JOURNAL

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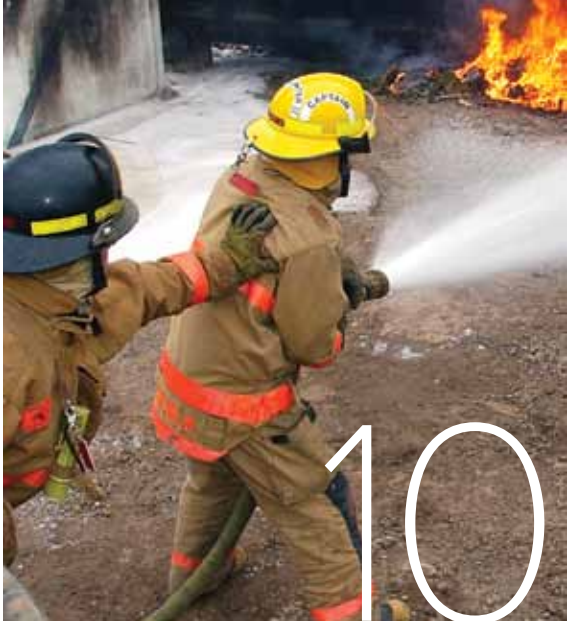

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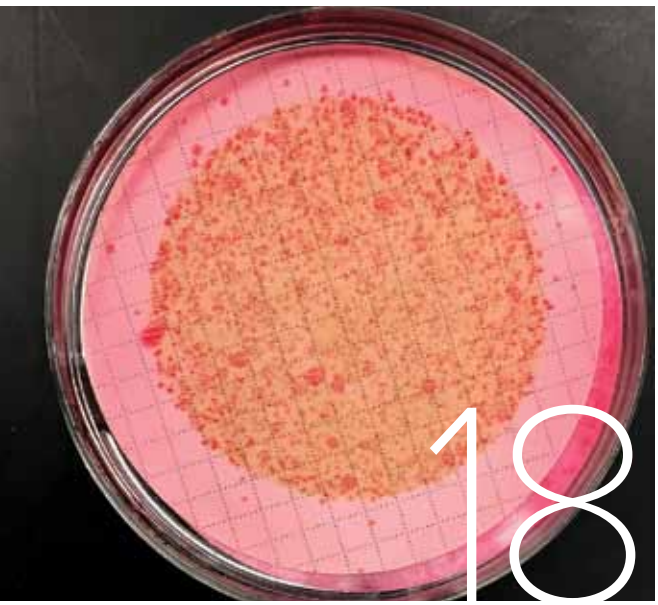

On the cover: Muddy River (the Fens) in Boston is the water source for the experiments described in "Evaluating the efficiency of low-cost ultrafiltration"

Page 74: Measurement unit conversions and abbreviations

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Annual Conference
(pages 56–73)
Cindy Loo Photography,
Charles Tyler and Michael Spring

OUR ASSOCIATION WAS ORGANIZED NINETY-ONE 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.

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Academic	185
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PWO	110
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President's Message

Hello, my dear friends and NEWEA colleagues. I am excited and energized to take the reins as NEWEA president for 2020. As we move into a new decade, NEWEA has many accomplishments to be proud of and to build upon. Coming into this role, I'd like to share with you an expression that motivates me to champion this new era: **advocate, act, be the change**.

In the year before us, I would like for each of us to advocate, act, and be the change. What does this mean? It means putting the full weight of our organization behind our public advocacy and government relations work. In collaboration with our Public Awareness Committee, I ask each of you to get involved in one of three ways. Whether you choose to build our network within and outside the water industry, expand our partnership and outreach activities, or work to strengthen our relationships with state and federal elected officials, anything you can do will help.

New England businesses, industries, and individuals often lack an understanding of the work the water industry performs and the essential need for funding infrastructure. NEWEA has an opportunity to increase awareness of the vital roles water professionals, and our water infrastructure, play in communities.

As we work to build our networks, our partnership and outreach activities are pivotal to our success. Our merger with Northeast Water Innovation Network (NEWIN) is a huge step in the right direction (see page 36). This newly incorporated innovation community benefits each of you, by providing direct contact to new water cycle innovations and entrepreneurs, with access to new technologies and thought leadership.

Working with partners like these, who share our goals and objectives, we are empowered to tell inspiring stories about our profession. Our Water for Life campaign and Water Champions segments continue to be instrumental in this pursuit. Through these efforts, we will continue highlighting and bringing awareness to water quality efforts in the region, career opportunities for a more collaborative and diverse water industry, and critical infrastructure funding.

Imagine a Day Without Water event—York, Maine (see story on page 44)

I encourage each of you to take ownership of this pursuit. Get involved in your communities. Participate in events that inspire you. Use all the resources available to you to proactively champion the water industry's needs.

I encourage each of you to take ownership of this pursuit. Get involved in your communities. Participate in events that inspire you. Use all the resources available to you to proactively champion the water industry's needs.

Building our network and expanding our partnership and outreach activities are essential to NEWEA's future. Under the leadership of our Government Affairs Committee and all six of our affiliated state associations and state directors, we will continue striving to be the trusted advisors for elected officials. We will continue to build our state associations' important work and will provide more readily available information to all NEWEA members to further facilitate contact with our representatives at all levels.

I implore each of you to engage with your state and federal elected officials and advocate for the vital work the New England water industry performs. Use the Water Environment Federation (WEF) Water Advocates program to send information to your state and federal

elected officials who serve your community. Use the tool kit provided on the NEWEA website to reach out and have a conversation with your elected ambassadors. Every conversation you have moves us one step closer to our goals, and to a more resilient water future.

Finally, I thank my employer and my Arcadis work family for all their contributions, support, and hard work. Together, we can advocate, we can act, and we will be the CHANGE.

From the Editor

Hello NEWEA! I am so happy to welcome Jenn Lachmayr as NEWEA president. Jenn's first President's Message documents her important mantra for her term: advocate, act, be the change. Jenn's mantra comes at a fitting time, amidst new regulatory pressures (I promised myself I would refrain from mentioning that four-letter acronym beginning with "P"); as active members within a water professional organization, we must remain hyper-cognizant of elected officials' perceptions as we strive to prove that water's worth it. I look forward to Jenn's presidency as she advocates, acts, and becomes the change.

Alexandra Bowen, PE
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We thank Past President Ray Vermette for a successful term in 2019. To paraphrase a poignant quote from Ray's first President's Message (Spring *Journal*, 2019), "NEWEA is like an on-ramp for the membership toward an innovation highway." Perhaps hindsight truly is 20/20 (welcome to 2020)! NEWEA's recent merger with the Northeast Water Innovation Network (NEWIN) exemplifies our organization's commitment to promoting and supporting innovation as we further advance how we protect public health and the environment. This merger aligns like-minded professionals from each organization, positioning New England as a leader within the water–environment nexus. Resulting from this merger is the newly formed Innovation Council, led by Council Director Marianne Langridge, that will serve to more directly and efficiently connect utilities, regulators, academics, and innovators to propel new technologies and policies into full-scale implementation. Read more about this exciting milestone in the Merger Spotlight article.

Membership has already reaped the benefits of this merger, as evidenced by the success of another Innovation Pavilion at this year's Annual Conference. New to this year's program were Shark Tank pitches, given by talented undergraduate and graduate students who would have received accolades even from the most begrudging of sharks, Mr. Wonderful. Highlights from the Innovation Pavilion are featured in the Student Innovation article.

To follow suit with NEWEA's mission, the theme of this *Journal* is Innovation. Our first feature, "Evaluating the efficiency of low-cost ultrafiltration," by Dr. Gautham P. Das, an associate professor at Wentworth Institute of Technology, presents intriguing results for low-cost ultrafiltration's treatment efficacy on Boston's beloved Muddy River waters. The second feature, "On the road to a sustainable infrastructure: Part 2—integrating sustainability in planning, design and construction," is the second of a three-part series by three of New England's sustainability gurus: Wayne Bates, Courtney Eaton, and Meredith Zona. This article highlights key techniques to promote sustainability, including life cycle considerations, stakeholder engagement, and LEED and Envision certifications.

The final feature article wraps up this *Journal's* Innovation theme with a bow: "Role of technology in the water sector: LIFT (Leaders Innovation Forum for Technology) helps to accelerate innovation in the marketplace," by Kelsey Beveridge. This article highlights some successful applications of the joint LIFT initiative of the Water Research Foundation (WRF) and the Water Environment Federation (WEF). Nationally, this program focuses on accelerating new technologies to "real-world" full-scale implementation through technology scans, LIFT Link, utility working group, and university–utility partnerships.

It's an exciting time to be a NEWEA member, knowing that our local organization aligns so well with parent organizations WEF and WRF. Our profession's dedication to technology advancement and ultimate implementation proves we are ready to tackle today's and tomorrow's challenges because of initiatives and programs established by NEWIN and NEWEA.

Federal PFAS/CEC Legislation Recently Adopted

– Source: State Energy and Environmental Impact Center, NYU School of Law

At the end of 2019 Congress passed, and the president signed into law, the Department of Defense's (DOD's) authorization bill (the National Defense Authorization Act [NDAA]) and some government-wide appropriations bills. These bills included important provisions (discussed below) related to perfluoroalkyl and polyfluoroalkyl substances (PFAS) and other compounds of emerging concern (CECs).

The NDAA, which annually authorizes DOD programs, included several PFAS-related provisions because significant PFAS contamination of water supplies has been identified at or around military installations. The enacted version (S. 1790) of the fiscal year 2020 NDAA fell short of the initial optimism that the NDAA would include provisions to spark the cleanup of PFAS chemicals across the country under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or the Superfund statute) and a hoped-for mandate that the EPA establish drinking water standards for PFAS chemicals.

Nonetheless, the legislation included notable PFAS-related provisions, some based on House of Representatives and Senate bills aimed at PFAS issues. In particular, the legislation does the following:

1. Phases out the military's use of firefighting foam containing PFAS chemicals. Under the bill, the military is prohibited from using firefighting foam containing PFAS chemicals after October 1, 2024, except for use on ships, in emergency responses, and in limited testing and training circumstances. For legacy firefighting foam containing PFAS chemicals, the legislation calls for its incineration, conducted at a temperature range adequate to break down PFAS chemicals, while ensuring the maximum reduction in emission of PFAS chemicals.
2. Provides PFAS blood testing as part of routine physicals for military firefighters.
3. Authorizes DOD to temporarily supply uncontaminated or treated water to agricultural users whose irrigation water is contaminated with PFAS chemicals from military installations and to acquire property within the "vicinity of an Air Force base that has shown signs of (perfluorooctanoic acid [PFOA] and perfluorooctane sulfonate [PFOS]) contamination" due to activities on the base.
4. Requires DOD, upon the request of a governor of a state, to "work expeditiously" on cooperative agreements to address, test, monitor, remove, and remediate PFAS contamination in drinking and surface water or groundwater emanating from DOD activities to meet or exceed the most stringent state or federal limits that apply to the release of PFAS chemicals; creates an interagency task force to improve federal coordination on emerging environmental contamination; develops a National Emerging Contaminant Research Initiative to fill in research gaps on emerging contaminants; creates a state assistance program to provide federal assistance to eligible states for the testing and analysis of emerging contaminants; and requires DOD to seek agreements with municipalities or municipal drinking water utilities located near military installations to share monitoring data related to PFAS chemicals and other emerging CECs collected at the military installation. DOD must also maintain a publicly available website with a clearinghouse for information about the exposure to PFAS chemicals of military members, its families, and its communities, including information on PFAS testing, cleanup, and recommended available treatment methodologies.
5. Requires EPA, under the Toxic Substances Control Act (TSCA), to take final action on the agency's January 2015 proposal to amend a significant new use rule for long-chain PFAS chemicals and to promulgate a rule to require any manufacturer that has produced PFAS chemicals since 2011 to maintain records and report on the production of PFAS chemicals under TSCA.
6. Bans PFAS chemicals in packaging for military field food rations after October 1, 2021.

Along with the NDAA passage, two spending packages were signed into law on December 20, 2019: the domestic priorities and the national security appropriations bills, both of which included PFAS-related provisions. The domestic appropriations bill included $3 million for EPA to establish maximum contaminant levels for PFAS chemicals under the Safe Drinking Water Act; $5 million for EPA to designate PFAS chemicals as hazardous substances under CERCLA; $1 million for PFAS work in drinking water systems; $7 million to address PFAS and other CECs in state public water system supervision programs; and $13 million for state-led cleanup and remediation.

The national security appropriations bill includes an added $60 million (above Administration proposals) for immediately planned PFOS and PFOA cleanups, $100 million for PFAS contamination remediation near Air Force bases, and $10 million for the Center for Disease Control to further assess the health impacts of exposure to PFOS and PFOA.

House-proposed legislation

The House of Representatives expressed disappointment that the above 2019 legislation did not go far enough to address PFAS issues. Accordingly, in January 2020, the House passed the PFAS Action Act (H.R. 535), omnibus-PFAS legislation. Its provisions are discussed below. The Senate is not expected to take up companion legislation anytime soon.

Originally introduced by Rep. Debbie Dingell in the House, the PFAS Action Act included portions of several previously introduced bills. H.R. 535 would do the following:

- Require EPA to designate PFOA and PFOS chemicals as "hazardous substances" under CERCLA within one year of enactment of the legislation as well as determine within five years of enactment whether to designate all other PFAS chemicals as hazardous substances and post on its website its determination within 60 days of its final decision.
- Require EPA within one year of enactment to revise the Safer Choice Standard of the Safer Choice Program to require absence of any PFAS chemicals to place a Safer Choice label on any pot, pan, cooking utensil, carpet, rug, clothing, upholstered furniture, stain-resistant, water-resistant, or grease-resistant coating not subject to Section 409 of the Federal Food, Drug, and Cosmetic Act. The Safer Choice label assists consumers in identifying products with safer chemical ingredients.
- Require EPA to issue guidance for firefighters and other first responders to minimize the use of foam and other firefighting materials containing PFAS to minimize health risks from PFAS exposure. EPA in consultation with the U.S. Fire Administration would also need to issue reports to Congress (1) on the effectiveness of EPA guidance to minimize firefighters' and other first responders' health risks from PFAS exposure and (2) on the agency and other relevant federal departments identifying viable alternatives to firefighting foam and related equipment containing PFAS chemicals. Also, Federal Aviation Administration and local fire departments would be included in discussions about the risks of PFAS in foam for aviation hangars.
- Amend the Safe Drinking Water Act by authorizing until 2024 a $125 million annual grant program for community water systems affected by PFAS chemicals, including contamination by the GenX PFAS chemical (an alternative to a PFOA used to make Teflon), and for communities in which climate change, pollution, or environmental destruction have exacerbated systemic racial, regional, social, environmental, and economic injustices. The grants would help pay for the costs to implement eligible new treatment technologies, where current technologies do not reduce substantially detectable amounts of PFAS chemicals in the community water system.
- Require EPA, within 180 days of enactment, to issue a final rule to list PFOS and PFOA as hazardous air pollutants under the Clean Air Act and, within five years of enactment, determine whether other PFAS chemicals should be listed as hazardous air pollutants under the Clean Air Act.
- Require EPA to investigate methods and means to prevent contamination of surface waters, including drinking water, by GenX; develop a public risk communication strategy by disseminating information about the risks or potential risks of PFAS substances in land, air, water, and products; and notify the public about exposure pathways and mitigation through outreach and education resources.
- Make U.S. territories eligible to receive Safe Drinking Water Act funding to address emerging contaminants, with a focus on PFAS chemicals.

Numerous other proposed bills are undergoing committee reviews in the House. .

EPA Providing $1.3 Million to New England States for Wetlands Projects

On January 17, 2020, EPA announced grants of varying amounts totaling $1,323,000 to the six New England states for state- and institution-led programs and projects that will protect, manage, and restore wetlands across the region. EPA expects to award a second round of these grants in the same amounts later this year. The funds are provided through EPA's Wetland Program Development Grant program, which enables state, local, and tribal governments to conduct projects that promote research and pollution reduction related to wetlands.

"Wetlands provide a range of important benefits to ecosystems and local communities across New England, including critical habitat for various species of wildlife and natural buffers against flooding," said EPA New England Regional Administrator Dennis Deziel. "These grants exemplify EPA's commitment to helping our state and local partners further their wetlands research and protection programs that will have lasting impacts for decades to come."

Grant awards were made as follows:

- Maine: The Department of Environmental Protection received $375,000 and the Department of Agriculture, Conservation and Forestry received $57,157
- Rhode Island: The Department of Environmental Management received $131,190
- Connecticut: The Department of Energy and Environmental Protection received $63,750
- New Hampshire: The Department of Environmental Services (NHDES) received $124,400

Note: All EPA industry news provided by EPA Press Office

- Vermont: The Department of Environmental Conservation received $190,944, and the Fish and Wildlife Department received $45,000
- Massachusetts: The Massachusetts Department of Environmental Protection received $122,001, and the governor's Executive Office of Energy and Environmental Affairs received $35,185. The University of Massachusetts Amherst received $125,000, and the New England Interstate Water Pollution Control Commission received $53,373.

EPA Draft Permit Will Reduce Nitrogen Discharges, Improve Health of Great Bay

On January 7, 2020, EPA announced that it has issued a draft Clean Water Act (CWA) permit for public comment. If finalized as proposed, EPA believes this draft permit could significantly decrease nitrogen discharges to New Hampshire's Great Bay estuary, improving the estuary's water quality and the health of its ecosystems. Under the terms of the draft permit, which EPA developed with NHDES, 13 wastewater treatment plants in 12 New Hampshire communities would take steps to reduce nitrogen discharges to Great Bay.

"This draft permit is another step toward a cleaner, healthier Great Bay and reflects many years of hard work among federal, state and local governments to address a critical environmental problem," Mr. Deziel said. "We look forward to receiving the public's input. We expect the result to be a permit that achieves important reductions of nitrogen in Great Bay in a cost-effective way, which is good news for New Hampshire communities and their ratepayer customers."

The 12 communities that would be covered by the general permit are Portsmouth (two facilities), Newington, Durham, Newmarket, Epping, Exeter, Newfields, Dover, Rochester, Rollinsford, Somersworth, and Milton. The draft permit, issued under the CWA's National Pollutant Discharge Elimination System (NPDES) permit program, was open for a 60-day public comment period that ended at the beginning of March.

The Great Bay estuary, an estuary of national significance under EPA's National Estuary Program and a critical resource in New Hampshire, has for years experienced water quality problems such as low dissolved oxygen, algae blooms, and declining eelgrass habitat—all results of excessive nitrogen discharges. EPA and NHDES have been working for years with Great Bay communities to reduce nitrogen from both point sources, such as wastewater treatment plants and stormwater pipes, and non-point sources, such as runoff from farms and lawns, septic systems, and atmospheric deposition. Many communities have upgraded or optimized their wastewater treatment systems, and some are reducing stormwater discharges.

The communities asked EPA and NHDES for the flexibility to reduce nitrogen from non-point sources rather than from additional treatment at municipal wastewater treatment plants. EPA and NHDES have responded to that request, and the draft general permit largely accommodates the communities' preference to achieve the necessary nitrogen reductions through investments in non-point source controls. The draft permit also includes limits on the discharge of nitrogen from municipal wastewater treatment plants that almost all communities are expected to meet by optimizing existing facilities.

EPA Reaches Negotiated Settlements Regarding MS4 Water Permits in Massachusetts and New Hampshire

EPA has reached proposed settlement agreements resulting from two years of negotiations with the regulated community and environmental groups over implementation of small Municipal Separate Storm Sewer System (MS4) permits affecting many cities, towns, and other entities in Massachusetts and New Hampshire (the 2016 Massachusetts MS4 General Permit and the 2017 New Hampshire MS4 General Permit).

The proposed settlements result from all parties' efforts to ensure that, when fully implemented, both MS4 permits protect the environment, adhere to the CWA and EPA regulations, and address municipalities' implementation concerns. Stormwater is the largest contributor of pollutants to impaired rivers, lakes, streams, ponds, and other waters in both states, and the MS4 permits are important in reducing the impacts of stormwater on these waterbodies.

Upon execution of these settlement agreements (or subsequently modified and noticed settlement agreements, as necessary), EPA will propose and offer the opportunity for public comment on the agreed-upon permit modifications to both the Massachusetts and New Hampshire MS4 permits.

Background

EPA's New England regional office issues CWA NPDES permits in Massachusetts and New Hampshire. MS4 permits are NPDES permits that authorize certain discharges of municipal stormwater to surface waters. EPA issued the Massachusetts Small MS4 General Permit in 2016 and the New Hampshire Small MS4 General Permit in 2017. These permits replaced a single MS4 permit that EPA issued in 2003 that covered municipal stormwater discharges in both states for municipalities subject to the permit. The 2016 and 2017 MS4 permits built upon the requirements of the 2003 permit to address the largest sources of pollutants, specifically nutrients and sediment, discharged to both states' waterbodies.

After EPA issued both permits, various parties filed petitions for review: the National Association of Homebuilders, the Home Builders and Remodelers Association of Massachusetts, Inc., the New Hampshire Home Builders Association, the Center for Regulatory Reasonableness, the Massachusetts Coalition for Water Resources Stewardship, the town of Franklin, Massachusetts, the city of Lowell, Massachusetts, the Conservation Law Foundation, and the Charles River Watershed Association. These petitions were consolidated in the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit) and then entered into the D.C. Circuit's mediation program. After more than two years, the parties have negotiated the three proposed settlement agreements.

Evaluating the efficiency of low-cost ultrafiltration

GAUTHAM P. DAS, Associate Professor, Department of Civil Engineering and Technology, Wentworth Institute of Technology, Boston, Massachusetts
ABIGAIL CHAREST, Assistant Professor, Department of Civil Engineering and Technology, Wentworth Institute of Technology, Boston, Massachusetts

ABSTRACT | Low-cost ultrafiltration is frequently incorporated into water purification systems to treat potable water. For this project, we applied water quality criteria to evaluate the efficiency of a low-cost ultrafiltration product. Treatment was assessed by comparing influent and effluent biochemical oxygen demand (BOD), turbidity, coliforms, and concentrations of heavy metals, including arsenic, lead, and selenium. Water for the experiments was obtained from the Muddy River in Boston. Results indicated a significant decrease in the level of contamination after ultrafiltration. Fecal coliforms reduced from >500 to 0 CFU/100 mL; Turbidity reduced from over 6.8 to 0.6 nephelometric turbidity units (NTU); and BOD levels dropped from 20.0 to 6.0 mg/L. Because of the low heavy metal concentration in the unfiltered water, further testing was discontinued. Although further testing is recommended, the tested low-cost ultrafiltration method showed potential for providing potable drinking water.

KEYWORDS | Membrane filtration, ultrafiltration, indicators, coliforms, BOD, turbidity, and heavy metals

INTRODUCTION

Contaminated drinking water is a leading cause of over 1.6 million child deaths each year (Wardlaw *et al*., 2009). Drinking water is often contaminated by waterborne pathogens, such as cholera, that are the leading causes of gastrointestinal diseases. Also, the increase in population is causing an exponential increase in the use of polluted water.

