operator of the Year*
  Steve Cote, Town of Richmond
- *Bob Wood Young Professionals Awards*
  Hannah Yates, City of Burlington and Brad Snow, Town of Richmond
- *Operator Excellence for Wastewater*
  Nate Fraser, Town of Springfield
- *Facility Excellence for Drinking Water*
  Richmond Water Resources
- *Corporate Sponsor of the Year*
  Otter Creek Engineering
- *President's Award*
  Jeff Strong, Town of Springfield

Upcoming and recent GMWEA events

- The 2024 George Dow Golf Tournament was held at Cedar Knoll Country Club in Hinesburg on August 16.
- Fall Tradeshow, DoubleTree Hotel in South Burlington, November 7, 2024. Each fall, over 400 water, wastewater, and stormwater professionals, water quality technology and service providers, DPW administrators, staff from nonprofit organizations, and state administrators convene at the DoubleTree Hotel. After a night-before welcome session in the exhibit hall, they attend six hours of training sessions, tour over 90 vendor exhibits, eat a delicious lunch, and hear distinguished speakers from Vermont and throughout New England. Trainings and speakers vary each year, dependent upon member preferences.

Please note that GMWEA's Continuing Education Committee is seeking papers for presentation at the Fall Tradeshow at gmwea.org/gmweafall.

Massachusetts State Director Report

by John Digiacomo
jdigiacomo@natickma.org

If 2023 was considered the year of getting "back to normal," 2024 might be the year of "moving forward and growing." It has been a busy and exciting year so far for the Massachusetts Water Environment Association (MAWEA).

During the spring, I attended the 2024 National Water Policy Fly-In on April 9 and 10 in Washington, D.C., with numerous other NEWEA leaders and members. This is the country's largest annual grassroots advocacy event for water policy issues and attendance is crucial in helping to engage and educate our representatives in the government on the amazing work we do, the need for funding for both current and future legislation/initiatives, and the importance of their support for certain legislation that we feel will positively affect our industry.

This was the second year in a row I represented Massachusetts. Our Massachusetts delegation, which also included New England Water Works Association (NEWWA) Chief Executive Officer Kirsten King, WEF Delegate at Large Peter Garvey, Springfield Water and Sewer Commission Public Communications Manager Jaimye Bartak, and University of Massachusetts doctoral candidate Lucca Mancilio, met with eight of the eleven Massachusetts delegations. Our national representatives are busy and managing so many issues, it is difficult for them to be completely versed on all of them. They were appreciative of our group spending time away from our jobs and families to come to Washington to share our feedback and expertise. We were especially excited that we had a sit-down for over 30 minutes with Representative Jim McGovern.

Issues that were discussed included polyfluoroalkyl substances (PFAS), State Revolving Fund access, Comprehensive Environmental Response Compensation and Liability Act liability, biosolids management, and non-flushable wipes. It was timely that the EPA released the final PFAS limits and standards during our visit, as it gave us much to talk about with the representatives and their staffers. All of the congressional delegations are aware of the issue of non-flushable wipes, as it has been discussed on the Hill for a few years. However, they noted that they were unaware of the huge toll that wipes (many of which are non-flushable) have on the sewer systems and the financial ramifications. Our meeting helped them to understand the extent of the issue, and they agreed that this legislation is a potent first step to remedy this situation. They all agreed to support the bills when voted on. In June, the House of Representatives passed the Wastewater Infrastructure Pollution Prevention and Environmental Safety (WIPPES) Act (H.R. 2964). The bill now goes to the U.S. Senate for its consideration.

During our Fly-In visit in 2023, both of the Massachusetts senators agreed to sign this important bill as co-sponsors after our meetings. Having these high-profile and well-respected senators signing on was a huge win that we hope will help the bill pass the Senate as well. It clearly shows that even one person can make a difference. If you would like to "make a difference" and attend the 2025 National Water Policy Fly-in, please reach out to me or NEWEA Government Affairs Committee Chair Jeff McBurnie.

Events—past and future

MAWEA's year started with many members of the board of directors attending the NEWEA Annual Conference and taking part in numerous government affairs meetings and state association events.