Deaths from waterborne disease include deaths due to cholera. The World Health Organization (WHO) estimates between 3 million to 5 million cholera cases and 100,000 to 120,000 deaths occur every year, of which only a fraction is officially reported. In 2013, three years after a major cholera outbreak began in October 2010, 129,064 cases and 2,102 deaths were reported worldwide, with 44 percent of cases reported in Africa and 45 percent in Haiti alone (where between October 2010 and December 2013, 696,794 cases were reported with 8,531 deaths) (WHO, 2013 and 2014). Cholera outbreaks can occur during emergencies, such as earthquakes and flood events, or in refugee settings when water supply, sanitation, and hygiene infrastructure is compromised.

These issues demonstrate the need for robust, selective, and economical purification techniques. Membrane filtration is one of the most promising purification technologies to emerge in the past decade. Membrane development started in the 1960s with the first reverse osmosis membranes for desalination. Since then, membrane technology has seen tremendous growth in development, creating a new and extensive market for membrane filtration applications. A wide range of membrane filters have been created, from nanofiltration (NF, good for softening and decoloring) through ultrafiltration (UF, good for virus removal) to microfiltration (MF, good for suspended solids removal) (Kreissel *et al*., 2012).

UF (10 to 50 nm) has been established for removing microbiological contaminants in drinking water, but because of their size, enteric viruses (20 to 160 nm) may not be as effectively removed compared to bacteria (Elhadidy *et al*., 2013). The UF system tested purports to effectively remove microorganisms to log reduction values of 4 to 7. The low cost to produce and easy maintenance have made UF promising for treating drinking water because the systems can be set up virtually anywhere with no electricity or fuel required; for example, the tested unit operates from 6 to 13 ft (2 to 4 m) of water head for the inlet feed. These units have been especially popular in disaster situations and more impoverished developing countries. This low-cost UF product was used to test the effectiveness of microorganism removal in this research. UF shows promise for virus removal not only based on size exclusion but also because of other mechanisms such as adsorption and electrostatic repulsion (Kreissel *et al*., 2012).

Pathogens are excreted in the feces of infected humans and animals and may directly or indirectly contaminate water intended for human consumption (Figueras *et al*., 2010). Hundreds of different enteric microorganisms are known to infect humans, and more than 140 of them are known waterborne pathogens (Figueras *et al*., 2010; Reynolds *et al*., 2008). Pathogens capable of causing waterborne illness include viruses, bacteria, and protozoa. The impact of waterborne pathogens in humans is often acute gastrointestinal disease. Immunosuppressed subpopulations are more likely to be infected and experience morbidity and mortality resulting from waterborne illness (Reynolds *et al*., 2008). While testing for all enteric pathogens in drinking water would be ideal, time and financial constraints make it impractical. Therefore, indicator organisms are used to assess the potential presence of pathogenic microorganisms (Yates, 2007).

There are many different indicator organisms, and no one indicator is appropriate for every water system. Factors including detection methodology and survival rates influence an indicator system's validity. An indicator's most important attribute is a strong quantitative relationship between the indicator concentration and the degree of public health risk; therefore, a strong correlation between the indicator concentration and pathogen levels is vital (Yates, 2007). Bonde (1966) first described the ideal qualities of an indicator.

Organisms, surrogates, and physical models are used to establish potential risk from fecal contamination in drinking water. Bacterial groups, such as total coliforms, are commonly used to indicate the microbiological quality of water, and their detection is included in drinking water regulations. Fecal coliforms and *Escherichia coli* (*E. coli*) are used as indicators of fecal contamination in regulations by EPA, the Council of European Communities (CEC), and WHO. Two commonly tested viral surrogates are the bacteriophages MS2 and φX174 because they are safe for laboratory workers, are 27 to 34 nm in size, and contrast in structure. MS2 has an outer diameter of 27 nm while φX174 has an outer diameter of 33 nm due to 12 extruding protein spikes (McKenna *et al*., 1992). Another method of testing UF's effectiveness at virus removal is measuring the passing of nanoparticles through a membrane and correlating the size of the nanoparticle to a virus. For example, Pang *et al*. (2009) observed the ability of protein-coated nanoparticles to model MS2.

MF and UF can filter out contaminants based on particle size; they also can retain macromolecules or high-molecular-weight compounds as well as colloidal and suspended matter (Arnal *et al*., 2004). Because UF and MF membranes filter out particles based on size, they are classified as porous membranes. MF pore sizes typically range from 0.1 to 10 µm while UF pore sizes typically range from 0.01 to 0.05 µm (Koyuncu *et al*., 2015).

The use of low-pressure membrane systems using UF and MF is increasing for water treatment. The global market for MF and UF is projected to rise at a compound annual growth rate of 10 percent and 5.7 percent, respectively over the next five years (Koyuncu *et al*., 2015). Membrane technology offers many advantages, such as its modular nature, scale flexibility (small to very large), quality of the product water, small environmental footprint, and, in most cases, low energy usage (Fane *et al*., 2011).

Fane *et al*. state that MF membranes typically have a high permeability (>5001·m^{-2}·h^{-1}·bar^{-1}) and can operate at a low pressure, from 1.5 to 30 psi (0.1 to 2.0 bar). MF membranes can be fabricated from both polymeric and inorganic materials with either symmetric or asymmetric structures, while UF membranes usually have an asymmetric structure to maximize membrane permeability. UF membranes are commonly selected by their molecular weight cutoff (MWCO), defined as the molecular weight of a particle in the solution to be treated in which 90 percent of the particles of that weight will be rejected (removed) by the membrane. UF membranes typically have a MWCO of 1 to 300 kilodaltons (kDa)—one dalton is defined as 1/12 the mass of an unbound neutral atom of carbon 12 or approximately the mass of one hydrogen atom. A membrane with a larger MWCO indicates lower rejection (a lower removal rate) and larger pore size (Fane *et al*., 2011).

In this study, a commercially available UF unit was used to filter water from the Muddy River in Boston. The UF unit uses 6 to 13 ft (2 to 4 m) of water head pressure as the driving force to push water through the membrane system while leaving particles on the opposite side of the membrane without further operation. This apparatus is purported to produce a maximum 185 gal (700 l) of clean drinking water per hour. The tested device uses an outside-to-inside polyvinylidene fluoride (PVDF) hollow fiber UF membrane. The membrane has a nominal pore size of 0.04 µm, which characterizes it as a UF membrane.

The test used the membrane UF technology to remove contaminants and pathogens including

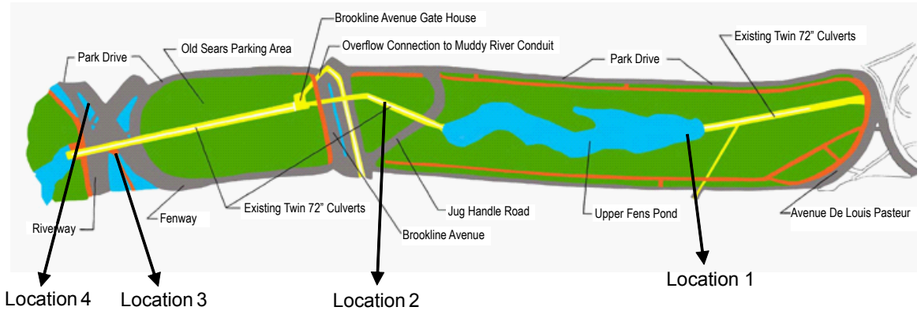


Figure 1. Muddy River testing locations (source: adapted from Muddy River MMOC, 2019)

bacteria and viruses, and the unit significantly removed dirt and turbidity without the use of chemicals. This unit is designed to be a low-cost method to provide potable water to areas affected by natural disasters and developing countries without access to electricity. According to the manufacturer's data, the hollow fiber membrane filters out pathogens including bacteria, protozoa, cysts, helminths, total coliforms, and *E. coli* to a log reduction value >4. The data sheets also state that the membrane will lower the turbidity to <0.1 NTU and remove all total suspended solids.

This research evaluated the efficacy of a low-cost membrane water filtration system for use in developing countries by comparing water quality parameters pre- and post-filtration.

MATERIALS AND METHODS

The samples of water used in all testing criteria were taken from the Muddy River in Boston. Two gal (7.5 L) was withdrawn from each of four locations along the river including the end of the river where it is dammed prior to the Charles River. These sampling locations were based on the recommendations from a consulting firm working with the researchers. The locations are shown in Figure 1.

Initial testing of water quality at all locations showed location 2 as the most polluted. An additional 10 gal (38 L) was taken from location 2 for the filtration assessment. The filtered sample was then tested for water quality parameters such as biochemical oxygen demand (BOD), turbidity, coliforms, and concentrations of heavy metals.

The BOD was determined from the manufacturer's recommended method using a commercially available dissolved oxygen (DO) meter. Muddy River samples were tested as oxidized effluents with anticipated BOD values ranging from 10 to 50 mg/L and as polluted rivers with anticipated BOD values from 2 to 6 mg/L.

A commercial turbidity meter was used to test the samples' turbidity of filtered and unfiltered Muddy River water. The meter was calibrated each time before measurements were taken. The turbidity was determined for the four sampling locations and the filtered samples. All tests were done in triplicate.

To test the metal contents of the samples, an atomic adsorption spectrophotometer (AAS) was used. As the concentration of heavy metals in the Muddy River was unknown, the AAS was calibrated for the concentration shown in Table 1 (Santos *et al.*, 2005 and Emmanuelle *et al.*, 2012). The flame atomic absorption method measures the change in energy state of the flame when it interacts with the atoms from the sample and correlates that visible change to the metal content. Each of the four Muddy River locations was tested for selenium, lead, and arsenic prior to filtration, and location 2 was tested after filtration.

To evaluate the efficiency of the UF unit for coliform removal, Muddy River samples were tested for total coliforms, fecal coliforms, and *E. coli*. The vacuum filtration method was used to determine the total and fecal coliforms (EPA Method 1604). The testing procedure for all samples consisted of filtering the sample through a filter membrane 47 mm diameter, 0.45 µm ± 0.02 µm pore size using a suction pump. The filter membrane was then placed in agar plates with pads that had a total/e-coliform indicator broth poured over them and were incubated at 114˚F (45˚C) for 24 hours for fecal coliforms and 95˚F (35˚C) for total coliforms. Testing was done on two unfiltered Muddy River water sample types: 1) undiluted and 2) diluted using 90 percent distilled water to 10 percent unfiltered water.

Table 1. Constituents and properties

Constituent	Chemical Symbol	Common Oxidation State(s)	Common Aqueous Metal Complexes	AAS Stock Solution Used in Preparation (1000 mg/L)	Concentration Range Tested (mg/L)	Drinking Water Standards (mg/L)
Arsenic	As	–3, 0, +3, +5	As^{3+}, As^{5+}	As_2O_3	100, 10, 1, 0.1	0.0100
Lead	Pb	2	Pb^{2+}	$Pb(NO_3)_2$	100, 10, 1, 0.1	0.0015
Selenium	Se	-2, +2, +4, +6	Se^{-2}, Se^{+4}	SeO_2	100, 10, 1, 0.1	0.0500

Table 2. Unfiltered Muddy River water—Biological Oxygen Demand (BOD)

Location	Day 1	Day 2	Day 3	Day 4
1	4.50	12.75	12.75	12.75
2	10.50	15.00	15.75	20.25
3	5.25	15.00	16.50	12.75
4	5.25	12.75	15.75	13.50

Table 3. Filtered Muddy River water—Biological Oxygen Demand (BOD)

Location	Day 1	Day 2	Day 3	Day 4
1	0.90	2.55	2.55	2.55
2	2.10	3.00	3.15	4.05
3	1.05	3.00	3.30	2.55
4	1.05	2.55	3.15	2.70

RESULTS AND DISCUSSION

Treatment was assessed by comparing influent and effluent BOD, turbidity, coliforms, and concentrations of heavy metals including arsenic, lead, and selenium. Results indicated a significant decrease in contamination after ultrafiltration.

BOD Testing Results

The BOD levels of the four locations without filtration ranged between 4.5 to 20 mg/L, whereas the filtered sample ranged from 0.9 to 4.05 mg/L, as shown in Tables 2 and 3.

These results indicate that before filtration the river had a high level of oxygen-reducing biological matter, which consistently consumed the oxygen within the sample while the filtered sample did not have the same quantity of oxygen-reducing biological matter, as shown in Figures 2 and 3. Oxygen consumption in the filtered samples was low, though greater removal would be desirable. (BOD is not normally used as a drinking water parameter.) The higher BOD in the stream at location 2 could be attributed to a sewer outfall, which is about 1,500 ft (460 m) away.

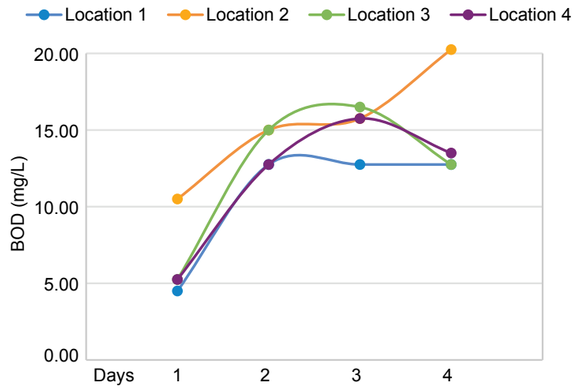


Figure 2. Unfiltered Muddy River water—Biological Oxygen Demand (BOD)

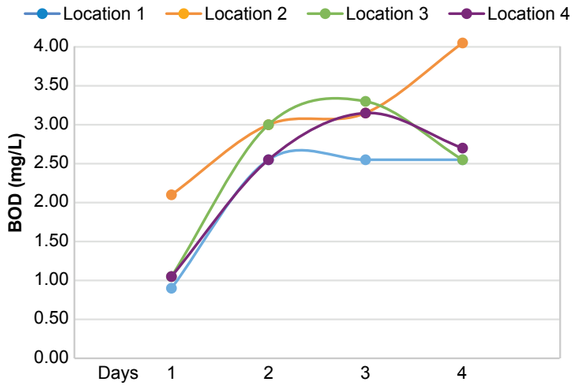


Figure 3. Filtered Muddy River water—Biological Oxygen Demand (BOD)

Coliform Testing Results

Unfiltered (undiluted and diluted) and filtered samples were tested for colony-forming units (CFUs) for total coliforms, fecal coliforms, and *E. coli*. The CFU counts are included in Tables 4a and 4b (see next page). Approximately 1,000 total coliform colonies were observed after a 24-hour incubation period for the unfiltered water both for undiluted and for a dilution of 90 percent distilled water and 10 percent unfiltered Muddy River water.

At an average of 14 total coliform colonies observed in the filtered water from location 2, the UF unit tested effectively removed 81.5 percent of the total coliforms. This is a log reduction value of less than 1 compared to the cited log reduction value of greater than 4 log removal from the product literature. No fecal coliforms were observed in the filtered samples,

Table 4a. Unfiltered Muddy River water—undiluted samples

Location	Total Coliforms (CFU)	Fecal Coliforms (CFU)	*E. coli* Colonies (CFU)
1	>500	>500	>500
2	>500	>500	>500
3	>500	>500	>500
4	>500	>500	>500

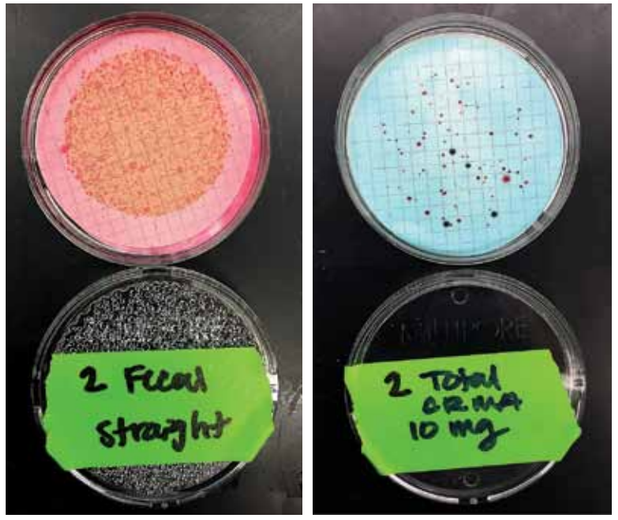
Table 4b. Unfiltered Muddy River water—diluted samples

Location	Total Coliforms (CFU)	Fecal Coliforms (CFU)	*E. coli* Colonies (CFU)
1	139	64	1
2	76	93	7
3	109	81	0
4	104	58	1

so the tested unit appeared effective at removing detectable fecal coliforms, as shown in Table 5 and Figures 4a and 4b.

Table 5. Filtered Muddy River water from Location 2—undiluted samples

Day	Total Coliforms (CFU)	Fecal Coliforms (CFU)	*E. coli* Colonies (CFU)
1	5	0	0
2	20	0	0
3	17	0	0



Figures 4a and 4b. Filtered Muddy River water

Turbidity Testing Results

The turbidity for the Muddy River locations prior to filtration averaged between 5.02 and 7.25 NTU, as shown in Table 6. These values indicate a high level of suspended solids within the samples. The filtered water, shown in Table 7, measured an average of 0.6 NTU indicating that most suspended solids were removed during filtration.

Table 6. Unfiltered Muddy River water

Location	Test 1 (NTU)	Test 2 (NTU)	Average (NTU)
1	4.81	5.79	5.30
2	6.15	7.46	6.81
3	6.08	8.41	7.25
4	5.74	4.29	5.02

Table 7. Filtered Muddy River water from Location 2

Sample	Test 1 (NTU)	Test 2 (NTU)	Test 3 (NTU)	Test 4 (NTU)	Average (NTU)
1	0.41	0.2	0.27	0.32	0.60

Metal Testing

EPA permissible limits for each metal tested are 0.015 mg/L for lead, 0.01 mg/L for arsenic, and 0.05 mg/L for selenium (EPA, 2009). The filtered water was below all three detection limits for potable drinking water, but each of the four unfiltered samples was below the limits, as well. Since the unfiltered heavy metal concentration was below permissible limits, this testing does not conclusively assess filter removal of metal content; however, the filtered results were lower than the unfiltered results, as shown in Table 8.

Table 8. AAS Results

Location	Metal Content (mg/L)		
	Se	As	Pb
1	ND	0.003	0.0005
2	0.0038	0.0065	ND
3	0.0002	0.004	0.0001
4	0.0052	0.005	0.0001
Filtered water	ND	0.0008	ND

CONCLUSION

Based on this research, the tested UF unit treated the Muddy River to near-potable water standards. The BOD levels, turbidity, and coliform counts in the filtered samples from this test came close to United Nations standards for drinking water and were also proximate to National Primary Drinking Water Regulations (NPDWRs) as prescribed by 40 CFR 141.208 and as promulgated by EPA (EPA, 2009); however, further confirmatory research is indicated. The next steps will be to conduct challenge tests using spiked (heavy metals) samples of unfiltered water. Also, viruses were not tested in this research, and we recommend the efficacy of virus removal be further evaluated in future testing.

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On the road to a sustainable infrastructure: Part 2—integrating sustainability in planning, design, and construction

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ABSTRACT | This article, the second in a three-part series, provides methods and techniques for integrating sustainability during the planning, design, and construction of infrastructure projects. Sustainable approaches are identified for common project phases from inception through design and construction, as well as through its service and retirement. Various techniques to promote sustainability are highlighted such as doing the "right project right," considering the life cycle, engaging stakeholders, using tools such as LEED and Envision, and incorporating general strategies.

KEYWORDS | Sustainability, cradle to cradle, life cycle thinking, social well-being, environmental stewardship, economic prosperity, circular thinking, total cost assessment

INTRODUCTION

In our first article, published in the Winter 2019 issue of the *NEWEA Journal*, we discussed how sustainability is defined and for infrastructure projects why it is so important to include its three responsibilities—social well-being, environmental stewardship, and economic prosperity—in decision-making and infrastructure design. In this second of our three-part series, we provide methods and techniques for integrating sustainable responsibilities and principles during planning, design, and construction of infrastructure projects. We review a project's life cycle from inception to retirement, or decommissioning; demonstrate the importance of thinking about the life cycle and viewing a project as an asset; identify techniques to promote sustainability in planning, design, and construction; and highlight tools such as LEED and Envision that can help to achieve sustainable solutions.

MOVING THE PROJECT LIFECYCLE TOWARD A CRADLE-TO-CRADLE APPROACH

Traditional infrastructure projects commonly use a linear process, moving from planning to conceptual design to final design, and ending with project implementation or construction. However, if a project is viewed more like an asset by also incorporating its operational life, that linear process expands to include both an operational phase and the asset's end-of-life phase, as illustrated in Figure 1.

A linear process draws natural capital without replenishing it, generates by-products that must be managed throughout the operational phase, and results in waste at the end of life. This linear process is also referred to as "cradle-to-grave." (Figure 2).

By bending the linear process into a circular one and expanding it to consider upstream and downstream stages, the cradle-to-grave perspective of the more traditional linear way of thinking transforms into an "open-ended" asset life cycle (Figure 3). This circular thinking begins to expose the natural resource demands, as well as the by-product and waste generation across the life cycle. Applying asset life cycle thinking can help designers to understand an asset's impacts throughout its life from raw material extraction to final disposal.

Figure 1. Project life cycle—phases

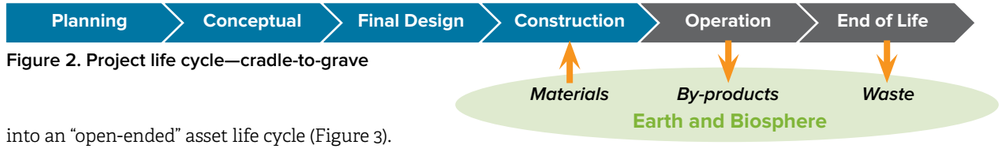


Figure 2. Project life cycle—cradle-to-grave

Applying sustainability principles during the project's design phase helps to minimize the asset's impacts across the life cycle. For example, by reviewing raw material sourcing during the design process (i.e., looking upstream), designers may identify potential social and/or environmental impacts of the products and materials being specified for construction. The design team could then seek alternative materials and products and modify the specifications to avoid certain products and materials with negative impacts. Alternatively, design teams should consider the asset's post-construction use, service, retirement, and disposal (i.e., looking downstream), and increase the potential for asset reuse, remanufacturing, and recycling at the end of its serviceable life. Incorporating specifications to address end-of-life asset reuse, remanufacturing, and recycling during design helps to close the life cycle loop by recovering the natural capital embedded in the asset. If incorporated into the design processes, these examples shift the project approach from one of "cradle-to-grave" to that of "cradle-to-cradle" (Figure 4).

The bituminous asphalt roadway design example (see inset on page 27) shows that sustainable life cycle thinking early in the design of an asset can reduce the potential for negative impacts. Cradle-to-cradle thinking emphasizes consideration of function, fit, and form of the asset well beyond construction (see sidebar on page 26 for definitions). While infrastructure assets must be designed to meet their intended purpose (i.e., function), equally important is that projects be designed to synergistically interact with their surroundings (i.e., fit) and be constructed with materials that minimize their impact on people, profits, and the planet, while maintaining the asset's characteristics (i.e., form). To effectively apply cradle-to-cradle thinking, design teams must bring that to the very inception—the beginning of the asset's design—and carry it through implementation and beyond. Practical thoughts on how to do so are shared in the following pages.

Cradle-to-Cradle Project Life Cycle

All materials and products used to construct and operate an asset have embedded value that should be incorporated back into the asset, keeping the natural capital in a closed loop. This reduces the demand for natural resources and waste requiring treatment and disposal.

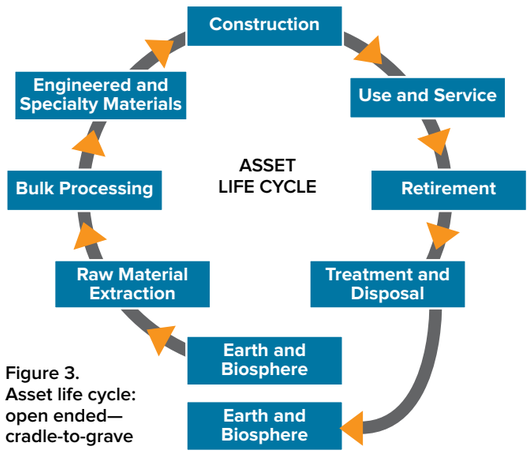


Figure 3. Asset life cycle: open ended—cradle-to-grave

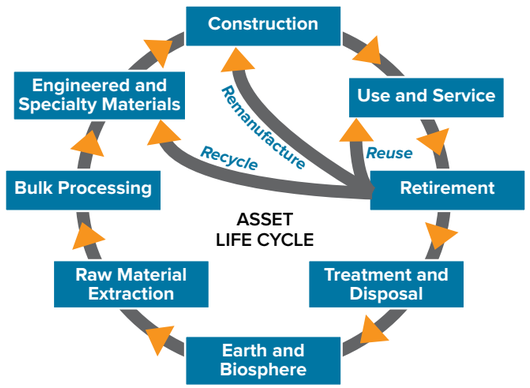


Figure 4. Asset life cycle: close ended—cradle-to-cradle

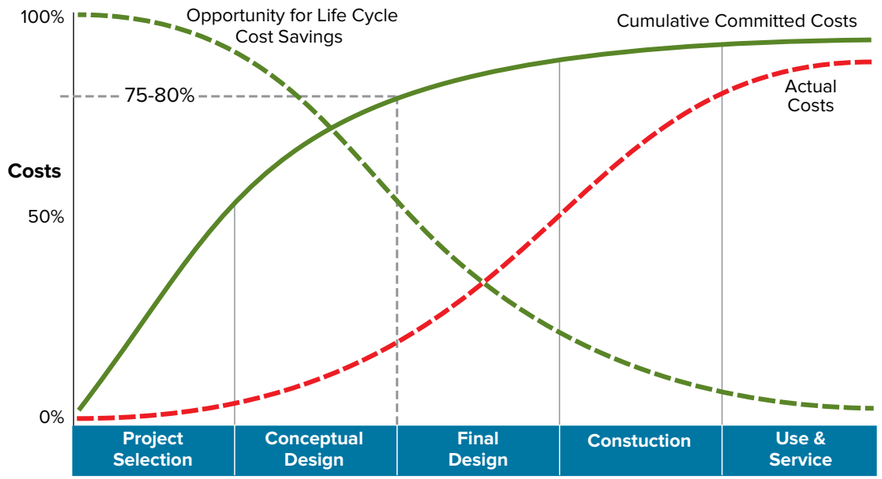


Figure 5. Incorporating sustainable decisions early in the asset life cycle is key to realizing cost savings over the asset's life

INCORPORATING SUSTAINABILITY IN KEY PROJECT PHASES

The design of an infrastructure asset begins with understanding the various design standards, specifications, and quality control procedures to ensure the asset's quality and performance. What if, however, identifying the right project were to begin with a comprehensive understanding of how the final asset will fit with its surroundings, and the form it will take during and after construction? This may require the design team to look beyond the immediate problem being solved to better understand how the project came to be. The earlier in the life cycle, the better, when evaluating whether a project is the "right project." Figure 5 illustrates much of an asset's total life cycle cost is committed early in design, well before construction and operation costs are incurred. Figure 5 also emphasizes that the impact an asset has across its life can best be minimized at the very beginning of design. As the design advances, the opportunity for life cycle cost savings diminishes as the cumulative committed costs increase. Once the project goes to construction, these committed costs become actual costs, and there is no turning back.

An Asset's Function-Fit-Form

In any project planning and design process, and especially for one that is sustainable, the design teams should consider the function, fit, and form of an asset. These terms are defined as follows:

Function—an asset's primary purpose

Fit—how the asset interacts with its surroundings

Form—characteristics each asset exhibits such as shape, color, noise, and size

Early project planning/inception

Several steps can be taken during the early planning of an infrastructure asset to ensure that the design teams are "doing the right project" and are "doing the project right." In Policy Statement 418, the American Society of Civil Engineers (ASCE) states that civil engineers shall be committed to the following ASCE Principles of Sustainable Development:

> ***Principle 1—Do the Right Project***
> *A proposed project's economic, environmental, and social effects on each community served and affected must be assessed and understood by all stakeholders before a decision is made to proceed. Consider non-structural as well as structural (built) solutions to the needs being addressed.*
>
> ***Principle 2—Do the Project Right***
> *The civil engineer shall engage stakeholders and secure public understanding and acceptance of a project's economic, environmental, and social costs and benefits. To move toward sustainability, engineers must design and deliver projects that address sustainability holistically (from concept to demolition or reuse), rather than adding a variety of "green" features into a conventional project.*

Over the years, design teams have learned that *stakeholder engagement* during the planning and design processes can reduce potential "showstoppers" during the permitting and construction phases. Stakeholder engagement often leads to a greater understanding and awareness of other groups' plans and needs for the community, and the synergies that might exist between those plans and the infrastructure asset.

This engagement should also be applied to an asset's environmental aspects and its fit and form with the natural surroundings. Project designs that meet the minimum standards and comply with the regulations may be considered "eco-efficient" projects, but in reality, these are projects that are "less bad." While eco-efficient projects are a step in the right direction, applying cradle-to-cradle thinking to the design can result in restorative, or "eco-effective," projects. Eco-effective projects require design teams to not only deliver projects efficiently but, more importantly, provide projects that are sustainable.

Obtaining active stakeholder engagement in the project planning phase is referred to as integrated project delivery (Figure 5). This project delivery approach can also be applied to the sustainability of a project where early integration of sustainable principles in the project selection and early design phase can help select the "right project." Once the right project is selected, the design team can incorporate design standards and specifications that call for sustainable materials and methods in the contract documents that will drive the project to be "done right."

Conceptual design

Once the project has been identified, ensuring that the asset's design incorporates the three responsibilities of sustainability—social well-being, environmental stewardship, and economic prosperity—is no small task. Incorporating these responsibilities often requires asking questions not typically considered and being willing to commit to areas outside of "business-as-usual" conditions.

Recently green design has been more at the forefront with the development of several decision-making and implementation frameworks that guide project teams and owners in broadening the project beyond just addressing the immediate requirements. These frameworks can help teams evaluate long-term, life cycle benefits and impacts of the alternatives being considered (see sidebar on page 28).

Typically, in the conceptual design phase, design teams develop and evaluate various project alternatives to meet overall goals and objectives, some of which could be sustainable. Often those alternatives are measured against metrics or criteria to determine how effective each alternative would be relative to those metrics or criteria. Each framework or tool listed in the sidebar invites project teams to consider not just the first cost of the alternative, but the economic, social, and environmental costs over the project's life cycle. These frameworks then go a step further and encourage project teams to consider costs and benefits beyond those that can be typically quantified. Figure 6 illustrates an example of such expanded criteria. This

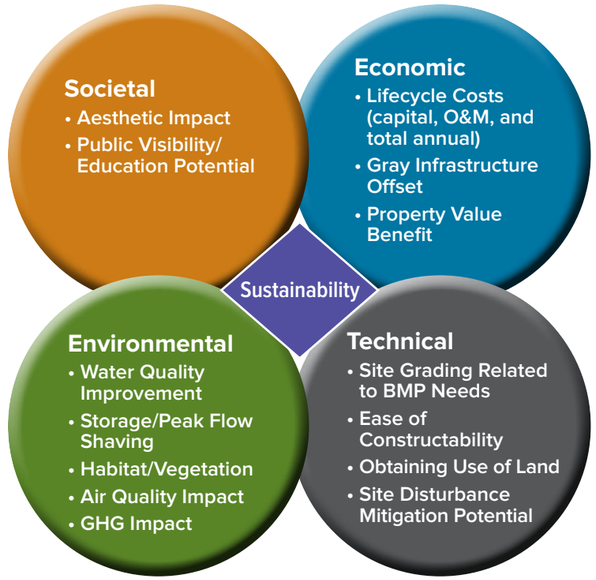


Figure 6. Expanding the evaluation criteria beyond the initial economic cost drives more sustainable decision-making during conceptual design

Incorporating Cradle-to-Cradle Thinking during Project Design—One Example

Closing the resource loop can be illustrated in the following example: a bituminous asphalt roadway is damaged beyond repair and must undergo a full-depth restoration. The design team, designing linearly, could specify complete demolition and reinstallation of the full-depth asphalt roadway with landfill disposal of all demolished materials. Alternatively, drawing upon sustainable principles and cradle-to-cradle thinking, the team could incorporate into its design the reuse of a portion of the pulverized roadway in the base course, promoting reuse, and the use of reclaimed asphalt in the binder course, promoting remanufacturing. These steps help comply with solid waste landfill bans (i.e., banning the landfill disposal of millings) and promote material recycling. Further life cycle considerations of this roadway asset could be incorporated in the "use and service" stage through proactive pavement management such as crack sealing, micro-paving, and routine maintenance to extend the asset life before the need for full-depth reconstruction at retirement.

Sustainable Decision-Making Frameworks and Tools

Sustainable frameworks provide guidance and tools for broadening the set of questions during project planning and preliminary design. They can also offer a roadmap for implementation. Examples include the following:

US Green Building Council's **Leadership in Energy and Environmental Design** (LEED): ideal for occupied building spaces

Institute for Sustainable Infrastructure's **Envision** Rating Tool: best applied to infrastructure projects; broad enough to apply to many types of infrastructure work

The Sustainable Sites Initiative's **SITES**: best applied to landscape planning and design, and could be used with LEED or Envision to enhance implementation

EPA's **Effective Utility Management/Sustainable Practices Roadmap**: useful in helping utilities create pathways and opportunities for sustainable decision-making

"total cost assessment" can be done using a variety of methodologies; the key is to expand the criteria beyond the well-known economic costs to understand the full picture of economic, societal, and environmental costs and the benefits of a given alternative.

Detailed design and construction

After the conceptual design for the identified sustainable project alternative is completed, the important step of detailed design and implementation begins. Setting a project on the right path toward sustainability is critical, but "doing the project right" considers sustainability even in the project's minute design and construction details. Although no "one size fits all" approach exists in sustainable solutions, below are examples of general principles and strategies to be considered for almost every project.

Reduce/reuse/recycle (aka "Triple R principles")

The order is important here. First, consider ways to reduce the overall materials or energy used, and then consider reusing or specifying recycled content. These strategies reduce the amount of native or virgin materials or resources extracted from the environment. Examples of this follow:

- Upon upgrade of treatment facilities, consider reuse or repurpose of tankage for another process or equalization
- When feasible, use cured-in-place pipe lining rather than full replacement to rehabilitate sewers

Energy efficiency/renewables

Energy use demonstrates the Triple R principles from above; whenever possible, consider making the processes more efficient (reduce). Renewables, though not specifically reuse or recycling, inherently use a renewable resource such as the sun, wind, or biogas. Consider use of the following:

- Variable frequency drives (VFDs) for pumping stations to better match energy use to variable flows; include high-efficiency pump motors as well
- High-efficiency lighting, such as LEDs
- Solar power for low-power equipment
- Dissolved oxygen (DO) or ammonia-based control of aeration systems that perform nitrification to reduce aeration's high energy costs

Water efficiency/reuse

Regarding water, similarly to energy, projects should first consider using less potable water and "right sourcing" to match the use to the quality of water. For example:

- Use xeriscaping or landscaping with native species to reduce irrigation needs
- Monitor unaccounted-for water and fix leaks in distribution systems
- Consider gray water for process water needs, offsetting potable water use (see award-winning example in page 29 inset)

Construction demolition and debris recycling/upcycling

In 2017 in the United States, 569 million short tons (516 million metric tons) of construction and demolition waste were generated, more than twice the amount of municipal waste.[1] Potential reuse or recycling of the material generated upon demolition and also in construction keeps that same material out of landfills and reduces the need for virgin resources. Examples include the following:

- Recycled concrete can be used as an aggregate base course for future projects
- Steel can often be recycled into new structural rebar and steel beams
- Many carpets are available made up of mostly recycled fibers; designers should look for these alternatives when specifying carpeting

CONCLUSION

This article challenges the traditional linear approach to infrastructure asset, or project, design and offers an alternative circular, cradle-to-cradle approach that will require innovative, "out-of-the-box" thinking. A key is identifying the "right project" during inception or planning and then executing the "project right" using sustainable materials and methods, applying life cycle thinking, and incorporating and promoting sustainability at each step. These methods will likely reduce operation and maintenance costs and waste during construction and at the end of life, reduce the demand for natural capital, achieve stakeholder and public support, and provide a more resilient project.

Our next and final article in this three-part series on incorporating sustainability in infrastructure projects will present case studies on such projects now in operation, and will identify how to overcome the challenges of achieving sustainability in similar projects.

REFERENCES

1. https://www.epa.gov/smm/sustainable-management-construction-and-demolition-materials#America

ABOUT THE AUTHORS

- Wayne Bates, a principal engineer and industrial sector practice leader at Tighe & Bond, has more than 30 years of civil and environmental engineering experience. Mr. Bates is also an adjunct professor at Worcester Polytechnic Institute (WPI) and UMass Dartmouth where he teaches courses in sustainable infrastructure and green product design. Over the past three years he has traveled with the UMass Amherst Engineers Without Borders Ghana team as a professional mentor.
- Courtney Eaton a Senior Professional at Kleinfelder, has 20 years of experience in the planning and design of wastewater and water reuse systems, with an emphasis on sustainable planning and design. She has been a member of the NEWEA Sustainability Committee for the past 10 years and chair since 2017.
- Meredith Zona, an Associate at Stantec, has more than 40 years of environmental engineering experience, with a focus on wastewater system design and incorporation of energy-efficient measures. She is a past publications director of NEWEA and has served on several NEWEA committees.

GREEN STEPS AWARD WINNER

Courtney Eaton of NEWEA's Sustainability Committee presents the first "Green Steps" award to Stephen Pozner of Globalcycle, Inc.

Globalcycle, Inc., is the first commercial and industrial wastewater treatment and recycling facility in Massachusetts. The company takes in wastewater streams from sources such as excavation dewatering, cooling towers, tank cleaning, and catch basin cleaning, treats them at its facility in Taunton, and trucks the reclaimed water to Covanta's waste-to-energy incinerator in Rochester, Massachusetts, where the water is used in the facility's air quality control systems. Before Covanta began receiving this water from Globalcycle, it obtained water from onsite wells. Globalcycle's processes thus provide both significant water reclamation and a reduction in the amount of water withdrawn from the aquifer.

For its effective reuse of commercial and industrial wastewater, Globalcycle received the first annual "Green Steps" award from NEWEA's Sustainability Committee.

Role of Technology in the Water Sector:

LIFT helps accelerate innovation in the marketplace

by Kelsey Beveridge

THE WATER SECTOR FACES A VARIETY OF CHALLENGES such as outdated infrastructure, new water quality requirements, lower revenues, and greater water scarcity in many regions. In addressing challenges, the water sector is traditionally risk-averse to implementing new technologies, primarily due to the capital costs involved and lack of knowledge of which technologies are effective. Proactively identifying innovations, however, can reduce costs, improve treatment processes, and benefit the environment. In response to these challenges and needs, the Leaders Innovation Forum for Technology (LIFT) formed to help bring technology and innovation to the field quickly and efficiently.

LIFT is a joint program of the Water Research Foundation (WRF) and the Water Environment Federation (WEF). A multi-pronged initiative, it offers technology providers the opportunity to introduce their innovations and enables utilities to conduct pilot tests and be early adopters. At present, 150 technologies and 138 companies are participating in LIFT. The program seeks to help combat the industry's conservative approach to implementing new technologies by increasing direct interaction between vendors and end users to ultimately implement these innovations. LIFT has many initiatives to support the growth of innovation, including technology scans, LIFT Link, utility working group, and university–utility partnerships.

TECHNOLOGY SCANS

LIFT has many resources for technology providers to share their innovations. LIFT technology scans aim to move innovation into practice and have engaged some 1,200 organizations, including municipal and industrial facility owners, consulting firms, regulators, and venture capitalists. The technology scan process identifies, evaluates, and markets innovative technologies and processes to inform end users and ultimately promote early adoption. Using a three-step process, the initiative starts with an application from the technology provider that an expert panel of consulting, academic, and utility representatives evaluates for technical claims and commercial readiness. If the application is approved, the technology provider is invited to present to LIFT audiences to garner interest in early adoption.

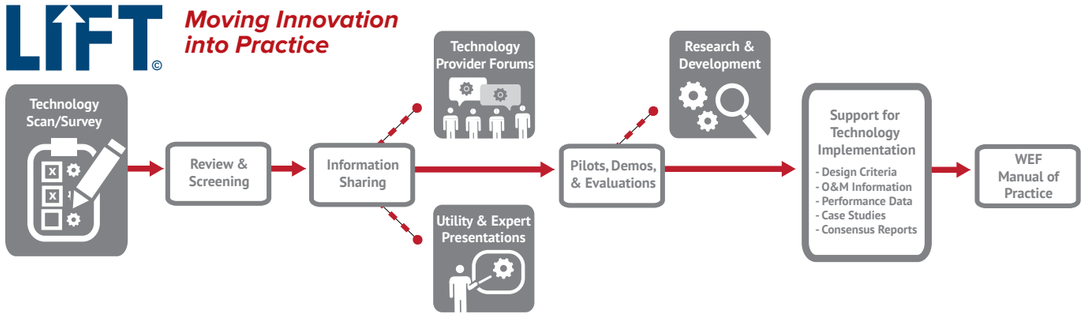
More information about LIFT and its initiatives can be found at waterrf.org/lift

Several technologies have gone through LIFT from application to commercial availability and use in operating facilities. For example, Genifuel Corporation applied for a LIFT technology scan in 2014 for its hydrothermal processing (HTP) technology. In working with LIFT, sights were set on applying HTP to wastewater sludge to reform the organic matter into biofuels at elevated temperatures and pressures. In 2015, WRF organized a group of interested collaborators to begin testing the technology's limits and advancing its potential. Through the LIFT biosolids-to-energy utility focus group, 10 wastewater facility owners agreed to share the evaluation costs and began supporting bench-scale testing of wastewater sludge. Pilot tests at the Pacific Northwest National Laboratory began on three types of wastewater solids and measured the amount of biocrude oil and methane gas produced from various sludge feeds by HTP. An independent WRF report on the tests confirmed the technology's potential for treating wastewater, prompting interest in pilot testing at participating utility sites. One site, Metro Vancouver in British Columbia, is leading an effort to build a demonstration plant. Conservative estimates predict this technology could produce up to 30 million barrels (4.8 million m^3) of oil each year in the United States alone.

The technology scans enable utilities interested in pilot tests, potential funders, and the WRF subscriber base to learn about the technology's functions and merits directly from the vendor, all of which are captured in the online platform LIFT Link.

LIFT LINK

To further support technologies and provide more information about innovation implementation, LIFT Link is an online platform developed to facilitate interaction among municipal and industrial water, wastewater, and stormwater agencies, technology providers, consultants, academics, investors, and others. It allows users to discover new technologies and research needs, connect with others with similar needs and technology interests, and collaborate on research, projects, and proposals. LIFT recognizes that innovation is a social process, and this platform enables innovators to offer solutions and utilities to find experts to help solve challenges. The technologies are searchable, allowing utilities to directly filter by category or technology.



Using the platform's needs forum, users with similar needs and interests can connect to pilot technology and share the risk and costs of trialing new innovations. Utilities can "follow" a challenge or indicate the same need, sending a signal to the marketplace and solution providers that opportunities exist to address ongoing industry challenges.

UTILITY WORKING GROUP

Beyond LIFT Link, LIFT's network for information sharing and collaboration on technology and innovation includes 600 participants and at least 12 technology focus areas. The utility working group consists of utility and industrial facility owners who subscribe to WRF. The utility working group is subdivided into focus groups, including biological nutrient removal, energy efficiency, intelligent water systems, odor control, perfluoroalkyl and polyfluoroalkyl substances (PFAS), water reuse, and energy recovery. Members interested in one or more of these categories discuss and share experiences through a focus group. Overall the utility working group provides peer-to-peer networking for technology and innovation that includes expert presentations on technologies, state-of-the-art technology guidance reports, and web-based and in-person meetings.

UNIVERSITY–UTILITY PARTNERSHIPS

Research, development, and testing of innovative solutions is a priority to LIFT. The university–utility partnership program aims to communicate best practices, challenges, and examples of successful collaboration to advance water research. Improved collaborations and engagement between utilities and universities provide win–win scenarios for both sectors and can help improve the utility-to-university ecosystem for innovation. This program benefits universities by providing real-world training and experience for students that increases post-graduation employment potential, synergies with practitioners in developing new technologies and processes, additional patent opportunities, and improved understanding of research and development solutions. Through this relationship, utilities get new solutions and insight into utility problems, low-cost technical problem-solving, identification of new talent for staffing and contracting, progressive approaches to problem-solving, and minimized risk for innovative technologies for faster adoption and cost savings.

In Michigan for instance, the Great Lakes Water Authority (GLWA) has developed a partnership with Wayne State University. The memorandum of understanding includes collaboration on leading-edge research into constituents of emerging concern such as pesticides, endocrine-disrupting compounds, and antibiotics. The research is done at Wayne State University's laboratories and GLWA's water works park pilot plant, which has a 240 mgd (910 ML/d) treatment capacity. GLWA's goal for this partnership is to obtain actionable information from research that allows it to provide better, more reliable, cost-effective treatment and distribution protocols. Wayne State's goals are to contribute new applied knowledge and technical resources for utility operators and society, and to train the next generation of water utility practitioners in innovative and sustainable operations. Funding was provided to the Healthy Waters advisory board through the Erb family foundation. This support has allowed students to work as interns and staff to perform the research at GLWA's water works park pilot plant.