The MAWEA Spring Operators Trade Show and Barbeque was held at Mt. Wachusett on May 15. While the 2023 Trade Show was about getting back to a sense of normalcy after Covid, this year's event was about growing. It was our best-attended trade show in a while. As part of the trade show, the board of directors held a roundtable discussion with members to give an update on MAWEA business and to discuss updates on State House legislation that affects our industry. Most important, however, was giving the members a chance to provide feedback about the association and how it could better serve them. As part of the roundtable, MAWEA held the annual election of MAWEA directors. Incumbents Bob Greene and Landon Kendricks and newcomers Chris Hayward and Tracy Santoro filled the four open positions, and we thank our outgoing directors, Michael Jennings and Eric Smith, for their years of service. This was the second year in a row that we have held a member roundtable, and it has been well received.

A special thank you is due to all the trade show vendors and exhibitors. The event was also the culmination of this year's Operator Exchange visit from Rhode Island. The Rhode Island Clean Water Association (RICWA) sent David Pennetti of Veolia Cranston to visit the New Bedford wastewater treatment plant, the Greater Lawrence Sanitary District, and the Upper Blackstone Clean Water plant, where he was welcomed by incoming MAWEA President Denise Descheneau. Thank you to RICWA, David, and the three plants that allowed us to visit.

MAWEA is excited to restart our Awards Program after many years and the first awards ceremony was held at the trade show. Congratulations to Joe Parker (Operator of the Year), Karen Driggers (Laboratory Analyst Excellence Award), and Benjamin Smith (Charles W. Tyler Service Award) for your distinguished service to Massachusetts.

The MAWEA Annual Golf Outing took place at the Heritage Country Club in Charlton on June 12. This was the largest golf tournament that we have had with 122 golfers signed up. The golfers had an amazing time, the dinner was incredible as always, and everyone enjoyed the weather and the new wrinkles that we added. The "golf cannon" was a huge success and will definitely be repeated in the future.

Mass Chaos—WEFTEC bound again

The Mass Chaos team will again compete in the national Operations Challenge at WEFTEC in New Orleans in October. The team took part in the Operations Challenge at the NEWEA Spring meeting in Newport, Rhode Island, in June and performed well enough to qualify to attend the 37th annual national event. This year's team consists of Scott Urban (Holyoke), Kelly Olanyk (Springfield), Joe Holmes (Holyoke), Justo Cabrera (Springfield), and Ramon Garrick (Springfield). The team is thrilled to represent Massachusetts again in New Orleans this year. Good luck, Mass Chaos!

Upcoming Meetings & Events

NEWEA GOLF CLASSIC
Derryfield Country Club
Manchester, NH
September 27, 2024

WEFTEC
Ernest N. Morial Convention Center New Orleans, LA
October 5–9, 2024

NEWEA/WEF PRESIDENT'S RECEPTION
The Chicory, New Orleans, LA
October 7, 2024

CSO/WWI CONFERENCE & EXHIBIT
Doubletree Hilton, Manchester, NH
October 22–23, 2024

JOINT NEWEA/NEWWA IT & ASSET MGMT FAIR
Holliston, MA
November 6, 2024

NORTHEAST RESIDUALS & BIOSOLIDS CONFERENCE, EXHIBIT & TOUR
Graduate Hotel, Providence, RI
November 13–14, 2024

INDUSTRIAL WASTEWATER CONFERENCE
Allagash Brewing, Portland, ME
December 10, 2024

NEWEA ONBOARDING
Boston Marriott Copley Place Hotel
Boston, MA
January 26, 2025

NEWEA ANNUAL CONFERENCE & EXHIBIT
Boston Marriott Copley Place Hotel, Boston, MA
January 26–29, 2025

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

NEWWA FALL CONFERENCE
Sea Crest Hotel, Falmouth, MA
September 15–18, 2024

MAINEWEA GOLF TOURNAMENT
Sunday River, Newry, ME
September 18–20, 2024

MAINEWEA FALL CONVENTION
Sunday River, Newry, ME
September 19–20, 2024

MAWEA FALL QUARTERLY MEETING
Marconi Club, Springfield, MA
September 25, 2024

CTWEA FALL WORKSHOP
AquaTurf, Plantsville, CT
October 2, 2024

GMWEA FALL TRADE SHOW
Double Tree Hotel, Burlington, VT
November 7, 2024

NERPCA ANNUAL CONFERENCE
Nashua, NH
October 29–31, 2024

MAWEA QUARTERLY MEETING
Virtual
December 4, 2024

NHWPCA WINTER MEETING
Merrimack, NH
December 6, 2024

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 2024 ANNUAL SPONSOR PROGRAM PARTICIPANTS

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

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

Join NEWEA's 2025 Annual Sponsor Program

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

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

Sponsorship Benefits:

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

For more information
contact Jordan Gosselin
Email: jgosselin@newea.org
Phone: 781-939-0908

NEWEA
WORKING FOR WATER QUALITY

Advertiser Index

Upcoming *Journal* Themes

Winter 2024—**Biosolids Management**

Spring 2025—**Collection Systems**

Summer 2025—**Utility Management**

Fall 2025—**Stormwater**

Winter 2025—**Climate Justice & Sustainability**

NEWEA/WEF* Membership Application

Personal Information (please print clearly)

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

Business Name (if applicable) | Job Title

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

City, State, Zip, Country

Home Phone | Cell Phone | Business Phone

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

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

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

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

ACQ. Code (for WEF use only) | WEF24

Membership Categories (select one only)

		Dues
☐ **Professional**	Individuals involved in or interested in water quality	$215
☐ **Young Professional**	Water quality professionals, under the age of 35, are eligible to join. This program is available for new member applicants and Student Members and is available for 3 years..	$88
☐ **Professional Operator**	Individuals in the day-to-day operation of wastewater collection, treatment or laboratory facility, or for facilities with a daily flow of < 1 mgd or 40 L/sec. License # _____	$127
☐ **Academic**	Instructors/Professors interested in subjects related to water quality.	$215
☐ **Student**	Students enrolled for a minimum of six credit hours in an accredited college or university. Must provide written documentation on school letterhead verifying status, signed by an advisor or faculty member.	$27.50
☐ **Executive**	Upper level managers interested in an expanded suite of WEF products/services.	$385
☐ **Corporate** (member benefits for one person)	Companies engaged in the design, construction, operation or management of water quality systems. Designate one membership contact.	$446
☐ **Dual**	If you are already a member of WEF and wish to join NEWEA	$50
☐ **Associate Membership**	This membership category is a NEWEA only membership reserved for the general public who have an interest in water and the environment but are NOT currently employed in the industry (e.g., attorney or supplier). Examples of Associate Members include: teachers; journalists who cover water quality issues; citizen samplers/members of various watershed/sportsman/conservation organizations, etc.	$45
☐ **New England Regulator**	This membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, CT Department of Energy and Environmental Protection, ME Department of Environmental Protection, MA Department of Environmental Protection, NH Department of Environmental Services, VT Department of Environmental Conservation, and RI Department of Environmental Management	$50
All memberships receive these:	■ Water Environment & Technology ■ Water Environment Research Online ■ WEF Conference Proceedings Archive Online ■ WEF SmartBrief ■ Complimentary WEF Webcasts	

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

Payment (Forms without payment will not be processed till payment is received.)

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

Charge
☐ Visa
☐ American Express
☐ Master Card
☐ Discover

Card # | Security/CVC

Signature | Exp. Date

Name on Card (please print)

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/membership--community/membership-center/code-of-conduct/) is applicable for all members.

NEWEA/WEF Membership Application

MEMBERSHIP PROFILE

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

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

1 Consulting, Contracting, Planning Services

2 Educational Institution

3 Industrial Systems/ Plants

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

5 Non-profits/NGOs

6 Finance, Investment, and Banking

7 Laboratories

8 State or Federal Government

9 Utility: Wastewater

10 Utility: Drinking Water

11 Utility: Stormwater

12 Utility: Wastewater, Drinking Water, and Stormwater

13 Utility: Wastewater and Drinking Water

14 Utility: Wastewater and Stormwater

15 Other

_____

(please define)

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

1 Executive Level

2 Management Level

3 Elected or Appointed Official

4 Educator

5 Student

6 Consultant/Contractor

7 Engineering/Design

8 Operator

9 Scientist/Researcher

10 Legislator/Regulator

11 Analyst

12 Sales/Marketing

13 Manufacturer's Representative

14 Communications/ Public Relations

15 IT/OT

16 Other

_____

(please define)