Proactively identifying innovations can reduce costs, improve treatment processes, and benefit the environment

LIFT enables utilities to directly access the latest water and wastewater technologies and adopt them sooner for cost savings and process improvements. It also helps utilities to fill knowledge gaps as the interests and needs of the water sector continue to evolve. Furthering LIFT's presence in the drinking water field will help advance innovation across water and support technology providers and utilities.

Kelsey Beveridge is a technical writer with the WRF, where she writes and develops weekly newsletters, produces articles for outside publications, press releases on published research, contract awards, and organization news, and promotes dissemination of WRF research in industry magazines and online publications. She holds a bachelor's degree with a focus on environmental studies from Franklin and Marshall College.

NEBRA Highlights

WEF Biosolids Convening Meeting

NEBRA was invited by the Water Environment Federation (WEF) to attend a "Biosolids Convening" meeting of regulators, utilities, biosolids management companies, researchers, consultants, and biosolids associations from around the country. The two-day meeting of about 60 attendees was held near the WEF offices in Alexandria, Virginia, on November 20 and 21.

The meeting began with a panel discussion on national perspectives with speakers from EPA, DC Water, and WEF. All three organizations have prioritized work on biosolids programs as a result of contaminants of emerging concern (CECs)—especially perfluoroalkyl and polyfluoroalkyl substances (PFAS). (NEBRA is investing heavily in assisting members with the impacts of PFAS on biosolids management.) EPA risk assessments are well underway for polyfluorooctanoic acid and perfluorooctanesulfonic acid (PFOA and PFOS), and much more work will come out of EPA soon, including a screening model to prioritize risk assessments for the remaining 4,800 or so PFAS compounds. After nearly a decade of research, EPA will host a meeting with state and tribal biosolids coordinators in early 2020.

EPA is working on a process for addressing resource recovery programs that were not contemplated by the 40 CFR Part 503 regulations for use/disposal of biosolids. Certain states lead in resource recovery and beneficial reuse programs, including California and Washington, driven mostly by regulations for addressing healthy soils and climate change.

After the meeting participants briefly reviewed the 2018 Office of Inspector General report on EPA's 40 CFR Part 503 program concerning land-applied biosolids (epa.gov/office-inspector-general/report-epa-unable-assess-impact-hundreds-unregulated-pollutants-land), they dug into current issues with biosolids programs. The issues comprised three needs—program, communication, and research. The group identified major gaps in each area and suggested actions to address those gaps.

Program recommendations, to be implemented by numerous stakeholders in collaboration with as many interests as possible, address biosolids quality and public acceptance of biosolids use, updating the regulations, promoting sound scientific approaches to mitigating CECs, increasing regulatory oversight and assistance, and addressing future management options and market pressures.

Communication recommendations focus on improved and targeted public information about biosolids benefits and advantages, raising awareness to urge rational CEC risk assessment, increasing resources and positive strategies to respond to negative press, and improving communications among the states and with EPA.

Research suggestions, which will be directed by WEF to the Water Research Foundation for follow-up, involve evaluating CEC characteristics regarding risks in biosolids usage, exploring biosolids benefits (such as carbon sequestration) and biosolids roles in nutrient conversion and availability, seeking innovative technologies in areas such as co-digestion and odor mitigation, and researching social aspects of biosolids reuse.

A biosolids action plan presented to the WEF board of directors in February and to WEF's Residuals and Biosolids Committee in March included establishing a steering committee, developing beneficial research and communications plans regarding CECs and biosolids, re-invigorating the Association of Boards of Certification (ABC) Biosolids Operator Land Application Certification initiative, focusing on broad partnerships for sustainable and innovative biosolids management, and submitting a letter (in advance of meetings with state and tribal biosolids management staff) exhorting EPA to support training, coordination, and guidance on CEC challenges.

Collaboration with NEWEA's Government Affairs Committee on PFAS Public Awareness Campaign

NEBRA and NEWEA have been discussing how to collaborate on much-needed public information campaigns to support its municipal members' biosolids process and management programs. *The Boston Globe* recently published a series of articles on PFAS in wastewater, including the following: "Toxic chemicals can be dumped into the Merrimack River, federal and state officials say (November 5, 2019)," which led the city of Lowell's wastewater treatment facility to cease accepting leachate from a New Hampshire landfill; and "'Forever chemicals' are found in MWRA fertilizer, drawing alarm (December 1, 2019)," concerning PFAS in the Class A biosolids fertilizer produced by the Massachusetts Water Resources Authority. NEBRA followed up that latter story with a letter to the editor, "Group is on the front line of water quality protection," which the *Globe* published in its December 5 issue. These articles and NEBRA's letter can be read at nebiosolids.org/pfas-biosolids.

...there is concern that federal and state legislation/regulations will result in the loss of important and proven biosolids recycling/resource recovery programs and shrinking outlets for biosolids and residuals.

NEBRA has provided initial funding for NEWEA's Government Affairs Committee (GAC) public relations campaign planning and development with the hope of having some messaging and materials to present to federal legislators during Water Week in late April. The media and the general public are other primary audiences that will be targeted.

NEBRA and NEWEA are also participating in a national multi-media advocacy effort, "The PFAS Receivers Group," emphasizing that water resource recovery facilities (WRRFs) merely receive PFAS and do not manufacture or use them when cleaning the water. The group, an informal alliance of representatives from biosolids, solid waste, wastewater, drinking water, and energy sectors across the country, is working on an Op-Ed, a possible media tour, and a congressional briefing in 2020. From the Receivers Group perspective, there is concern that federal and state legislation/regulations will result in the loss of important and proven biosolids recycling/resource recovery programs and shrinking outlets for biosolids and residuals. This concern is quickly becoming reality in the Northeast.

Working with NEWEA's GAC and the Receivers Group, NEBRA will push for an economic study or report on the costs that will be associated with setting very low levels or limits for PFAS in drinking water, groundwater, and surface waters. In the interim, NEBRA is helping its members by compiling and distributing various guides for reducing PFAS entering WRRFs from industrial and commercial sources and from septage wastes. NEBRA's Regulation/Legislation Committee has been reactivated around the PFAS issue, and has been watching legislation at the federal and state levels and seeking the best way to assist members with testifying, commenting, or even informally speaking with elected officials about the unintended impacts and costs of regulating PFAS in wastewater and biosolids to extremely low levels. Something new is developing every day; for the latest updates, please visit NEBRA's website.

NEBRA Increasing Educational Offerings with Monthly "Lunch and Learn" Sessions Online

For the past few years, NEBRA has hosted the North East Digestion Roundtable (NEDR). NEDR provides free quarterly lunchtime webinars to all interested in advancing their knowledge of anaerobic digestion process operations. A different topic is discussed each quarter with time allowed for operators to ask questions and exchange information with other operators.

In 2020, NEBRA will expand its educational offerings to include monthly Lunch and Learn webinars on various topics of interest to biosolids professionals. Not surprisingly, the first session, held on January 31, was a PFAS Literature Review and Update with Michael Rainey, former biosolids coordinator at the New Hampshire Department of Environmental Management, that summarized the recently updated and compiled literature review on biosolids/residuals research.

NEBRA has an initial list of topics to present, for instance, a review of the 40 CFR Part 503 regulations, a topic that could benefit both new and young biosolids professionals as well as those well established in their careers. NEBRA is looking for your ideas on further useful topics to cover in these webinars on biosolids recycling and management; please email your ideas to janine@nebiosolids.org. The monthly webinars will continue to be free for NEBRA members, while non-members will pay a nominal fee.

NEBRA Members Advance in Vermont Phosphorus Innovation Challenge

The Village of Essex Junction WRRF in Vermont has teamed up with Chittenden Solid Waste District (CSWD), the University of Vermont (UVM), Efficiency Vermont, and James Morris Associates to test an innovative combination of technologies to remove phosphorus from wastewater. In 2018, the team received a grant from the state of Vermont's Phosphorus Innovation Challenge program being run by the Agency of Agriculture, Food, and Markets to find market-based innovative technologies to remove phosphorus from manure and other waste streams and make the recovered phosphorus available for beneficial reuse, for example as a fertilizer.

The project started because Essex Junction wanted a process to remove internally recycled nutrients, especially phosphorus, from its wastewater stream. The project team proposed generating magnesium ammonium phosphate (struvite) from a specific waste stream to cost-effectively capture phosphorous for processing into an agricultural fertilizer. Current commercially available technologies recycle phosphorus as struvite at large-scale facilities, but they lack feasibility for smaller facilities such as Essex Junction and most other facilities in Vermont.

Biosolids Management Award, Greater Lawrence Sanitary District: Cheri Cousens and Richard Weare

Elizabeth A. Cutone Executive Leadership Award, Ned Beecher

The Essex Junction/CSWD/UVM project proposes to employ a proprietary pipe descaling technology to precipitate struvite, which would then be collected using a custom-built filtration device. The project was one of 12 finalists in the first stage of Vermont's Challenge; it was then selected in the second stage as one of six to receive initial funding ($45,000) to start testing and in the final stage was awarded an additional $58,907 to start pilot testing after making a business case for the project.

NEBRA applauds Essex Junction for seeking its own solution and its partners for their willingness to innovate and take the next steps with the project. For more information, go to: agriculture.vermont.gov/Vermont_Phosphorus_Innovation_Challenge.

The Residuals (Odds and Ends)

NEWEA AWARDS FOR NEBRA PEOPLE

Some entities with NEBRA ties were recognized at NEWEA's annual awards luncheon. Congratulations to Ned Beecher, past NEBRA executive director, who received the well-deserved Elizabeth A. Cutone Executive Leadership Award. Also recognized was the Greater Lawrence Sanitary District (GLSD) for its outstanding biosolids management program; the award was accepted by GLSD Executive Director and NEBRA board member Cheri Cousens and GLSD Capital Projects Manager Richard Weare. Way to make us proud!

LONG-TIME NEBRA PARTNER BIOCYCLE IS GOING ALL-DIGITAL

NEBRA has long relied on *BioCycle Magazine* and worked with the BioCycle organization on the shared mission of advancing organics recycling for sustainability. The family business, editorial strengths, and innovation of BioCycle have been a consistent guiding light in the organics recycling world. Now, in 2020, BioCycle is going all-digital, and we encourage our members and contacts to sign up for the weekly emails at biocycle.net/resources/biocycle-connect. We congratulate BioCycle on this next phase (part of its more-than-60-year journey) and look forward to many more years of collaboration.

CALIFORNIA LEADS THE WAY IN DIVERTING ORGANICS FROM LANDFILLS

Even as challenges such as PFAS are causing some states, such as Maine and New Hampshire, to pull back from recycling organics to soils, California is required by major legislation to start enforcing a ban on organics going to landfill starting in 2022. See how Ventura County is preparing by aggressively building organics diversion and processing programs at vcreporter.com.

PART OF THE SOLUTION

NEBRA continues to advocate on behalf of members for science-based policies and common-sense regulations, now especially related to PFAS. But in concert with NEWEA President Jennifer Kelly Lachmayr's theme for 2020—advocate, act, be the change—NEBRA is also looking for more ways to help our members be better advocates. Everyone needs to be part of the solution; we all need to speak up! NEBRA, in collaboration with NEWEA, can give you the tools to advocate for your communities at this critical time. Here are a couple of good links to get you started: nebiosolids.org and newea.org/resources/government-affairs.

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

nebra
North East Biosolids & Residuals Association

Innovation Council

NEWEA/NEWIN Merger and the Innovation Council

At the Annual Conference on Monday, January 27, the NEWEA membership voted to approve changes to the NEWEA bylaws that completed the merger of the Northeast Water Innovation Network (NEWIN) with NEWEA. The merger was consummated by the addition of a voting NEWEA council director who will develop a new Innovation Council within NEWEA that will promote innovative concepts and technical achievements in water resources. This exciting development is the culmination of years of collaboration and planning by an interim Innovation Task Force, NEWEA leadership, and NEWIN. Innovation has always been important to NEWEA's identity and mission. This merger with NEWIN provides far greater opportunity to fulfill NEWEA's mission as well as the intent of NEWIN (when it was created in 2011) to foster economic development through water innovation. Innovation Council Director Dr. Marianne Langridge shares more about this merger in the interview below.

Journal *What do you think are the strengths of the merger of NEWIN with NEWEA?*

ML: The merger brings together two groups of members who are passionate about finding solutions to the water and environmental challenges our communities are facing. NEWIN's membership is primarily businesses developing innovative new water technologies and approaches, and they are looking to connect with organizations that can provide them with insights and testing of ideas to refine their offerings and bring them to market. NEWEA's membership includes a wide variety of people responsible for treating and managing water and the environment for communities and businesses across New England. It is the perfect partnership to foster the connections necessary for creative problem-solving.

Innovation Council Director Dr. Marianne Langridge

■ *As NEWEA's first Innovation Council director, what are your top priorities to promote innovation in the water industry?*

ML: I believe that innovation occurs when people with diverse perspectives come together around a common goal. With that in mind, the top priorities of the Innovation Council will be to build connections, expand perspectives, and foster collaborative action. To do this we will focus on hosting virtual and in-person events that include diverse interests from utilities, regulators, academics, and innovators to share perspective and knowledge. We will also support ideas and actions resulting from these connections in the form of experimentation, testing, and adoption of new technologies, methods, and policies that will improve the industry.

■ *Following the Innovation Pavilion at the NEWEA Annual Conference, what are your plans for activities that will provide NEWEA members with insights on innovative technologies and methods?*

ML: The 'Reverse Pitch' event at the Innovation Pavilion at this year's conference was a kickoff for a year-long program focused on solving specific water challenges. Over the course of 2020 the Innovation Council will hold quarterly events to support the connections and ideas shared at the event to identify potential solutions and develop them through partnerships and collaboration. These events will include thematic pitch events and roundtable discussions to explore the non-technical elements necessary to implement new technologies including economics, human resources, regulation, and policy.

■ *What specific activities would be beneficial for connecting utilities with innovators?*

ML: Most utilities are resource-constrained and do not have the research and development budget and staff to experiment and develop solutions for their challenges. Whether it is a treatment problem, data analysis opportunity, or efficiency issue, the day-to-day efforts to run a utility can be all-consuming. Making these challenges known to those in the innovation community will provide the additional attention needed to develop solutions.

In addition, the feedback we have heard from many innovators is that they need to be able to test their products, services, and ideas. Once a potential solution evolves from a theory to something testable, the more timely and convenient testing and experimentation can begin, the faster solutions can be brought to market. It will be a win–win for all sectors of the industry and ultimately for the health and well-being of our communities, and for the benefit of the environment.

■ *How do you plan to access innovation best practices used by WEF and its Member Associations, and bring them to New England?*

ML: EPA transitioned the leadership of the Water Innovation Clusters, which included NEWIN, to WEF. With this regional merger, the Innovation Council will continue to build on this legacy and participate in the activities that WEF coordinates to share ideas and lessons learned across all the clusters. In addition, there are international clusters with which WEF coordinates that will give us the opportunity to collaborate globally. We were fortunate to have a number of leaders from WEF and WRF (Water Research Foundation) at our Innovation Pavilion this year, including Bri Nakamura who leads the Innovation Pavilion at WEFTEC and Aaron Fischer who oversees the LIFT (Leaders Innovation Forum for Technology) program. We will continue to work with them to support all our members and to make sure they are aware of all the resources available through WEF and WRF.

The Innovation Council will be organizing its committee structure in the next few months. Members interested in committee involvement are urged to contact Dr. Langridge through the NEWEA office.

Spotlight: **Young Professionals**

We conclude our tour around New England, where we have showcased great Young Professional (YP) talent spread across the region. In this spotlight, we are pleased to showcase two talented YPs who are dedicated to keeping Vermont's waterways (and mountains) green. Ashliegh Belrose is an operator at South Burlington's Airport Parkway water resource recovery facility. Christopher Cox is the chief operator at the city of Montpelier's water resource recovery facility.

Journal *How did you come to enter the clean water profession?*

AB: I was able to social network through my husband, who was already working in the industry. I went with him to the conference in Boston and made a few connections there, eventually leading up to an open position in water quality at the city of South Burlington.

Christopher Cox

CC: Good luck mostly. My sister was on the Websterville Fire District Prudential Committee, which oversees Websterville's water treatment facility. One of the water operators for Websterville was Bob Fischer. At the time, Bob's primary job was chief operator of the Montpelier WRRF (water resource reclamation facility). Bob mentioned to my sister he was struggling to find anyone to fill an open wastewater operator position in Montpelier. I applied two days later, and the rest is history.

■ *How long have you been in the water environment field and why did you decide that this work would make a good long-term career for you?*

AB: I've been in the environmental field ever since I was studying science as an undergrad, about 12 years now. Everyone produces waste and everyone needs clean water! If I got into the wastewater field, I knew it meant job security and skills that I could take with me anywhere.

CC: I have been in the water environment field for eight years now. I was fortunate enough to travel to Rhode Island as the Vermont exchange operator in 2012. While in Rhode Island, I got to visit multiple facilities, spend time with a lot of great operators, and attend the Rhode Island Clean Water Association annual conference. The whole experience really motivated me to continue advancing my licensing and make this a long-term career.

■ *You have both been working in the industry for some time. What has surprised you most about this industry that you might not have been aware of when you were fresh out of school?*

AB: When I was an undergrad and a graduate student in the science field, I was used to being in a field dominated by men. As a student, I had many strong male role models to look up to who were all very supportive and helpful. Coming into the wastewater field, I wasn't surprised by how few women are in the field, but I was surprised by the seeming lack of support from some male colleagues. I was used to working with mostly men, but I wasn't used to being made to feel like I didn't belong. Not that it bothered me one bit! It was just surprising to me.

CC: I toured a wastewater facility in college and if you would have asked me then if I thought the operator giving me that tour was an environmentalist, I would probably have said no. I just didn't understand how important his job was at the time. Flash forward to now—I am giving my own tours of a wastewater facility, and I always make a point to tell the tour groups our primary job as wastewater operators is to protect the environment. Protecting the environment to the best of our ability every day of the year is what we get paid to do.

■ *Do you talk with people outside the profession about what you do for work? What kind of reactions do you typically get from those outside the profession?*

AB: Actually, the most common reaction I get from people is that they become instantly annoyed and start accusing me of putting raw sewage into Lake Champlain. Even after a lengthy educational speech about wastewater processes and geographic location of South Burlington's WWTF (wastewater treatment facility), I usually end up with a response of, "But still."

CC: Yes, I have had the opportunity to give lots of tours at the WRRF to children, teenagers, college students, and city residents. Most know very little about what we as water quality professionals do. The typical reaction I get from people outside the profession is normally, "Wow, this place is disgusting" or "How can you work here?"

■ *What benefit do YPs gain from being involved in NEWEA?*

AB: I wouldn't even be in this field if it weren't for NEWEA! I was able to attend its conference as a guest and social network my way into the field. Professional development and continuing education is everything, so I attended the conference to learn more. I made that decision four years ago, and I'm still reaping the benefits!

CC: Being involved with NEWEA as a Young Professional helps build relationships with more experienced water quality professionals, which translates to more knowledge.

■ *What challenges do you see for the water environment profession in the near future? How do you see the industry changing in response to these challenges?*

AB: The biggest challenge with the water environment profession is educating the public, and I learned this very early on in my career. If people understood the reasons we do what we do, how we do it, why we do it this way, and what we need to do our jobs even better, our jobs would be so much easier on so many levels. This all seems very obvious, but to many people, it just isn't.

CC: Institutional knowledge being lost as the majority of water/wastewater operators begin to retire and finding younger people to fill those vacant positions. Succession planning needs to be happening now. Increase the pay scale for water and wastewater operators to attract more Young Professionals to the industry. And utilize asset management software to get institutional knowledge into an electronic database before the people who know everything retire.

■ *What advice would you give to students or young people considering a career in the environmental field?*

AB: Don't worry too much! Decide on what subject you think is most interesting and from there, do your research, keep your options open, listen to your gut, and remember not to panic if you feel like you don't "have it all figured out." Just focus on the next step ahead and the path will become more clear.

CC: Take a tour of your local water and/or wastewater facility. If you are in the area come to Montpelier for a tour. Becoming a water quality professional is a very rewarding career. Every day is spent protecting public health and the environment. Also, there is job security in this profession and a growing opportunity for advancement.

■ *Thinking back, was there a particular person who helped you feel welcome in the field or served as a mentor to help you progress?*

AB: My husband, William Sanderson, has been nothing but a supportive partner and colleague from the very beginning. He's the one who knew I would not only absolutely love this field but excel in so many ways I never would have thought it was possible. He saw potential in me that I never even saw in myself. William was the one who invited me to go to the NEWEA conference, helped me with my application documents when an open position came up, and continues to serve as a pillar of advice as I continue my career in wastewater. He welcomed me into the field, watched me grow into a great operator, and continually brags about me and everything I've achieved thus far, which is probably the best part. I love that man!

Ashliegh Belrose

CC: Yes, without doubt, Bob Fischer. As chief operator, Bob hired me even though I had no experience in wastewater. Over the next few years, Bob gave me all the tools and opportunities I needed to succeed. With Bob's guidance and encouragement, I was able to obtain the highest wastewater and water licenses, participate in the Operator Exchange program and become involved in the Green Mountain Water Environment Association and NEWEA—all of which has helped to prepare me for the position I am in now as chief operator. I gained a mentor and a great friend the day I met Bob.

■ *What has been your most rewarding experience in your career thus far?*

AB: Every time I get to say something sassy to someone who assumes that I couldn't possibly be a hands-on operator because I'm a woman; I really try to think up sassy one-liners in advance so I have them ready to go. It happens more than you think!

CC: Giving tours and having people thank me for the team's dedication to protecting water quality and the environment.

■ *What is a fun fact about you that your professional network may be surprised to learn about you?*

AB: I promised myself I would earn my Grade 5 wastewater treatment license before I had kids. I passed my test in the morning and had my first ultrasound that same afternoon. Talk about cutting it close!

CC: My wife and I just had our first child. Her name is Samantha MacKenzie Cox, born on Halloween Day, 2019. Sam attended her first NEWEA conference this year at three months old.

2020 Student Poster Board Competition

The NEWEA Student Activities Committee once again hosted a student poster session on Tuesday during the Annual Conference. The competition was held with the Innovation Pavilion and students participated from eleven universities: Northeastern University, University of Hartford, University of Massachusetts, Roger Williams University, Smith College, University of Maine, University of New Hampshire, Indiana University, Worcester Polytechnic Institute, Tufts University, and University of Rhode Island. Eleven undergraduate and seven graduate poster entries were displayed and judged, and the proximity to the Innovation Pavilion allowed for plenty of interaction and enthusiasm among the students and entrepreneurs. One poster was by a high school student, Colin Speaker, of Greenwich High School in Connecticut. Mr. Speaker wowed the judges with his knowledge and will be submitting his research to the Stockholm Junior Water Prize competition.

The winning posters were presented by undergraduates Madeline DuBois, Jeffrey Ling, Louiza Wise, and Paul Yi of Northeastern University for their project, "Tidal Flow Constructed Wetland for Water Reuse: Performance Evaluation and Microbial Population," and by graduate student Erika Addison of the University of Rhode Island for her project, "Physicochemical Implications of Cyanobacteria Oxidation with Fe(VI)." The winning posters are reproduced here.

The Student Activities Committee thanks all the student teams. We also extend our sincere gratitude to all the volunteer judges. The quality of the posters was tremendous, and anyone attending the 2021 Annual Conference should definitely stop by the posters on Tuesday as part of your agenda.

Northeastern University

Tidal Flow Constructed Wetland for Water Reuse: Performance Evaluation and Microbial Population

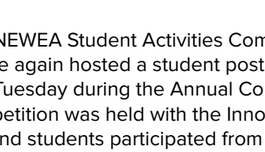
Undergraduate Research Assistants: Madeline DuBois, Kestral Johnston, Taylor Labbe, Jeffrey Ling, Paul Yi & Louiza Wise
Faculty Mentor: Dr. Annalisa Onnis-Hayden

Background

Centralized wastewater treatment is expensive and requires significant energy, chemical, and labor inputs. Constructed wetlands are an environmentally friendly alternative, and tidal vertical flow constructed wetlands (TFCWs) are a particularly promising option due to the significantly smaller space requirement. However, TFCWs are a relatively new technology with room for improvement. This TFCW pilot system was built by a Northeastern Environmental Engineering Capstone team in 2016 and since then has been used to better understand these systems.

Research Goals

- Measure the efficiency of the pilot system in removing water constituents that are outlined by MassDEP for Class A Water Reuse Standards
- Determine optimal configuration and operational strategy to increase the nitrogen removal efficiency of the system
- Understand the complex microbial ecology of the TFCW



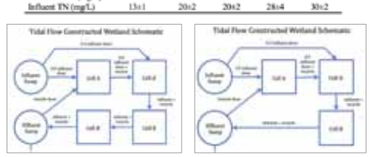
Tidal Flow Constructed Wetland set-up

System Operation

Operation

- Feed is prepared daily and contains organic matter and nutrients to simulate municipal wastewater influent
- Adjusted different system parameters in three phases to explore nitrogen removal under different conditions

Parameter	Phase I	Phase II		Phase III	
		IIA	IIB	IIIA	IIIB
# of secondary cells	2	2	2	2	1
Q (L/day)	70	70	70	70	70
# of cycle per day	4	4	6	4	4
Temperature °C	16-19	16-19	13-16	12-16	14-19
Influent COD (mg/L)	210±36	202±30	200±37	220±30	220±50
Influent TN (mg/L)	13±1	20±2	20±2	28±4	30±2

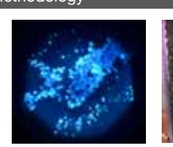


TFCW Operational Strategy Schematics in Phase I-IIIA (left) and Phase IIIB (right)

Methodology

Testing Performance

- **Nutrients** - Samples are taken in the influent, effluent, and between cells to test removal of constituents in different phases of the treatment cycle
- **Biofilm** - Media samples taken from sampling ports in each cell, DNA extracted from sample with Quigen DNAeasy Power Soil Kit and microbial population was quantified using qPCR



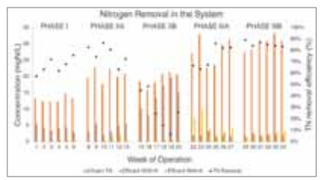
Microbial Analysis

Sampling ports

Results

Water Quality Analysis

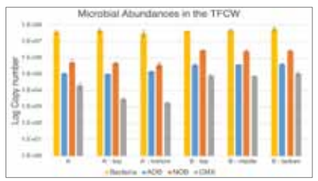
Parameter	Phase I	Phase II		Phase III	
		IIA	IIB	IIIA	IIIB
COD removal (%)	83±8	91±6	95±4	90±5	86±4
COD removal rate (g/m³-d)	36±5	39±4	40±7	42±6	61±11
Ammonia removal (%)	98±1	96±4	99±1	82±1	92±1
Ammonia removal rate (g/m³-d)	2.7±0.2	4.2±0.3	4.6±0.4	4.7±0.7	7.7±0.4
TN removal (%)	66±6	76±8	27±15	76±9	85±2
TN removal rate (g/m³-d)	1.9±0.2	3.4±0.4	1.1±0.5	4.5±0.8	7.4±0.4



- System successfully removes nitrogen, COD, and TSS below MassDEP Class A Water Reuse Limits
- Nitrification is impacted by operation strategy, with 4 cycles achieving higher TN removal than 6 cycles
- Still able to achieve same removal rates with less surface area during Phase IIIB after removal of cell B'

Microbial Analysis

Cell	A	A' top	A' bottom	B top	B middle	B bottom
AOB relative abundance (%)	0.27	0.21	0.44	0.91	0.80	0.70
NOB relative abundance (%)	1.38	0.99	1.19	6.99	5.34	4.72
CMX relative abundance (%)	0.05	0.01	0.01	0.19	0.16	0.19



- Ammonia oxidizing and nitrate oxidizing bacteria and commamox all present
- Higher nitrogen removal rate in secondary cells correlates with greater bacterial abundance

Future Research

- Investigate potential of system to remove microplastics
- Determine impact of microplastics on nutrient removal
- Conduct feasibility study for full-scale implementation

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Physicochemical characteristics of particulate suspensions resulting from Fe(VI) oxidation of cyanobacteria

Erika Addison[1], Joseph Goodwill[1]
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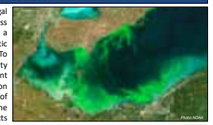
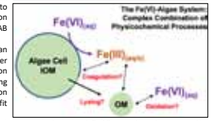
Introduction

Increasing occurrence of harmful algal blooms (HABs) in surface waters across the Northeastern United States poses a major threat to water quality, aquatic ecosystems, and the public's health[1,2]. To combat these HABs, water utility companies can adapt several different technologies, including algal oxidation with strong oxidants. However, the use of common oxidants may increase the formation of disinfection byproducts (DBPs) and release additional toxins into the water, making the use and selection of the best strong oxidant for HAB treatment unclear[3,6].

Ferrate (Fe(VI)) is emerging as an alternative strong oxidant in water treatment due to the limited production of hazardous by-products strong oxidation potential, and in-situ formation of Fe(III) particles that may benefit downstream treatment processes[2,4,5].





Despite the in-depth research that has been conducted about Fe(VI) oxidation, there are still major knowledge gaps. There has been a lack of focus on the coagulation performance of ferrate in the presence of representative algal conditions. Additionally, the dominant coagulation collision mechanism and the effect of NOM on ferrate decomposition during oxidation has not been effusively discussed.

The objectives of this study were (1) to gain a better understanding of the use of ferrate oxidation for HAB mitigation, and (2) to build towards its potential use as an intermittent solution to reduce risks from HABs in surface water systems by studying the oxidation and coagulation performance of Fe(VI).

Methods

- All experiments performed using a 6-paddle Jar Tester (Phipps & Bird)
- 1-L lab water batch solutions:
  - **Microcystis aeruginosa** algal concentrations of 0, 20,000, or 100,000 cells/mL
  - Buffered to pH 6.2 or 7.5 with 1 mM HCO_3^-
- Fe(VI) dosed at 0, 20, 50, or 100 µM
  - Obtained from Element 26 Technology, Houston TX
- The solution was rapidly mixed (G = 150 s^{-1}) for 1 minute, followed by slow mixing (G = 55 s^{-1}) for 30 to 60 minutes
- Resultant matrix was characterized by fluorescent index (PerkinElmer LS 55), zeta potential (Malvern Zetasizer Nano ZA), and particle counts (Chemtrac PC5000)
- Charge neutralization by cationic polymer (Nalco Nacrolyte) was quantified by streaming current value (SCV) measurements on a Chemtrac LCA-01
- Collision frequency functions (rectilinear & curvilinear) were modeled using particle count data
- Algal (100,000 cells/mL) influence on decay of 50 µM Fe(VI) at pH 7.5 was measured by periodically determining Fe(VI) concentration indirectly by the ABTS spectrophotometric method[8]

Results

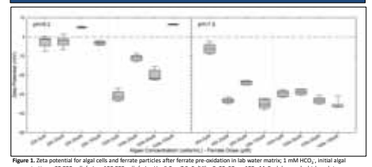


Figure 1. Zeta potential for algal cells and ferrate particles after ferrate pre-oxidation in lab water matrix; 1 mM HCO_3^-; initial algal concentration = 20,000 cells/mL or 100,000 cells/mL; pH = 6.2 or 7.5, Fe(VI) = 0, 20, 50, or 100 µM. Each box and whisker plot represents the median, 10th, 25th, 75th, and 90th percentile of 7 measurements.

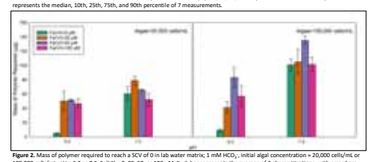


Figure 2. Mass of polymer required to reach a SCV of 0 in lab water matrix; 1 mM HCO_3^-; initial algal concentration = 20,000 cells/mL or 100,000 cells/mL, pH = 6.2 or 7.5, Fe(VI) = 0, 20, 50, or 100 µM. Each bar represents the average of 2 charge titrations, with error bars representing the positive and negative of two standard deviations.

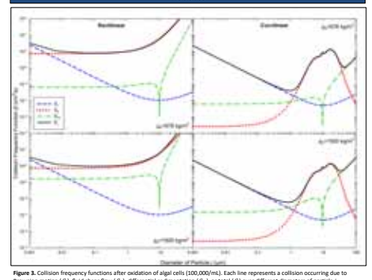


Figure 3. Collision frequency functions after oxidation of algal cells (100,000/mL). Each line represents a collision occurring due to Brownian motion (f_B), fluid shear flow (f_G), differential sedimentation (f_{DS}), or total (f_T) over different diameters of particle j. Experimental conditions: d_i = 9.38 µm, ρ_p = 978 kg/m³ or 1500 kg/m³, T = 20°C, G = 55 s^{-1}.

Results

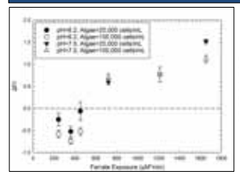


Figure 4. Changes in fluorescence index (FI) after oxidation of algal cells by ferrate in laboratory water matrix; 1 mM HCO_3^-, initial algal concentration = 20,000 cells/mL or 100,000 cells/mL, pH = 6.2 or 7.5, Fe(VI) = 20, 50, or 100 µM. Each point represents the average change in FI of 2 measurements from when Fe(VI) = 0 µM. Error bars represent the positive and negative of one standard deviation.

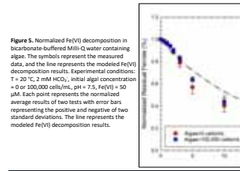


Figure 5. Normalized Fe(VI) decomposition in bicarbonate-buffered MilliQ water containing algae. The symbols represent the measured data, and the line represents the modeled Fe(VI) decomposition results. Experimental conditions: T = 20 °C, 2 mM HCO_3^-, initial algal concentration = 0 or 100,000 cells/mL, pH = 7.5, Fe(VI) = 50 µM. Each point represents the normalized average results of two tests with error bars representing the positive and negative of two standard deviations. The line represents the modeled Fe(VI) decomposition results.

Conclusions & Future Research

- Fe(VI) lyses algal cells, but further oxidation of released algal organic matter (AOM) is possible.
- Lysing & subsequent AOM oxidation were functions of pH, but not limited by total Fe(VI) exposure.
- Extensive coagulation of algal cells by Fe(VI) likely did not occur. Additional coagulant is required in all cases to achieve a SCV of 0. However, pH 6.2 is more conducive for coagulation than at pH 7.5
- The dominant mechanism for Fe(VI) and algae coagulation at pH 7.5 is differential settling (f_{DS}).
- Algae does not have a dramatic effect on the rate of Fe(VI) decomposition at a near neutral pH with 100,000 algae cells/mL.
- Opportunities for optimization of Fe(VI) pre-oxidation likely exist for drinking water treatment plants. The low capital expenditure of Fe(VI) makes it an attractive oxidant choice for small and large treatment facilities.

Acknowledgements

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Enhancement of a Flow-Through Solar Water Disinfection (SODIS) System using Riboflavin as a Photocatalyst

Colin Speaker
Greenwich High School, Greenwich, CT

Summary

Access to clean water is a challenge for many people worldwide. At present, 4 billion people face severe water shortage for at least one month per year, and it is believed that 1.5 million deaths annually are due to drinking contaminated water. Obtaining clean drinking water can be extremely time-consuming. The burden of collecting clean water falls on women and children and prevents people, especially women, in the developing world from being productive and escaping from poverty.

Establishing suitability of water for drinking involves in large part ensuring that microbiological contamination has been eliminated. There are many different types of contaminants and microorganisms that can be present in water, including bacteria, viruses, and amoebas or cysts. The World Health Organization (WHO) established a set of guidelines for drinking water quality in 2011. In order to simplify microbiological testing, the absence of coliform bacteria was chosen as an acceptable single indicator of satisfactory purity. The gram-negative rod, *Escherichia coli*, or *E. coli*, is the bacteria from this group that is typically tested for because it is an indicator of fecal contamination. *E. coli* has also been chosen because it meets the WHO criteria and is non-pathogenic, so that it is not a hazard to the people doing the testing.

In equatorial regions of the world, sunlight is readily available. Two million people get their purified drinking water from a SODIS system, but limitations on efficiency and reliability come from cloud cover and the fact that only 4 hours during the day are most productive. Current catalysts are expensive and impractical, but in this investigation, I am evaluating the potential of a nutrient, riboflavin (vitamin B2), to act as a photocatalyst to improve the efficiency and reliability of SODIS. This approach has the potential to lessen water insecurity for those in need.

Solar disinfection utilizes solar radiation to both heat and inactivate the DNA of microorganisms through UVA generated reactive oxygen species, superoxide anion (O_2^-), hydroxyl radical ($OH^\bullet$), hydrogen peroxide (H_2O_2), and singlet oxygen ($^1O_2$). The antimicrobial effect of UV light is enhanced by photosensitizing compounds.

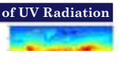
One example is riboflavin, or vitamin B2, a naturally occurring compound and an essential human nutrient, as it is the central component of FAD, one of the major cofactors in cellular metabolism. Riboflavin potentiates the effect of the UV by absorbing 365 nm photons, creating reactive oxygen species, such as superoxide anion (O_2^-), hydroxyl radical ($OH^\bullet$), hydrogen peroxide (H_2O_2), and singlet oxygen ($^1O_2$). UV combined with riboflavin may be superior because the potentiating effect of riboflavin on the microbicidal activity of UV can provide the desired microbicidal activity at lower doses of UV, thus making the SODIS system less susceptible to interference from cloud cover. Any residual riboflavin would be expected to be non-toxic since it is a naturally occurring substance in the human body.

Solar heating or pasteurization has a synergistic anti-microbial effect on SODIS. This occurs above 45-50° C and is referred to as thermally enhanced (TES) SODIS, which can increase the antimicrobial activity by a factor of 170% at 45° C and increase exponentially at higher temperatures.

I chose to evaluate the bactericidal effect of the combination of UV and riboflavin against *E. coli* because it is the WHO standard for assessing decontamination of drinking water.

Worldwide Intensity of UV Radiation

Daily UV intensity is reported as UV Index = (mW/m²) / 25



Engineering Goal

The study's goal is to develop an enhanced solar water disinfection system using riboflavin as a photocatalyst that is more efficient, faster, and less vulnerable to reduction of solar UV radiation by clouds, that is more reliable as a method of producing clean water in the developing world.

Experimental Design

This investigation was designed to be carried out in two phases. In the first phase, the effects of riboflavin on UV-mediated killing of *Escherichia coli* bacteria was evaluated in a PET plastic water bottle system. This simple system allows for the evaluation of riboflavin concentration dependence of UV bactericidal effects, exposure times and intensity, and bacterial density effects. In the second phase, a simple flow-through water disinfection system was constructed to evaluate the practicality of this approach in a high-volume disinfection system.

Evaluation of UV Light Sources

Two light sources were evaluated, a low-intensity portable UV flashlight (Quantum), and a high-intensity industrial UV light source (Cure UV, Lens Bright), and UV output was measured with a General UV513AB Light Meter.

Figure 4. Fluence (mW/cm²) as a function of distance from UV Flashlight

Distance from UV Flashlight (inches)	Fluence (mW/cm²)
0	0.120
1	0.095
2	0.030
3	0.025

Figure 5. Fluence (mW/cm²) as a function of distance from Cure UV

Distance from UV Flashlight (inches)	Fluence (mW/cm²)
6	1.60
12	0.85
24	0.12
36	0.07

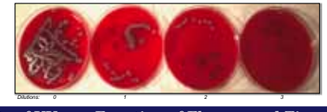
Figure 6. Ferrate reacting with water

Establishment of *E. coli* Cultures and Quantification Method

E. coli was established in culture on sheep's blood agar plates and in thioglycolate broth. Serial dilutions were performed to validate bacterial cell density assumptions and establish a standard density for experiments. Serial dilutions were performed in 0.9% NaCl solutions in 24 well uncoated tissue culture plates to validate the serial dilution method of determining the density of colony forming units per ml (cfu/ml).

Figure 6. 10-fold serial dilutions were performed in tissue culture plates

Figure 7. Plating of 10-fold serial dilutions of E. coli on sheep's blood agar



Bactericidal Effects of UV as a Function of Fluence and Time

In order to evaluate the effect of UV fluence and exposure time on bacterial killing, *E. coli* suspensions were prepared to match the McFarland 2.0 turbidity standard and were found to contain 1 x 10^7 cfu/ml. Plastic water bottles containing 400 ml of sterile water were prepared with 10^5 cfu/ml of *E. coli*. The fluence was varied by placing water bottles at 12, 18, and 24 inches from the UV light source. The suspensions

Figure 8. UV irradiation of E. coli suspensions at different fluences determined by distance from UV light source to bottle

Effect of Riboflavin on the Bactericidal Activity of UV

Water bottles containing *E. coli* at a density of 10^5 cfu/ml were exposed to UV light at a distance of 24 inches in the presence and absence of riboflavin 0.1%. The bottles were sampled for culture at 0, 5, and 10 minutes of UV exposure.

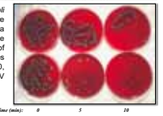


Fig. 10: Effect of UV exposure without (top) and with 0.1% riboflavin (bottom) on E. coli in suspension

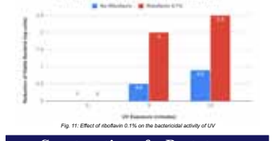


Fig. 11: Effect of riboflavin 0.1% on the bactericidal activity of UV

Construction of a Prototype

In the second phase of the research, an inexpensive flow-through water disinfection system was constructed with a compound parabolic collector to increase the intensity of incident UV radiation (Fig. 12). The goal of this prototype is to evaluate riboflavin's effectiveness as a photocatalyst in a high-volume solar water disinfection system.

Fig. 12. Prototype of the Riboflavin-UV Catalyzed High Volume Solar Disinfection System.

Discussion

The availability of clean water in the developing is a major determinant of health. In addition to affecting the health of billions of people in the developing world, time spent on retrieving drinking water places significant limitations on productivity.

The goal of this project is to evaluate the feasibility of using riboflavin as a catalyst to improve the reliability of a SODIS system, as a faster, more efficient system would be less affected by cloud cover. In this study, I set up a plastic water bottle model SODIS system to evaluate the potential of riboflavin to serve as a non-toxic photocatalyst to improve efficiency. Using a commercially available UV bulb, the bactericidal effect of UV on *E. coli* was found to be dependent on the fluence as determined by the distance of the

Colin Speaker, of Greenwich High School in Connecticut wowed the judges—poster shown here abridged

Student Innovation Shark Tank

At this year's NEWEA Annual Conference the Student Activities Committee and the Innovation Council jointly sponsored a student "Shark Tank" competition. Three student projects were selected and offered the chance to provide a five-minute pitch of their concept to a panel of judges, including Bri Nakamura from the Water Environment Federation, Dr. Chintan Vaishnav from Massachusetts Institute of Technology, Joshua Griffis from Evoqua, and Dr. Francis (Jerry) Hopcroft from Wentworth Institute of Technology. The session was moderated by Kamal Daghistani from Springlane Capital.

All the projects represented important research and advancements, and the NEWEA community is fortunate to have such a passionate student population active in the field. After spirited presentations and cogent responses to challenging questions, the rankings were not an easy task for the judges, but the H2gO project was selected as the winner. We look forward to hosting this event again at the 2021 Annual Conference.

Consideration of 3D-Printed Biofilm Carriers for Wastewater Treatment

by Bryan Ovelheiro of the University of Massachusetts, Amherst

Because of increasingly stricter wastewater treatment (WWT) objectives and aging infrastructure, low-cost retrofits are needed to maintain WWT ability. Improving biofilm carriers can improve treatment without the need to rebuild existing infrastructure by utilizing biofilms. Biofilm carriers were designed by 3D-printing 10 lattice structures of varying geometries and compared to an equal volume of conventional carriers. Biofilm was grown on the 11 carrier types in flow-through scenarios for six months. The carriers were subjected to batch conditions where the chemical oxygen demand (COD) and ammonia removal rates were observed. These removal rates after eight hours were higher for the 3D-printed supports (B-4 geometry, 14.15 mg COD/L-hr), (O-6 geometry, 0.90 mg NH4-N/L-hr), compared to conventional carriers (1.1 mg COD/L-hr, 0.35 mg NH4-N/L-hr). Biofilm formation seems to be influenced by its support architecture, suggesting better biofilm retention than conventional carriers, and by the ability to select for different treatment objectives by selecting differently optimized carriers.

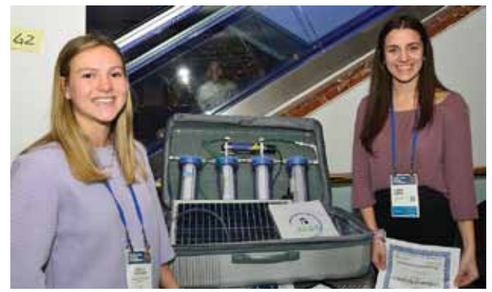
Assessment of Activated Ferrate for Wastewater Reuse Applications

by Charles Spellman, Jr., of the University of Rhode Island

Ferrate (Fe(VI)) is one of the more promising emerging water treatment technologies, but research has been limited on potential benefits in a water reuse paradigm. Fe(VI) has a relatively high oxidation potential and is known to inactivate waterborne pathogens. The ferric iron resulting from Fe(VI) reduction could support downstream coagulation processes. The California Title 22 "Water Recycling Criteria" (CCR 22) identifies water quality parameters that must be met for new recycled water oxidation technologies to be accepted. Recent literature has shown that Fe(VI) oxidation could be enhanced by "activation" with the addition of reductants or acids. This study examined the impact of sodium sulfite-activated Fe(VI) in laboratory-prepared solutions and spiked municipal wastewater effluents with the goal of meeting 69% removal of an organic contaminant without generating harmful levels of brominated disinfection byproducts (DBPs) as outlined in CCR 22. Generally, the results indicate that activated Fe(VI) seems viable for water reuse with the possible achievement of CCR 22 guidance in full-scale applications.