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

☐ **I would like to join the communities associated with my key focus area(s).**

1 Air Quality and Odor Control

2 Biosolids and Residuals

3 Climate

4 Collection Systems and Conveyance

5 Disinfection and Public Health

6 Drinking Water

7 Energy

8 Finance and Investment

9 Industrial Water Resources

10 Intelligent Water Technology

11 Laboratory Analysis and Practices

12 Nutrients

13 Operations

14 Public Communications and Outreach

15 Regulation, Policy, Legislation

16 Research and Innovation

17 Resource Recovery

18 Safety, Security, Resilience

19 Small Communities

20 Stormwater and Watershed

21 Utility Management and Leadership

22 Watershed Management

23 Wastewater Treatment, Design, and Modeling

24 Water and Wastewater Treatment

25 Workforce

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

Gender: ☐ Female ☐ Male ☐ Non-binary

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

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

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

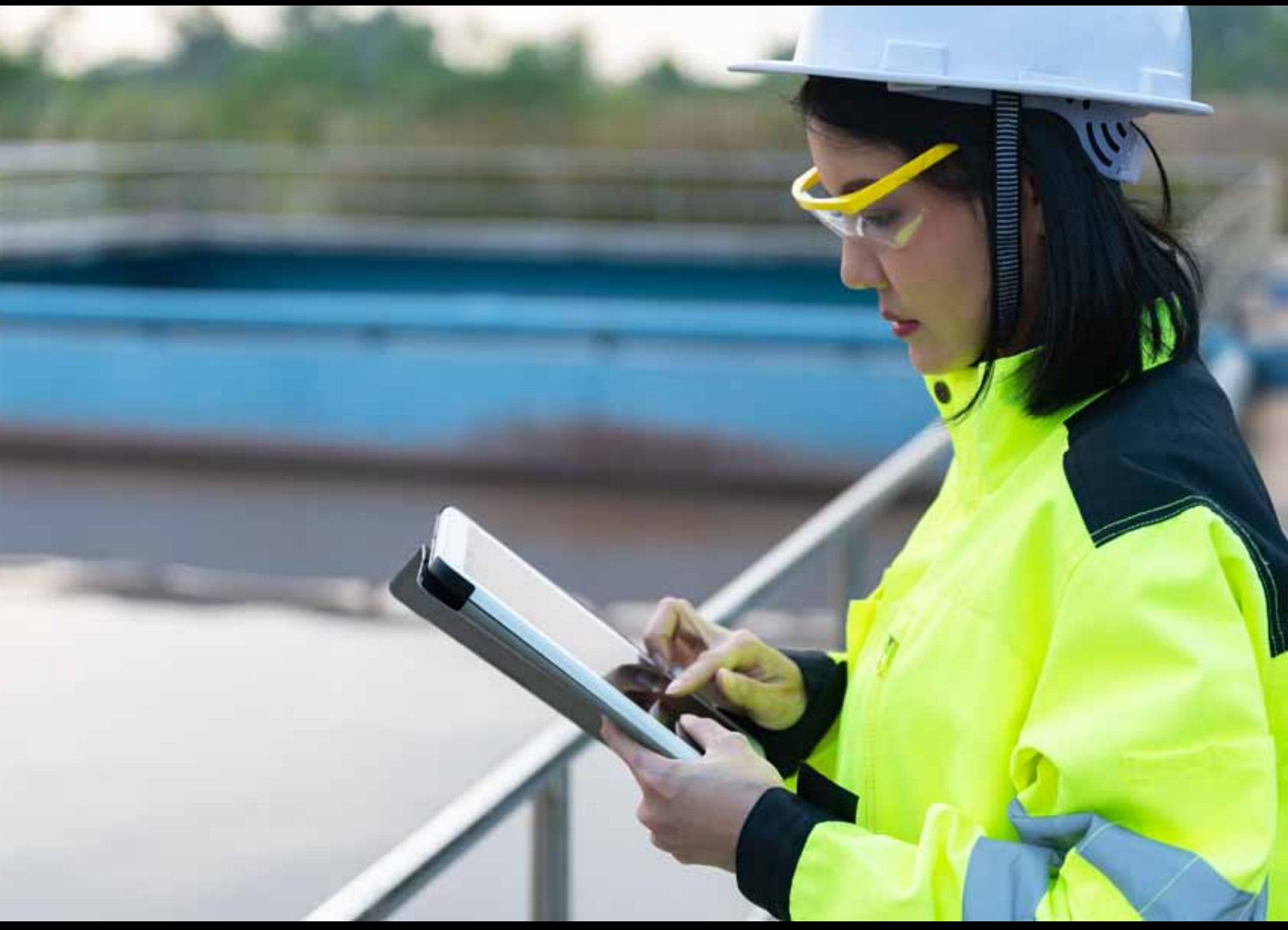
☐ Pacific Islander or Native Hawaiian ☐ Other

How Did You Learn About NEWEA/WEF?

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

Innovative Solutions Throughout The Water Cycle

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



Visit our Ideas Page

Stantec

Design with community in mind
stantec.com/water