The Portable Water Treatment System (PWTS) – H2gO

by Isabella Silverman, Alexa Leone, Justin Hayes, and Max Bliss of the University of Rhode Island



H2gO is an all-in-one water treatment suitcase to be implemented in developing countries that face water quality issues and commonly have natural disasters, such as the Dominican Republic (DR). Owing to the poor water infrastructure, many communities and schools in the DR rely on expensive bottled water for potable water or simply use dirty water. Generally, water treatment systems neutralize one or a few contaminants and are not portable. Also, coastal zones are prone to natural disasters, saltwater intrusion, and the presence of additional contaminants in waterways. Our system can adapt to remove newly introduced contaminants, is completely portable, and can be assembled in 10 minutes. The system is solar powered as many communities do not have a consistent source of electricity. H2gO is reliable and economical for schools and communities, even when natural disasters damage water and electricity infrastructure.

Maine State Director Report

by Jeffrey McBurnie
Jeff.McBurnie@casella.com

The state of Maine is celebrating its bicentennial this year. For over a quarter of those 200 years, Maine Water Environment Association (MEWEA), along with its predecessor, Maine Wastewater Control Association (MWWCA), has been helping to protect Maine's water environment. Supported by more than 700 water quality professionals, MEWEA continues to provide training, legislative advocacy, public outreach and education, and perhaps most important, industry networking. The membership of MEWEA proudly serves the state (and the New England region) and, with the capable leadership of its executive board, will continue that service well into the future.

Imagine a Day Without Water, York Sewer District

On October 23, York hosted an Imagine a Day without Water event for over 200 local kindergarteners and first-graders. MEWEA's Young Professionals Committee sent several volunteers to assist with the event. Educational stations were set up to provide activities for our future water quality professionals. MEWEA donated tote bags for all the participants, while NEWEA generously provided water-related goodies to fill those tote bags. Maine Department of Environmental Protection (DEP) Commissioner Jerry Reid appeared in support of the event.

NEWEA Conference

In January, we observed the annual pilgrimage to Boston for the convening of NEWEA's Annual Conference and Trade Show. Several MEWEA members were there as committee chair, state director, treasurer, affiliated state association representative, and Executive Committee member, or being recognized as awardees. As always, many Maine utilities and vendors ably represented the state of Maine. Awardees from Maine who were recognized at the awards luncheon included Aubrey Strause (Alfred E. Peloquin), Alex Buechner (Operator of the Year), Travis Peaslee (Bedell), Marina Mowahass (Stockholm Junior Water Prize), and Howard Carter (Founders).

Perfluoroalkyl/Polyfluoroalkyl Substances (PFAS) Task Force

The PFAS task force concluded eight months of review and discussion on December 18, 2019. MEWEA was represented by Andre Brousseau (Certified Wastewater Operators) of Sanford Sewerage District and Jeff McBurnie (Biosolids Management) of Casella Organics. The final meeting at the Augusta Civic Center was a "live" edit of the final draft. At the conclusion, the final draft was sent to the Maine DEP for incorporation of the final edits agreed to at this meeting. On January 23, 2020, the final PFAS task force report was presented to the governor, and the following day it was released to the public (go to maine.gov). Recommendations covered eight broad categories of action, with more than 30 recommendations by the task force.

A briefing on the task force report before the Maine Legislature's Joint Standing Committee on the Environment and Natural Resources was held on February 6 in Room 216 of the Cross Office Building in Augusta. We expect several initiatives will be launched by the governor's office including direct mandates to the following: DEP; Health and Human Services; Agriculture, Conservation and Forestry; and Defense, Veterans, and Emergency Management. We also anticipate that legislation suggested by the recommendations will be proposed by the departments affected by, or responsible for, that legislation.

Arthur Sidney Bedell Award, Travis Peaslee

Quarter Century Operators' Club, Jennifer Nicholoson

Founders Award, Howard Carter

Collaborative Training with Maine Water Utilities Association

MEWEA once again provided two full days (February 5–6) of joint training with the Maine Water Utilities Association at its Annual Conference. This year's conference was relocated from its traditional venue at the Portland Holiday Inn by the Bay to the Augusta Civic Center. MEWEA sponsored nine hours of training on various topics, including UV disinfection, peracetic acid, MS4 compliance, climate change adaptation, PFAS, fiscal sustainability, operator hacks, and using algae for nutrient extraction. The sessions were well-attended. MEWEA members presented or moderated several sessions.

Legislative Breakfast

On February 27, MEWEA held its annual Legislative Breakfast at the Senator Inn and Spa in Augusta. The event was cosponsored by the Maine Water Utilities Association, NEWEA, and New England Interstate Water Pollution Control Commission. The theme for this year's breakfast was "PFAS Response: Unintended Impacts on Utility and Municipal Operations and Budgets." The keynote speaker was Andrew Carpenter from Northern Tilth, a consulting business that provides management services for the recycling of biosolids and residuals. This was an excellent opportunity for industry leaders to engage our legislators on a topic that is now all too common. Our elected officials must understand the issues that water quality professionals face, so they can provide the legislative and financial support utilities need to be sustainable.

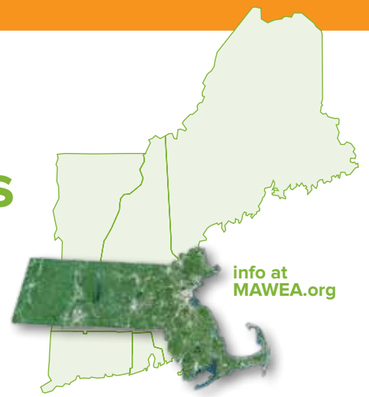
Events canceled or to be rescheduled due to pandemic

- **MEWEA SPRING CONFERENCE (APRIL 3)**
  This year's conference will be at the Black Bear Inn in Orono, home of the University of Maine's flagship campus. A robust and enlightening program is planned. The conference will be preceded by a strategic planning meeting on April 2.

Upcoming 2020 MEWEA Events		
Urban Runoff 5K	April 25	Deering High School, Portland
Southern Maine Children's Water Festival	May 15	University of Southern Maine, Portland
Androscoggin Land Trust Paddle After Hours	August TBD	Gritty's, Auburn
MEWEA Fall Convention	Sept 16–18	Sunday River Ski Resort, Newry

Massachusetts State Director Report

by Adam Yanulis
FAYanulis@tigheBond.com



Announcing our Association Name Change

Following some months of discussion and organizational paper gymnastics, and in the spirit of raising our professional public image, the Massachusetts Water Pollution Control Association (MWPCA) has officially changed its name to the Massachusetts Water Environment Association (MAWEA). As with many organizations in the water quality field, this is our third name change in over five decades since our inception in 1965 as the Massachusetts Wastewater Treatment Plant Operators' Association (MWWTPOA). We are pleased to join most of the regional and national professional associations that recognize the need to emphasize the very positive work that our existing and prospective members perform in protecting the quality of humanity's (and nature's) historically most-recycled resource. Our new website has also changed to MAWEA.org. Please visit regularly to catch up with our activities, plans, programs, and other opportunities.

NEWEA Annual Conference Boston January 26–29, 2020

The Massachusetts clean water community was well represented at this year's NEWEA Annual Conference in Boston. Members of the newly named MAWEA participated in the Executive Committee meeting on Sunday as well as several other committee meetings. MAWEA was active at the ASA/State Director Leadership Committee meeting and shared the recent process of the name change. According to Mickey Nowak, MAWEA executive director, "This name change further aligns Massachusetts with other New England and Northeast organizations. It reflects the evolution of our industry and our members as stewards of our water environment."

MAWEA representatives also participated in the NEWEA Government Affairs Committee meeting as several issues were discussed, including the rapid development of PFAS regulations in the six New England states.

Massachusetts Developing an Interagency PFAS Task Force

The House Ways and Means Committee of the commonwealth is developing an interagency perfluoroalkyl and polyfluoroalkyl substances (PFAS) task force to address the emerging crisis of contamination. The task force will comprise representatives of several state agencies as well as other interest groups. We are working to ensure that MAWEA is a part of this task force so that the interests of clean water utility managers and operators are adequately represented.

Clean Water Professionals Recognized at NEWEA Awards Luncheon

On Wednesday of the NEWEA Annual Conference, the Annual Awards Luncheon took place, where NEWEA, WEF, and EPA awards are presented each year. This year several Massachusetts industry professionals were recognized. NEWEA presentations included the Operators Safety Award to Aram Varjabedian of Hull, James J. Courchaine Collections Systems Award to Jim Barsanti of Framingham, Paul Keough Award to Robin Leal Craver of Charlton, Public Education Award to John Lee of Walpole, Asset Management Award to the city of Westfield wastewater treatment plant (WWTP), Biosolids Management Award to Greater Lawrence Sanitary District, Clair N. Sawyer Award to Paul Dombrowski of Holyoke, Young Professional Award to Danielle DiRuzza of the MWRA, and Quarter Century Operators Award to Frank Cavaleri of Hingham. Public Outreach and WEF awards included the Public Communications and Outreach Award to Meg Tabacsko of Massachusetts Water Resources Authority (MWRA) in Chelsea, Ralph Fuhrman Medal to Paul Dombrowski, and WEF Life Memberships to Henry Albro of West Townsend, Dennis Green of Westborough, Ed Quann of Rockland, and Bob Sheldon of Framingham. Other NEWEA Awards included the NEWEA Operator Award to Michael Delaney of Norfolk and Alfred E. Peloquin Award to John Murphy from the Massachusetts Department of Environmental Protection. The town of Westborough WWTP received the Operations and Maintenance Excellence Award from EPA.

Award recipients from the 2020 NEWEA Annual Conference

Operator Award, Michael Delaney

Asset Management Award, the city of Westfield WWTP

Alfred E. Peloquin Award, John Murphy

Young Professional Award, Danielle DiRuzza

Operator Safety Award, Aram Varjabedian

Massachusetts Upcoming Events

Mark your Calendars for the Annual Golf Tourney on June 17 at Heritage Country Club in Charlton. The Massachusetts Coalition for Water Resource Stewardship Annual Symposium will be held on May 28 at the Courtyard Marriott in Marlborough.

Connecticut State Director Report

by Bill Norton
WNorton@fairfieldct.org

State of Connecticut DEEP PFAS Action Plan

On November 4, 2019, Governor Ned Lamont officially released the final PFAS Action Plan prepared by the Connecticut Interagency PFAS Task Force. The plan recommends comprehensive actions that the state could carry out to address perfluoroalkyl and polyfluoroalkyl substances (PFAS) in Connecticut. The task force, led by the Department of Health (DPH) and Department of Energy and Environmental Protection (DEEP) with representatives from a variety of state agencies, completed and presented the report to the governor. The action plan (posted on the DEEP website) contains the following broad strategies:

- Minimize human health risk for state residents
- Minimize future releases of PFAS to the environment
- Identify, assess, and clean up historic releases of PFAS to the environment

DEEP/Municipal POTW Proposed MISC General Permit Changes and Issues

Sally Keating of The Metropolitan District (MDC) and her committee met with DEEP on January 31. It may have been their most productive meeting yet! DEEP requested a list of items to be resolved. To streamline things, the committee set up a Sharepoint site to combine comments in one document to give to DEEP. DEEP provided two outdated lists of municipal publicly owned treatment works (POTWs) and contacts; the committee is checking with the Connecticut Water Pollution Abatement Association (CWPAA) for an updated POTW contact list.

A smaller group will meet later to re-define treatment for approval by DEEP. The regulations now define treatment facility, but not treatment. The committee will suggest removing the term "passive" treatment from required language for O&M and spill plans written by professional engineer/certified hazardous material managers.

Highlights from the January 31 meeting include:

- Vehicle Maintenance (VM) General Permit will continue to January 2021, when VM facilities should notify under the Miscellaneous Industrial User regulation.
- We succeeded in changing the Group II (non-process wastewater) de minimis quantity to 5,000 gpd (19,000 lpd).
- Attachment C—DEEP will add questions regarding location of sample, sample type, etc.
- DEEP has agreed that the permittee need not submit monitoring data unless requested by the POTW, or in the case of a violated permit.
- DEEP is to review all certification language for uniformity.
- For Section 4(a)(1)(A), the last bullet: DEEP should put something in writing to explain how "other process wastewaters"—as defined by the commissioner—will be applied.
- All references to "variance" will be changed to "minor variance" with an added definition for minor variance. One issue: Can DEEP allow POTWs to grant minor variances?

The committee's comments were due to DEEP on February 14, with a February 21 meeting following.

Connecticut Association of Water Pollution Control Authorities Fall Meeting

The Connecticut Association of Water Pollution Control Authorities (CAWPCA) Fall Workshop was held on October 25, 2019, again at the Aqua Turf Club in Plantsville. The event was well attended by managers, consultants, and state officials from Connecticut and throughout New England. Several workshops and updates were given, from a CAWPCA report by President Denis Cuevas to a PFAS update by Ned Beecher of NEBRA. All the updates and workshops are available for review on the CAWPCA website.

Legislative Matters

CWPAA and CAWPCA's lobbyist (Melissa Biggs, Esq. of DePino, Nunez & Biggs) is working on several key issues for this year's legislative short session. Attorney Biggs will be working on increasing funding for raising manholes and Department of Transportation paving practices on state roads, and amending state statutes and regulations to achieve the following: allow for online WWTF operator certification exams; incorporate a Class IV Operator In Training classification; allow an operator to retain certification through appropriate continuing education after leaving the field; and allow transition of an operator certification renewal program's administration to the New England Interstate Water Pollution Control Commission (NEIWPCC), which handles such programs for other New England States. Attorney Biggs will also look to NEIWPCC to help establish a Connecticut wastewater operator certification program (as it has in Massachusetts, Maine, New York, and Rhode Island).

Annual CWPAA Product Show

The CWPAA will hold its Annual Product Show on April 30, again at the New Life Church in Wallingford. This is a great opportunity to informally network with colleagues, vendors, consultants, Certification Advisory Committee (CAC) members, and DEEP staff. This year's program will feature as usual the Annual Business Meeting, election of officers, and important association updates. Admission is free to all operators, with lunch provided to all CWPAA members—another great reason to join CWPAA!

Operator Exchange Program

For 2019, Connecticut's exchange operator was George Ciccione from the town of Fairfield's water pollution control facility (WPCF), who reported on his excellent experience on the CWPAA website. Connecticut hosted Casey Mitchell from the Dover, New Hampshire wastewater facility. He spent Tuesday and Wednesday touring six WPCFs, and his visit culminated with his attending the Managers' Forum sponsored by CWPAA and NEIWPCC on November 21 in Hartford. Thanks to the following for making Mr. Mitchell's Operator Exchange experience successful: Jeff Bowers and the MDC staff; Ray Weaver and the Hockanum River WPCF staff; Linsey King and the Milford–Housatonic WPCF staff; Tom Hyde and the Stratford WPCF staff; John Bodie and the Fairfield WPCF staff; and Manny Furtado and the Westport WPCF staff. A special thank you goes to Ray Weaver for making all the hosting arrangements.

2020 CWPAA Ski Classic

For the tenth annual Ski Classic on January 31, 28 skiers and snowboarders traveled to Stratton Mountain in Vermont for a day of skiing, enjoying each other's company, and networking.

Despite this year's warmer and rainy winter, with the help of cold temperatures, Stratton Mountain did a fantastic job and the skiing was great.

We met at the Grizzly's lounge after a full day of skiing and boarding for well-deserved nachos, wings, adult beverages, and networking in our own private gathering area. Attendees represented engineers, municipalities, water companies, vendors, and government officials.

Thanks to our six vendor sponsors—Aqua Solutions, AARON Associates, Distinctive Tree Care, Green Mountain Pipeline Services, New England Environmental Equipment, and Pond Technical Sales, who help make the event successful by allowing us reduced-price lift tickets!

Operator Award, Todd Wolowicz

Alfred E Peloquin Award, Virgil Lloyd

CWPAA & CAWPCA Continuing Collaboration

Discussions continue regarding CWPAA and CAWPCA collaboration for the benefit of Connecticut. Generally, the CWPAA provides programs primarily targeted to operators, while the CAWPCA focuses primarily on management professionals and volunteers. These are generalizations, however, and program content and common interest have much overlap.

Leaders of the two organizations have held joint meetings and are working together on several initiatives. Discussions will continue through 2020, so watch for future updates and collaborations.

Connecticut Managers Forum

On November 17, the 2019 Connecticut Wastewater Management Class graduated at the Managers Forum at the MDC Training Center, after completing a 10-month program that covered topics from budgeting and finance to GIS and SCADA.

It is hoped that a new class will start up soon, led by a vibrant new group of operators. Past program graduates Jeff LeMay of the South Windsor WPCF and Megan Ambrose of the University of Connecticut WPCF have expressed interest in continuing this valuable program, and a schedule for the new class is forthcoming. With encouragement from Art Enderle (who plans on hanging up his instructor's hat), Mr. LeMay and Ms. Ambrose are enthusiastic about moving this forward.

On behalf of all the graduates and the many water pollution control facilities throughout the state, we thank Mr. Enderle for the tremendous service he has provided over the years for the water pollution control community—a job well done!

Upcoming 2020 CWPAA/CAWPCA Events		
CWPAA Product Show	April 30	New Life Church, Wallingford
CAWPCA Spring Workshop	May, TBD	Aqua Turf Club, Plantsville
Operators Appreciation Day	TBD	More info at: ctwpaa.org

New Hampshire State Director Report

by Steve Clifton
sclifton@underwoodengineers.com

Welcome to 2020. Already this year New Hampshire has advanced from last year's stringent limits on perfluoroalkyl and polyfluoroalkyl substances (PFAS) on the drinking water side to the New Hampshire Department of Environmental Services (NHDES)-established work plan for PFAS on the wastewater side. NHDES was tasked to submit this work plan to the state legislature by January 1 of this year, and it is awaiting enabling legislation and funding. Additionally, EPA has issued a new Draft Great Bay Total Nitrogen General Permit for municipalities in the Great Bay watershed. Twelve communities and 13 wastewater treatment facilities (WWTFs) will be required to address total nitrogen in the watershed through this unique permit. This year will be a blockbuster in addressing environmental challenges. Here is a review of the past year's events since my last article in July 2019.

NHWPCA 2019 Fall Meeting

The New Hampshire Water Pollution Control Association (NHWPCA) Fall Meeting took place on September 13, 2019, starting with a tour of the North Conway Water Precinct WWTF and culminating with a luncheon meeting at the Red Fox Bar & Grille in Jackson. Hosted by President Kurt Robichaud, the event was highlighted by a tour of the recent $3.5 million septage receiving and dewatering upgrades.

One of three newly installed inclined screw dewatering presses

The WWTF serves the town of North Conway, the Conway Village Fire District, and a small portion of the town of Bartlett.

Three new inclined screw dewatering presses were installed as part of the upgrade. The equipment replaced the old plate and frame presses that used lime and ferric chloride for conditioning the sludge.

NHWPCA 2019 Winter Meeting

The NHWPCA 2019 Winter Meeting was one of the best-attended events in our history. Held on December 13, 2019, it included a tour of the town of Exeter's new four-stage Bardenpho process that replaced the aerated lagoons. The new process and equipment provide low total nitrogen effluent prior to discharge into the Squamscott River that empties eventually into the Great Bay. This upgrade is one of the key improvements toward addressing Great Bay's environmental problems. After touring the facility, the association convened at the business meeting at Ashworth by the Sea in nearby Hampton for a luncheon and presentation on the upgrade. During the luncheon, the city of Lebanon was awarded Plant of the Year by the NHWPCA. Dan Knox and staff were all present for the award.

New Hampshire will be proud to host an Operations Challenge team with new blood this year. Four young operators, training with Coach Patty Chesebrough and veteran Mike Carle, are promising to put on an excellent show this year. The newly staffed Seacoast Sewer Snakes Operations Challenge team is eager to prove its worth, and we hope everyone will support them so they can go the distance.

The NEWEA Operator Exchange program is between New Hampshire and Massachusetts this year. The NHWPCA board has charged Rob Robinson from Manchester and Mike Carle from Hampton with hosting the Massachusetts operator. We are soliciting our New Hampshire operators now to see who is interested in touring the facilities in Massachusetts this year. I look forward to working with Eric Smith, John Downey, and Mickey Nowak from the Massachusetts Water Environment Association (MAWEA) to coordinate this event.

NEWEA 2020 Annual Meeting

NEWEA's Annual Conference in Boston was the most enjoyable event I have attended. Ray Vermette, NEWEA president from New Hampshire, passed the gavel to Jennifer Kelly Lachmayr. It was hard to determine which of them had the bigger smile on their face. We are lucky to have such enthusiastic people leading NEWEA.

Close to my heart are two outstanding people who were awarded life memberships in the Water Environment Federation (WEF). Frank Underwood and Gene Forbes have each invested a lifetime of blood, sweat, and tears into their profession, their work life, and the people they have touched. It was good to see them receiving this support and admiration from their peers.

Other award winners from New Hampshire included the following: Jamie Wood from the Somersworth WWTF received the NEWEA Energy Management Award on behalf of the city and the plant staff for outstanding energy efficiency in the face of an old plant needing an upgrade; Mary Jane Meier, formerly of NHDES, received the Alfred E. Peloquin Award; and Noelle Osborne of Nashua received the Operator Award. We are proud of all our award recipients and hope that they are acknowledged throughout the year for their accomplishments.

The NEWEA meetings held with different subcommittees at the conference were especially informative this year. One particularly impressive highlight was an impassioned speech given by Dan Bisson during the Government Affairs Committee. Mr. Bisson nailed it in expressing how we need to reach out beyond our normal circles to encompass the larger public with regard to pollutants such as PFAS and how prevalent they have become in our society even though some entities have known the issues with these chemicals for a long time. We are in good hands with people such as Mr. Bisson leading the way.

Other NHWPCA Events

The NHWPCA Legislative Breakfast was held on March 4 at the Holiday Inn in Concord. Our NHWPCA Annual Trade Fair is scheduled for June 12 at the Radisson Hotel in Nashua. We hope to see you at our events.

Be sure to check the NHWPCA.org website for current dates of all upcoming events.

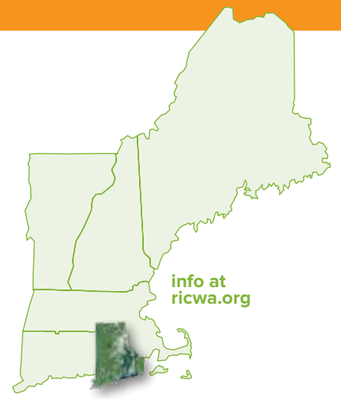
If you are not already a member of NEWEA, please consider joining to enhance your growth as a professional in the industry. As the NEWEA New Hampshire state director, I can be reached at sclifton@underwoodengineers.com or at 603-436-6192. Please feel free to contact me with any NEWEA questions. As I enter my second year as state director, I continue to look for ways to better serve the NHWPCA and NEWEA community.

Operator Award, Noelle Osborne

Alfred E Peloquin Award, Mary Jane L. Meier

Rhode Island State Director Report

by Scott Goodinson
sgoodinson@narragansettri.gov



It is official: The former Narragansett Water Pollution Control Authority (NWPCA) is now the Rhode Island Clean Water Association (RICWA). We are all excited about our new name, new board members, and an upcoming year chock-full of events!

Operations Challenge Division II—2nd Place Laboratory, Ocean State Alliance, (L-R): Kim Sandbach, Vinny Russo, Nicole LaBoy, Eddie Davies

As part of Clean Water Week last March, several Rhode Island publicly owned treatment works opened their doors to the public and offered tours of their facilities, answered questions, and had a great time. During the two-day event (Friday and Saturday), the public response was amazing; some attendees even sent letters to their local newspapers praising the facilities and the great job the employees are doing protecting their rivers and beaches. This was done just days after RICWA held its annual Rhode Island Legislative Luncheon inside the statehouse where state leaders, dignitaries, and regulators joined RICWA for a light lunch as they discussed local and federal regulations, upcoming changes, and infrastructure updates/funding opportunities.

Last June we had yet another sellout crowd as RICWA held its annual Golf Classic at the Potowomut Country Club. One hundred forty-four golfers enjoyed great weather, burgers and hot dogs at the turn, a huge selection of raffle prizes including a large-screen TV, big cash, several foursomes from local golf courses, and an awesome prime rib dinner. Everyone had a blast!

In August, RICWA held its sixth Annual Chowder cook-off along with the monthly general business meeting. The town of Narragansett hosted the event again at the picturesque Scarborough wastewater treatment facility (WWTF). Along with burgers, hot dogs, and many other sides, RICWA members and their guests enjoyed sampling 10 homemade chowders vying for the prestigious “Chowda King” award (and by the way, yours truly took home the prize again for the third time).

The annual RICWA Tradeshow and Clambake was held in September, an event that always enables great interaction among members of our profession. More than 40 vendors showcased their goods and networked with our members. The Rhode Island Operations Challenge team set up the pipes again this year, and the pipe-cutting competition was in full swing. The annual fast-paced competition was open to all attendees, and the top three individual times won gift certificates. As members dined on clam cakes, chowder, corn-on-the-cob, mussels and littlenecks, and other delicious sides, RICWA raffled off more than 40 prizes and awarded college-bound high school students scholarships totaling $3,000.

Upcoming 2020 RICWA Events		
Annual Awards Banquet	May 21	Potowomut Golf Club
Annual Golf Classic	June 22	Potowomut Country Club
Annual Clambake and Exhibition	Sept. 11	Twelve Acres, Smithfield

Please check ricwa.org, rinwpca.org, or our Facebook page for all association news and event updates.

The Annual Holiday Food Drive and Election of Officers Party gathered 619 lb (281 kg) of food for the Rhode Island food bank. RICWA members voted unanimously to approve the new association name and the 2020 board members while they enjoyed live music, a wonderful dinner, and some good old holiday cheer.

RICWA held its first monthly meeting of 2020 in January, at which committees were formed and there was review and discussion of the 2020 meetings and events calendar. The 2020 RICWA board includes President Peter Connell, Vice President Nora Lough, Secretary Kim Sandbach, Treasurer Jeff Chapdelaine, Executive Board members Dana DiScuillo, Michael Bedard, Mike Spring, and Vincent Russo Jr., State Director Scott Goodinson, Past President Peter Eldridge, Director of Wastewater Certification Paul Desrosiers, and vendor consultants Kelly Bailey and Chris Campo.

Congratulations to the Rhode Island Operations Challenge Team Ocean State Alliance, for its WEFTEC Division II second place Laboratory Event win. Well Done!

The following individuals were regaled at the NEWEA Annual Conference Awards Luncheon: Rhode Island Operator – Craig Danella, Cranston; Alfred E. Peloquin Award – Nick DeGemmis, Westerly; and the NEWEA Past President’s Plaque and Pin – Janine Burke-Wells, Northeast Biosolids and Residuals Association. Also recognized were NEWEA Scholarship winner Charles Spellman of the University of Rhode Island Graduate School and Rhode Island Stockholm Junior Water Prize winner Brooke Newbury of Riverside.

EPA Region 1 recognized Paul Desrosiers of the Narragansett Bay Commission with its Wastewater Treatment Plant Operator of the Year Excellence Award, and the cities of Cranston and Newport both received EPA Wastewater Treatment Plant O&M Excellence awards.

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1. **NEWEA Operator Award, Craig Danella**
2. **EPA Region 1 Wastewater Treatment Plant Operator of the Year Award, Paul Desrosiers**
3. **EPA Region 1 Wastewater Treatment Plant O&M Award, Newport—represented by (L-R) Marcelo Taveira and Tom Ciolfi**
4. **EPA Region 1 Wastewater Treatment Plant O&M Award, Cranston—represented by Earl Salisbury**

Vermont State Director Report

by Chris Robinson
chris.robinson@gmwea.org

This year has, again, been a very busy one in Vermont. The Green Mountain Water Environment Association (GMWEA) has been active under the leadership of President Tom DiPietro and part-time Executive Director Daniel Hecht. Below is a summary of the major events during 2019. A huge thank you to the volunteer committees and board of GMWEA for their dedication and commitment in making GMWEA such a great organization.

Vermont Science, Technology, Engineering, and Mathematics Fair

On March 30, GMWEA and the Vermont Rural Water Association (VWRA) sent a panel of special judges to the annual Vermont Science, Technology, Engineering, and Mathematics Fair. Our goal was to seek out the best student research projects of the year and encourage K-12 inquiry into water quality science by giving scholarship awards to the most promising investigators.

Hosted each year by Norwich University, the show features exhibits by about 200 middle school and high school students from throughout the state, all of them winners of their schools' science (and technology, engineering, and math) project competitions.

GMWEA Spring Meeting and Awards

On May 23, GMWEA held their annual Spring Meeting at the Killington Grand Hotel. The six technical sessions along with the business meeting were well attended.

Congratulations to the winners of these GMWEA awards: Michael J. Garofano Water Operator Excellence Award – John Tymecki, Champlain Water District; Wastewater Operator Excellence Award – Peter Krolczyk, Edward Farrar Utility District; Wastewater Facility Excellence Award – Ludlow Wastewater Treatment Facility; Industrial Wastewater Facility Award – Global Foundries; Andrew D. Fish Laboratory Excellence Award – Rod Munroe, City of Rutland; Industrial Wastewater Operator Award – Kevin Corliss; Bob Wood Young Professional Award – Ashliegh Belrose, City of South Burlington; Stormwater Award – Chelsea Mandigo, Village of Essex Junction; Founder's Award – Jim Fay, Champlain Water District; and the President's Award – Chris Cox, City of Montpelier.

Golf Tournament

The George Dow Memorial Golf Tournament, was held on August 23 at Cedar Knoll Country Club. The tournament has been held annually for over 26 years and has been named for the past 12 years in honor of the late George Dow who was instrumental in starting and prolonging the tradition. Approximately 76 golfers participated in a day of golf followed by the famous chicken barbeque in the afternoon. Awards and raffle prizes were presented.

Trade and Technical Conference

GMWEA Fall Trade and Technical Conference
On October 30, 370 water/wastewater/stormwater operators and water quality folks converged on South Burlington's Double Tree Conference Center for GMWEA's largest annual event. The day-long conference featured 88 vendor booths, seven technical training sessions, and a delicious lunch. Thank you to NEWEA's 2019 President Janine Burke-Wells for providing a few words about regional activities. Thanks also to NEWEA Executive Director Mary Barry for attending.

Small Education and Outreach Grant

GMWEA received a Small Education and Outreach grant in 2019 from the Lake Champlain Basin Program, which is funded by EPA money administered by New England Interstate Water Pollution Control Commission.

The $9,860 grant is allowing GMWEA to produce a series of four brochures to be distributed to citizens by towns and cities in Vermont. Each brochure deals with a subset of pollutants typically flushed, poured, spread, or spilled by domestic water users. They will tell ratepayers/water end users what not to put into public systems or private septic systems and inform them of alternative disposal/use practices. In 2019, we completed and distributed two of the four brochures—FOG! and Flushables! Planned for 2020 are the final two brochures, Drugs! and finally one about household, and lawn and garden pollutants. Many of these pollutants cannot be removed by municipal systems, so only preventive action by polluters—average Vermonters—can alleviate the problem. GMWEA is also creating four web pages containing the same information and providing them to municipalities to post on websites or provide links to GMWEA's website.

The goal is 1) to clean up our natural waters by informing every Vermonter of best practice water uses and 2) to create a tool, provided free to cities and towns, to inform citizens of how to reduce household wastewater system-damaging FOGs, "flushables," pharmaceuticals, and garden chemicals to reduce the amount of these challenging pollutants in wastewater system outflows.

Operator Exchange

Vermont exchanged with Maine for the Operator Exchange this past fall. Chris Cline, from Yarmouth, Maine, arrived on October 28 and returned home on October 30. During his visit, Mr. Cline toured the White River Junction, Quechee, Montpelier, South Burlington, and Essex Junction facilities. He also attended our fall trade show and conference. Vermont truly enjoyed his visit.

Deer Island Tour

On October 3, 32 Vermont and New Hampshire water quality professionals caught a bus from South Burlington, Montpelier, West Lebanon, and Manchester to visit the Deer Island Wastewater Treatment Plant in Winthrop, Massachusetts. Initiated by GMWEA board member Ryan Peebles and presented in coordination with VWRA and the New Hampshire Water Pollution Control Association, the travelers enjoyed a rare, close-up view of one of the 20th century's most challenging and successful environmental improvement projects. Thank you to Deer Island retiree Charlie Tyler for assisting and making this such a memorable experience.

Regulators Meetings

GMWEA's Government Affairs Committee is in its third year of holding quarterly meetings with staff from Vermont's Agency of Natural Resources water quality divisions. In 2019, about 22 stakeholders attended each meeting, led by Department of Environmental Conservation (DEC) Commissioner Emily Boedecker. Included were staff from the DEC's water, wastewater, stormwater, residuals, and wetlands divisions, and municipal representatives from around the state. These meetings have been terrific for sharing information between regulators and stakeholders.

Alfred E Peloquin Award, Christopher Cox

Operator Award, Robert Fischer

Legislative Meet & Greet

This annual legislative event was held on January 16 at the statehouse in Montpelier. The event enables GMWEA government affairs and other members to meet informally with legislators to discuss various issues.

Award Winners

Congratulations to the following Vermont individuals who were recognized at the January NEWEA awards reception: Robert Fischer of the city of South Burlington received the Operator Award and Chris Cox of the city of Montpelier received the Alfred E. Peloquin Award for Vermont.

Board Members

2019 GMWEA Board Members, who will serve until our May 21 spring conference, are President Tom DiPietro from the city of South Burlington, First Vice-President Mike Barsotti of the Champlain Water District, Second Vice-President Chris Cox from the City of Montpelier, Secretary Amy Macrellis of Stone Environmental, Treasurer Wayne Elliott of Aldrich & Elliot, PC, Past President Rick Kenney from the town of Hartford, and directors Steve Crosby of South Burlington (retired), Robert Fischer of the city of South Burlington, Ryan Peebles of Clean Waters, Inc., Eileen Toomey of Endyne Laboratories, and Chris Robinson of the town of Shelburne. Our executive director, based in Montpelier, is Daniel Hecht.

Upcoming 2020 GMWEA Events		
GMWEA Spring Meeting	May 21	Killington Grand Hotel
George Dow Golf Tournament	August, TBD	Cedar Knoll Country Club, Hinesburg

For further information regarding GMWEA/NEWEA activities and events, contact Vermont Director Chris Robinson at crobinson@shelburnevt.org or visit our website at gmwea.org.

2020 Annual Conference & Exhibit Proceedings

Boston Marriott Copley Place, Boston, MA • January 26–29

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1. The Rhode Island college contingent enjoying the conference 2. Keynote Speaker Kit Krugman emphasizes a point about inclusion and cultural inertia 3. WEF President-elect Lynn Broaddus addresses the opening session 4. Mario Francucci reacts to a keynote comment

The 90th Annual NEWEA Conference convened with a meeting of the Executive Committee with all chairs on Sunday, January 26, 2020. More than 2,400 attended this three-day event, which featured over 200 exhibitors and 32 technical sessions.

The Annual Business Meeting was held on Monday, January 27. Nominating Committee Chair Matt Formica presented the slate of officers for 2020 as follows:

- Vice President – Frederick McNeill
- Treasurer – Clayton "Mac" Richardson
- Council Director – Collections Systems and Water Resources – Vonnie Reis
- WEF Delegate – Peter Garvey (WEFTEC 2020 through WEFTEC 2023)
- Massachusetts Director – Adam Yanulis
- Connecticut Director – William Norton
- Council Director – Innovation – Marianne (MacDonald) Langridge (to fill the newly created office)

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

- President – Jennifer Kelly Lachmayr
- President-Elect – Virgil Lloyd
- Past President – Raymond Vermette

The remaining incumbents are fulfilling unexpired terms:

- WEF Delegate – Matthew Formica (through WEFTEC 2020)
- WEF Delegate – Susan Guswa (through WEFTEC 2021)
- WEF Delegate – James Barsanti (through WEFTEC 2022)
- Council Director – Communication – Meg Tabacsko (3rd year)
- Council Director – Meeting Management – Katelyn Biedron (2nd year)
- Council Director – Outreach – Justin Skelly (3rd year)
- Council Director – Treatment, System Operations, and Management – Philip Forzley (2nd year)
- Maine State Director – Jeffrey McBurnie (2nd year)
- New Hampshire State Director – Steven Clifton (2nd year)
- Rhode Island State Director – Scott Goodinson (3rd year)
- Vermont State Director – Christopher Robinson (3rd year)

All nominees have indicated their willingness to serve. Respectfully submitted by the NEWEA Nominating Committee: Ray Willis (Chair), Jim Barsanti, Janine Burke-Wells, Katelyn Biedron, Christopher Robinson.

32 Technical Sessions

SESSION 1
Asset Management 1: Case Studies and Tools
Moderators:
- Dan Capano, Gannett Fleming
- John Sykora, Weston & Sampson

3D GIS and Asset Management
- Zachary Jaffe, LandTech Consultants
- Andrea Taveres, LandTech Consultants
- Chris Lorain, LandTech Consultants

Asset Management in the Granite State—a Case Study in Keene, NH
- Matthew Manchisi, Hazen and Sawyer
- Charles Wilson, Hazen and Sawyer
- Don Lussier, City of Keene, NH

Are there Benefits to Cloud Assets Managements and IoT?
- Ken Nolan, Watts Water Technologies
- Ian Baynes, Watts Water Technologies

Development of an Asset Management Roadmap Propelled by Work Team Initiatives
- Len Sekuler, Arcadis
- Sowmya Bhimanadhuni, Arcadis
- Alton Echols, Loudoun Water, VA
- Jessica Dzara, Loudoun Water, VA

SESSION 2
Collection System 1: Modeling/I/I
Moderators:
- Peter Garvey, Dewberry
- Ryan Wingard, Wright-Pierce

O&M Optimization via a Living Hydraulic Model
- Brian Brown, CDM Smith
- Laurie Kellndorfer, CDM Smith
- Jason Waterbury, The Metropolitan District Commission

Physical Hydraulic Modeling a Tool for Pumping System Design and Optimization
- Paul Moulton, AECOM

All Over Over-Unders! Addressing I/I, Water Quality, and CSO Abatement with an Over/Under Manhole Program
- Shawn Syde, City of New Bedford, MA
- Jamie Ponte, City of New Bedford, MA
- Jesse Herman, CDM Smith
- Karilyn Heisen, CDM Smith

Strategic Meter Migration Leads to Accelerated Solutions in Dover
- Eliza Morrison, Wright-Pierce
- Bill Boulanger, City of Dover, NH

SESSION 3
Stormwater 1: Tools of the Stormwater Trade
Moderators:
- Patrick Gordon, StormTrap
- Angela Blanchette, Town of Scarborough, ME

Targeting and Prioritizing Stormwater Master Planning Projects in Vermont
- Kerrie Garvey, Watershed Consulting Associates








1. Amanda Shanahan makes a point in the Young Professionals career discussion 2. Maddison Ledoux, Shannon Ruggieri, and Alexandria Hidrovo at the Young Professionals reception 3. Crowded audience at the Young Professionals Summit

Everything Counts—Expanding the Realm of Stormwater Treatment Credits
- Theresa McGovern, VHB
- Cambria Ung, VHB
- Alisa Richardson, RIDOT

Implementing Opti-Tool—Benefits, Complications, and Considerations for Putting this Technology into Action
- Hernan Peralta, Woodard & Curran
- Carly Quinn, Woodard & Curran

Utilizing the Massachusetts MVP Grant Program to Address Precipitation-based Vulnerabilities to Climate Change
- Jennifer Zoppo, Stantec
- Haleemah Qureshi, City of Somerville, MA

Session 4
Contaminants of Emerging Concern: Monitoring and Treating PFAS, Pharmaceuticals, and PCPs

Moderators:
- Brendan Curran, Stantec
- John Ross, Brown and Caldwell

Repelling the Repellent—PFAS Considerations for Water and Wastewater Utilities
- Christopher Curran, AECOM
- Rhonda Pogodzienski, AECOM
- Dr. Yujung Chang, AECOM

The Fate and Removal of Pharmaceuticals and Personal Care Products within Wastewater Treatment Facilities Discharging Upstream from the Great Bay Estuary
- Alexandria Hidrovo, University of New Hampshire
- Jenna Luek, University of New Hampshire
- James Malley, Jr., University of New Hampshire
- Paula Mouser, University of New Hampshire

Exploring Pharmaceutical Biotransformation by Denitrifiers
- Amy Hunter, Tufts University
- Dr. C. Andrew Ramsburg, Tufts University

Distribution of Per- and Polyfluorinated Alkyl Substances (PFAS) in Wastewater Treatment Plants
- Elham Tavasoli, University of New Hampshire
- Scott Greenwood, University of New Hampshire
- James Malley, Jr., University of New Hampshire
- Paula Mouser, University of New Hampshire

Session 5
Small Community: Potpourri

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

Wastewater Headworks Screening for Smaller Installations
- Joe Clark, JWC Environmental
- Kevin Bates, JWC Environmental

Pilot Test of Nutrient Removal by Large-scale Drip Dispersal of Tertiary Treated Effluent, Southern Vermont
- Craig Heindel, Waite-Heindel Environmental Management

Paying for Large Projects in Small Communities—Templeton's Replacement of its Main Wastewater Pump Station
- David Peterson, Kleinfelder
- Judy Arnobit, Kleinfelder
- Mark Thompson, Kleinfelder

Non-destructive Investigation and Proactive Hydrogen Sulfide Corrosion Rehabilitation of Collection System Infrastructure—Uxbridge, MA Case Study
- Anastasia Rudenko, GHD
- Sara Greenberg, GHD
- Benn Sherman, Town of Uxbridge, MA

Session 6
Government Affairs: GAC Regulators Roundtable

Moderators:
- Bob Fischer, City of South Burlington, VT
- Matt Formica, AECOM

There are many challenges facing the six states that make up the New England region. The Regulatory Roundtable Session allowed for discussion of common issues/solutions and facilitated the exchange of information.

Panelists included:
- Thomas O'Donovan, NH DES
- Emily Boedecker, VT DEC
- Angelo Liberti, RI DEM
- Brian Kavanah, ME DEP
- Susannah King, MassDEP
- Rowland Denny, CT DEEP

Session 7
CSO/Wet Weather 1: Long-term CSO Control Plans—Creating or Assessing

Moderators:
- Steven Perdios, Dewberry
- Jeff Cantwell, Flow Assessment Services

A City with a Plan is a City with a Vision. Developing the City-Wide Sewer Separation Master Plan in Chelsea, MA
- David Bedoya, Dewberry
- Lou Mammolette, City of Chelsea, MA

Swimming in Data—Collaboration to Collect, Review, and Effectively Use Data
- Erika Casarano, AECOM
- Sharon Tsay, AECOM
- Evelyn Grainger, AECOM
- Jeremy Hall, Massachusetts Water Resources Authority

Applications of Smart Data Infrastructure for Wet Weather Control and Decision Support
- Tony Omobono, Tetra Tech
- Diana Qing Tao, Tetra Tech

Your CSO Long-Term Control Plan is Constructed...What Happens Next?
- Charles Wilson, Hazen and Sawyer

Session 8
Plant Operations 1: Data/Instrumentation

Moderators:
- Tom Hazlett, Woodard & Curran
- Varun Srinivasan, Brown and Caldwell

Making the Most of Online Instrumentation to Improve Process Performance and Reduce Costs at the Westfield, MA WRF
- Jeff Gamelli, City of Westfield, MA
- Ken Gagnon, City of Westfield, MA

You've Got the Data—Now What? How to Effectively Integrate and Visualize Data to Facilitate Effective Process Control Decisions
- Susan Guswa, Woodard & Curran
- Alan Fabiano, Woodard & Curran
- Bob Amaral, Woodard & Curran
- Frank Cavaleri, Woodard & Curran

1. Renie Jesanis speaks at the Executive Committee meeting 2. Exhibit Hall ribbon cutting (L-R): Mary Barry, Kate Biedron, Paul P. Casey, Ray Vermette, Lynn Broaddus, Amy Anderson George 3. Justin Skelly reacts to Executive Committee discussion 4. Meg Tabacsko and Ben Mosher assist with attendee registration








1. Danielle Gallant, Leonard Young, and Elena Proakis Ellis at the Youth Education Committee meeting 2. John Rogers makes a point at the Asset Management Committee meeting 3.Tom Hazlett, Varun Srinivasan, and John Adie at the Plant Operations Committee meeting 4. Charlene Foss and James Plummer at the Innovation Council meeting

The Current State of Automation and Controls at New England WRRFs
- Nicholas Tooker, University of Massachusetts Amherst
- Wenjin Zhang, Northeastern University
- Amy Mueller, Northeastern University
- Mickey Nowak, Massachusetts Water Environment Association

Enabling Next-Generation Process Automation—Where are the Next Innovations in Sensing and Data Analytics?
- Wenjin Zhang, Northeastern University
- Amy Mueller, Northeastern University
- Nicholas Tooker, University of Massachusetts Amherst

Session 9
Residuals 1: Operation Issues and Residuals Management

Moderator:
- Natalie Sierra, Brown and Caldwell
- Dexter Lefavour, Tata and Howard

Navigate Through Design Codes and Standards for Biogas Systems
- Regina Hanson, Varec Biogas

Innovative Approach to Enhancing Dewaterability of Co-digesting Sludge and High Strength Waste from a Mesophilic Digester
- Christopher Muller, Brown and Caldwell
- Tim Mills, Brown and Caldwell
- Michael Nacrelli, City of Gresham, OR

Innovative Dewatering Approaches to Achieve Lowest Life Cycle Costs
- Micah Blate, Hazen and Sawyer

Using Sludge Rheology in Solids Systems Design, Planning, and Operation
- Tracy Chouinard, Brown and Caldwell

Session 10
Energy: Multi-Faceted Approach to Energy Optimization

Moderators:
- Nick Ellis, Hazen and Sawyer
- Karen Wong, Tighe & Bond

Designing Energy Efficiency and Nitrogen Removal Optimization for a Major WPCF Upgrade in Southington, CT
- Cynthia Castellon, Tighe & Bond
- Chris Bone, Tighe & Bond

Zero Net Energy Pumping Station Using On-site Water Source for Geothermal Heating and Cooling
- Tom Renaud, Massachusetts Water Resources Authority
- Mike Bartley, Stantec

Revenue through Energy Savings and Generation
- Alex Rozen, JKMuir
- Jen Muir, JKMuir
- Molly Keleher, JKMuir

A Multi-Sector Approach to Optimize Process Efficiency and Reduce Operating Costs at the Upper Blackstone
- Edris Taher, Upper Blackstone Clean Water
- Karla Sangrey, Upper Blackstone Clean Water
- Timothy Loftus, Upper Blackstone Clean Water

1. Zachary Jaffe speaks on GIS and Asset Management 2. EPA's Newton Tedder makes a point regarding stormwater nutrient management 3. Eliza Morrison adds to an asset management discussion 4. Hernan Peralta illustrates comparative advantages of trenchless technology

Session 11
Innovation: Advantage, Innovation! New Technologies to Solve Operational Problems

Moderators:
- Dave Polcari, CDM Smith
- Miles Moffatt, Tighe & Bond

Pushing Process Intensification Limits for Biological Nitrogen Removal using Gel Entrapment Technology
- Dr. Carla Cherchi, Stantec
- Kellogg Schwab, JHU
- Shu Tsuda, Hitachi

Improved BNR Performance Through Selective Sludge Wasting
- Daniel Dair, World Water Works
- Kristen Tucker, World Water Works
- Jason Boyd, World Water Works
- Chandler Johnson, World Water Works

First of its Kind Treated Effluent Discharge Saves City Over $5M
- Robert Polys, Woodard & Curran
- Maxwell Kenney, Woodard & Curran

Leaving Obsolescence Behind! A Case Study of Innovative Design/Build SCADA Upgrades
- Akshaya Selvaraj, Arcadis
- Zeeshan Amin, Arcadis
- Edward Kowalski, Arcadis
- Vanessa McPherson, Arcadis

Session 12
Collection System 2: Pumping

Moderators:
- Scott Lander, Retain-It
- Mike Armes, ADS Environmental Services-Idex

Alone on an Island—Designing a Pump Station with Resiliency in Mind and Facing the Storm of the Century During Construction
- Kevin Raftery, Hazen and Sawyer

When There is No Where to Go But Up
- Gary Simard, AECOM
- Richard Feminella, Town of Greenwich, CT

Dealing with Both Peaks and Valleys—Pump Station Upgrade Design
- John Scheri, Mott MacDonald
- Kevin O'Brien Mott MacDonald
- Ernie DeGraw, Two Bridges Sewerage Authority

Taking a Global Look—City-wide Pump Station Assessment for Portsmouth, NH
- Michael Theriault, Wright-Pierce
- Terry Desmarais, City of Portsmouth, NH

Session 13
Energy/Residuals Joint: Energy Optimization for Selected Processes

Moderators:
- Tracy Chouinard, Brown and Caldwell
- Sharon Nall, NHDES

Biogas Utilization for Small Utilities—Small Utilities Can Dream Big Too
- Bryan Lisk, Hazen and Sawyer
- Micah Blate, Hazen and Sawyer

No Digester, No Problem—CHP May Still be a Viable Option for Your Wastewater Treatment Facility
- Matthew Ribeiro, AECOM
- Alan Taubert, Jr., South Essex Sewerage District
- David Michelsen, South Essex Sewerage District

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1. A conference attendee snaps a shot of the electronic billboard 2. Annalisa Onnis-Hayden and Deb Mahoney relax at the 5S luncheon 3. WaterWorld Editorial Director Angela Godwin (right) interviews attendees at the student poster display 4. Gloria Kazeera, Marckenley Joseph, Renee Baxter, and Julia Miller enjoy the exhibit hall reception

- Peter Pommersheim, South Essex Sewerage District

Evaluating Thermal Drying—Energy and Economics
- John Ross, Brown and Caldwell

Asset Replacement to Improve Energy Efficiency and Achieve Net Zero Energy Goals
- Colin O'Brien, Brown and Caldwell
- Christopher Muller, Brown and Caldwell
- William Rehkop, Derry Township Municipal Authority
- Wayne Schutz, Derry Township Municipal Authority

Session 14
Operator Ingenuity: Wastewater Treatment Facilities Throughout New England—A Virtual Tour from the Operator's Perspective

Moderators:
- Helen Gordon, Environmental Partners Group
- Erik Meserve, AECOM

A virtual tour of wastewater treatment facilities in all six New England states. Operators from across New England described their facilities, provided insight on their operational successes and challenges, and shared the experiences among the other operators.

Panelists included:
- Frank Russo, City of Meriden, CT
- Mike Harris, City of Ellsworth, ME
- David Ford, Town of Wolfeboro, NH
- Kevin Gardner, Quonset Point Development, WWTF, RI
- Jeffrey Murawski, City of Fitchburg, MA

Session 15
Plant Operations 2: Emerging Issues

Moderators:
- John Adie, NHDES
- Pam Westgate, Kleinfelder

Reading the Tea Leaves—the Future of PFAS Treatment in Wastewater?
- Rob Little, Woodard & Curran
- Lisa Campe, Woodard & Curran
- Susan Guswa, Woodard & Curran
- Dan Bryant, Woodard & Curran

Optimizing Capacity at a Hybrid Rotating Biological Contactor Plant—Where Do We Stand and Where Do We Invest Next to Get the Capacity We Need?
- Frederick Mueller, Tighe & Bond
- Cynthia Castellon, Tighe & Bond
- Peter Boria, Town of Charlton, MA

Side-stream Enhanced Biological Phosphorus Removal (S2EBPR)—a Comparison of Performance and Microbial Ecology with Conventional EBPR
- Varun Srinivasan, Brown and Caldwell
- Annalisa Onnis-Hayden, Northeastern University
- Nicholas Tooker, University of Massachusetts Amherst
- April Gu, Cornell University

Review of Pilot Studies to Remove Zinc at the Sturbridge Wastewater Treatment Facility
- Austin Weidner, Tighe & Bond
- Ian Catlow, Tighe & Bond


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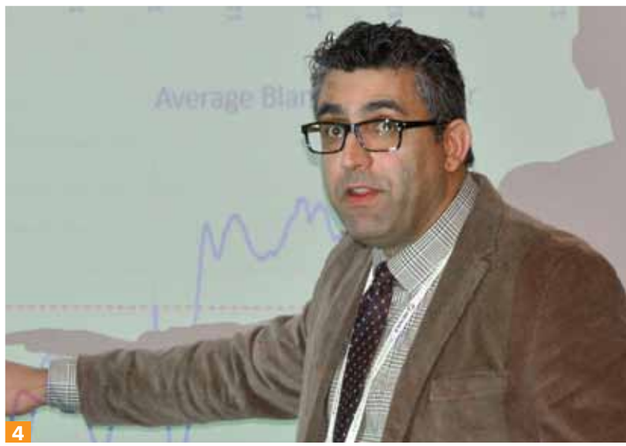

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1. Dr. Carla Cherchi presents a technique for enhanced biological nitrogen removal 2. Audience member presents a question following a collection system modeling presentation 3. Ken Nolan discusses benefits of cloud asset management 4. Edris Taher presents a strategy for retaining process solids during high flows

Session 16
Stormwater 2: Panel Discussion—Alternative Strategies for Managing Nutrients in Stormwater

Moderators:
- Zach Henderson, Woodard & Curran
- Kate Edwards, Arcadis

This two-hour session included a description of alternative approaches to managing nutrients in stormwater. The session was broken into two consecutive moderated panel discussions with each of the presenters providing insights on nutrient management innovations, challenges, and opportunities. The panel was moderated with the intention of engaging the audience in dialogue on the topic areas. The first hour included a short introduction to current regulatory requirements on nutrients in the MA/NH MS4 General Permit followed by presentations by each of the panelists describing their innovative efforts, programs, policies, or structural controls.

Panelists included:
- Doug Howie, Washington State Department of Ecology—Emerging Stormwater Treatment Technology Testing Program: Structural Controls
- Tom Schueler, Chesapeake Stormwater Network—Streambank Stabilization and Restoration
- Jamie Houle, University of New Hampshire Stormwater Center—Riparian Buffers
- Jason Sorenson, United States Geological Survey—Street Solids and Leaf Litter

Session 17
Water Reuse: Planning, Permitting, Technology and Trials

Moderators:
- Robert Scott, Woodard & Curran
- Meredith Zona, Stantec

Applicability of WERF's Risk Based Framework for Permitting Decentralized Non-Potable Water Systems in New England
- Bruce Douglas, Natural Systems Utilities
- Ed Clerico, Natural Systems Utilities
- Zach Gallagher, Natural Systems Utilities
- Adam Stern, Natural Systems Utilities

Full-Scale Loading Test at the MFN Regional Wastewater District Infiltration Basins for Assessing Maximum Capacity
- Kathryn Swanson, CDM Smith
- Buvana Ramaswamy, CDM Smith
- Christopher Rositer, MFN Regional Wastewater District

Rare Earth Technology in Wastewater Treatment
- Logan Wherry, Neo Water Treatment

Considerations for Water Reuse—Incorporating Water Reuse into Integrated Planning
- Troy Walker, Hazen and Sawyer

Session 18
Collection System 3: CMOM/Asset Management

Moderators:
- Matt Corbin, Wright-Pierce
- Brad Hayes, Woodard & Curran

1. Exhibitor Robert Simonds explains his display to a curious attendee 2. Debbie Cheng, Chelsea Durante, Doris Jenkins, and Daryl Coppola were among over 20 at the Young Professionals annual committee luncheon

1. Malcolm Moutenot at an Innovation presentation on PFAS detection and treatment 2. Mahesh Viswanathan presents his LeakSpotter invention at the Innovation Pavilion 3. WEF's Brianne Nakamura makes a point at the Innovation Pavilion 4. Thomas O'Donovan speaks on PFAS at the Innovation Pavilion

Ten Years of CMOMs—Lessons Learned and Future Plans
- Fred McNeill, City of Manchester, NH/EPD
- Jeremy Bouvier, City of Manchester, NH/EPD

Holistic Approach to Collection System Asset Management in Barnstable, MA
- Ryan Bodnaruk, Wright-Pierce
- Eric Lemoi, Wright-Pierce
- Marc Moccio, Wright-Pierce
- Andrew Boule, Town of Barnstable, MA

Beyond the Report—Integrating a Town-wide SSES Study with a District LTCP and CMOM Program
- Katelyn Biedron, CDM Smith
- John Harper, CDM Smith
- Joshua MacCulloch, The Metropolitan District Commission

CMOM—the Scary Sounding Acronym—Why Do I Need It? How do I implement It? And Tools, Tricks and Guidance to Make It Work for You
- Daniel Kramer, Hazen and Sawyer
- Sean Fitzgerald, Hazen and Sawyer

Session 19
Industrial Wastewater Treatment: Chemistry Advances Improve Treatment Technologies and Processes

Moderators:
- Darrell Interess, LabCentral
- Matthew Dickson, MGD Process Technology

Temporal Toxicity in Hydraulic Fracturing Wastewater from Black Shale Natural Gas Wells in the Appalachian Basin
- Mina Aghababaei, University of New Hampshire
- Jenna Luek, University of New Hampshire
- Paula Mouser, University of New Hampshire

Putting Out Your Treatment Fires—PFAS Treatment of Water & Wastewater
- John Civardi, Mott MacDonald

Industrial Wastewater Treatment Using Polyamides for Removal of Heavy Metals
- Mohamed Hamoda, Kuwait University

Applying Multi-Omics Tools to Guide New Treatment Processes: Anaerobic Conversion of Industrial Wastes to Valuable Chemicals
- Matthew Scarborough, University of Vermont

Session 20
Plant Operations 3: Wet Weather/Upgrades

Moderators:
- Ben Levesque, Tighe & Bond
- Ben Levin, Hazen and Sawyer

Process Control Collaboration to Balance Nitrogen Removal with Treating CSO Flows
- Paul Dombrowski, Woodard & Curran
- Marc Pariseault, Narragansett Bay Commission
- TJ Harrington, Narragansett Bay Commission

Phased Implementation and Startup of the Exeter WWTF Upgrades
- Edward Leonard, Wright-Pierce
- Steve Dalton, Town of Exeter, NH

Multi-phase Improvements to Address Peak Wet Weather Flows and Nutrient Limits at the Fitchburg Easterly WWTF
- Jeffrey Pinnette, Wright-Pierce
- Ben Stiles, Wright-Pierce
- Jeffrey Murawski, City of Fitchburg, MA
- Mark McNamara, City of Fitchburg, MA

Retaining and Maintaining—Tips and Tricks for Retaining Biomass and Maintaining Permit Compliance During High-Weather Events
- Edris Taher, Upper Blackstone Clean Water
- Karla Sangrey, Upper Blackstone Clean Water
- Timothy Loftus, Upper Blackstone Clean Water

Session 21
Residuals 2: Regulatory Issues and Other Hot Topics

Moderators:
- Eric Spargimino, CDM Smith
- Deborah Mahoney, Brown and Caldwell

Responding to the Maine DEP's Biosolids Utilization Memorandum
- Jeff McBurnie, Casella Organics

How Much Digestion Volume Do You Really Need for a THP Facility?
- Matthew Van Horne, Hazen and Sawyer
- Joe Uglevich, Stantec
- Kevin Selock, WSSC
- Andy Seaton, PC Construction

A Dose of Chaos—A Snapshot of the Current Biosolids Market and How PFAS Could Disrupt It
- Tom Schwartz, Woodard & Curran
- Jay Sheehan, Woodard & Curran

Manchester's SSI Compliance Project
- Robert Robinson, City of Manchester, NH/EPD
- Gillian Wood, Woodard & Curran

Session 22
Safety Forum

Moderators:
- David Wright, Weston & Sampson
- David Horowitz, Tighe & Bond

Most Challenging Safety Programs for Drinking Water and Clean Water Treatment Plant Operators
- David Horowitz, Tighe & Bond

Fall Protection—What's the Big Deal?
- David Wright, Weston & Sampson

A One-hour Discussion on the Industry's Most Relevant Safety Issues

Session 23
Watershed Management: New Tools and Technology for a Changing World

Moderators:
- Steve Wolosoff, CDM Smith
- Sara Greenberg, GHD

Leveraging State of the Science Tools to Identify Bacteria and Nutrient Sources in Urban Waters
- Jared Ervin, Geosyntec Consultants
- Adam Questad, Geosyntec Consultants
- Brandon Steets, Geosyntec Consultants

Taunton Estuary Update—Proactive Program Triggers Reassessment of TN Controls Needed to Meet Dissolved Oxygen Standards and Narrative Nutrient Criteria
- William Hall, Hall & Associates
- John Hall, Hall & Associates

A Decision Support Tool to Increase Resilience for the Mouse River Enhanced Flood Protection Project


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1. Mike Bonomo and Peter Frick check the conference program **2.** Eric Muir, Deb Mahoney, and Chris Peluso talk during a break **3.** Exhibitor Tom Stephens talks textiles to students at the exhibit hall reception **4.** Fred McNeill and Howard Carter prep for a morning meeting

- Laurie Kellndorfer, CDM Smith
- Michael Schmidt, CDM Smith
- Richard Wagner, CDM Smith

Mitigating Nutrient Impacts on a Stressed Watershed Through a New Ocean Outfall
- Anastasia Rudenko, GHD
- Marc Drainville, GHD
- Kelvin George, GHD
- Brandon Gott, GHD
- Lenna Quackenbush, GHD

Session 24
Asset Management 2: Panel Discussion—Show Us the Money! Funding Opportunities from Asset Management Through Construction

Moderators:
- Daniel Roop, Tighe & Bond
- Luis Adorno, NHDES

This two-hour session showcased funding opportunities throughout New England. The purpose of this panel was to provide a funding forum for attendees to learn from regulators and funding agents about various programs to support asset management planning projects, state revolving fund construction loans, climate adaptation plans, coastal resilience, water and environment rural development, and more. Panelists presented on their respective programs while interacting with the moderators and audience. Discussion ensued throughout the panel on how entities can actually fund, plan for, and implement the improvement and maintenance activities resultant from their asset management planning work.

Panelists include:
- Luis Adorno, NHDES – Drinking Water Groundwater Bureau
- Sharon Nall, NHDES – Wastewater Engineering Bureau, Water Division
- Megan Young, Vermont DEC – Drinking Water Capacity Program Supervisor
- Josh Lochhead, Vermont DEC – Drinking Water Capacity Program Specialist
- Maria Pinaud, MassDEP Bureau of Water Resources – Acting Director, Municipal Services
- Kelly Taylor, MassDEP Division of Municipal Services – State Revolving Fund Project Engineer
- George Hicks, CT Department of Environmental Protection – Municipal Wastewater Section
- Carolyn Meklenburg, Municipal Vulnerability Preparedness Program Regional Coordinator for Greater Boston – MA Executive Office of Energy and Environmental Affairs
- Brandy Piers, Maine DEP – Grants Coordinator
- Lyndon Nichols, USDA Rural Development MA Area Director

Session 25
Sustainability: Making Positive Gains Toward Sustainable Outcomes

Moderators:
- Courtney Eaton, Kleinfelder
- Kara Keleher, Weston & Sampson

Strengthening Water Infrastructure Planning and Design Outcomes Using Sustainability Concepts Within the Envision Rating System
- Jacob Cantor, Hazen and Sawyer
- Evan Bowles, Hazen and Sawyer
- Jorge Acevedo, City of Coral Gables, FL

1. Chris Cox and Wayne Graham smile at Chris's wife and child as Bob Fischer (in foreground) looks on **2.** Jane Madden and John Riccio catch up at the exhibit hall reception **3.** 2019 President Ray Vermette hands off the NEWEA gavel to 2020 President Jennifer Kelly Lachmayr

- Lauren Zuravnsky, Hampton Roads Sanitation District

Protecting the Future Through Sustainable Planning—Design to Prevent Catastrophic Failure in a Flood
- Bill Davis, Weston & Sampson

Rising Above the Storm—Greater New Haven's Resilient Pump Stations
- Jay Sheehan, Woodard & Curran
- Tom Sgroi, Greater New Haven WPCA

Green Steps Award Winner—Highlighting the Sustainability of the Globalcycle Water Reuse Process
- Kyle Kennedy, Globalcycle, Inc.
- Stephen Pozner, Globalcycle, Inc.

Session 26
CSO/Wet Weather 2: Projects Big and Bigger in CSO

Moderators:
- Peter Frick, ADS Environmental Services-Idex
- David Goncalves, Mott MacDonald

Dip Your Toe into the Water—Alternative Analysis of Crossing Massachusetts' Largest River
- Debbie Cheng, Kleinfelder
- Gus O'Leary, Kleinfelder

Hartford Metropolitan District Commission (MDC) Wet Weather Expansion Project (WWEP) Phase 2—New 200 MGD Wet Weather Treatment Facilities
- Brian McGuire, Arcadis
- Jeff Bowers, The Metropolitan District Commission

How Bangor, ME Expanded a 20-year-old Storage Facility Threefold Along a Vibrant Waterfront
- Kate Mignone, AECOM
- Gregory Heath, AECOM
- Andy Rudzinski, City of Bangor, ME
- John Theriault, City of Bangor, ME

Boston Water and Sewer Commission—Real-time Predictive Modeling for the Dorchester Interceptor
- John Rahill, Kleinfelder
- Kenneth Yu, Kleinfelder

Session 27
Plant Operations 4: Technologies

Moderators:
- Dave Press, Tighe & Bond
- Phil Forzley, Fuss & O'Neill

New Options for Slow-Speed Dewatering—Another Technology in the Engineer's Toolbox
- Matthew Burns, Wright-Pierce
- Bryan Levitt, City of Bath, ME

New Directions for Side-stream Nutrient Recovery at Municipal Water Resource Recovery Facilities
- W. Camilla Kuo-Dahab, Brown and Caldwell

Achieving Nutrient Removal in High-Purity Oxygen Systems
- William McConnell, CDM Smith

The Role of Aerobic Granular Sludge in Biological Nutrient Removal
- Jeffrey Reade, AECOM
- Beverley Stinson, AECOM

Session 28
Stormwater 3: Green Infrastructure—Sizing, Implementing & Maintaining our Stormwater Infrastructure

Moderators:
- Maria Rose, City of Newton, MA
- Janelle Bonn, Woodard & Curran

Identifying Green Infrastructure Opportunities for Phosphorus Reduction Within Boston's MS4
- Benjamin Agrawal, Hazen and Sawyer
- Charles Wilson, Hazen and Sawyer
- Charlie Jewell, Boston Water and Sewer Commission

How Provincetown, MA used Porous Pavement to Reduce Beach Closures and Ended Up with an Unexpected Benefit
- Marc Drainville, GHD
- Russ Kleekamp, GHD
- Sandra Tripp, GHD
- Richard Waldo, Town of Provincetown, MA

Downstream Sediment Interception—a Unique BMP Application
- Peter Enright, WSP

When Maintenance Drives Design—Collaboration in Philadelphia and NYC
- Robert Woodman, ACF Environmental

Session 29
Stormwater 4: Flood Mitigating Solutions, from Technology to Implementation

Moderators:
- Erik Kelley, Environmental Partners Group
- Jeff Cantwell, Flow Assessment Services

Conquering the Great Divide—Redirecting Stormwater to Reduce Urban Neighborhood Flooding
- Kate Goyette, Kleinfelder
- Jerry Friedman, City of Cambridge, MA
- David VanHoven, Stantec

Mitigating Flood Disaster Through a Renewed Approach
- Asad Choudry, Xylem

Identifying Flood Mitigation Solutions for a Small, Coastal Community Impacted by Sea Level Rise
- Joe Kirby, Woodard & Curran
- Colleen Kennedy, Weston & Sampson

Innovative Solution for Urban Flood Mitigation—Planning, Monitoring, Control and Forecasting
- Diana Qing Tao, Tetra Tech

Session 30
Collection System 4: Various Topics

Moderators:
- Ashley Dunn, City of Framingham, MA
- Tom Loto, AECOM

Jada Wong attends an Innovation session

A Tale of Two Cities—How Two Massachusetts I/I Control Plans Compare: City of Leominster, MA and City of Medford, MA
- Karen Chan, Wright-Pierce
- Lindsey Sylvester, Wright-Pierce

Should You Dig It? Trenchless Technology Saves Time & Money in Quincy, MA
- Hernan Peralta, Woodard & Curran

One Way to Get Out of Your NPDES Permit—Regionalize and Decommission Your Wastewater Treatment Plant
- Amy Sowitcky, Tighe & Bond
- Lori Carriero, Tighe & Bond
- Joe Fazzino, City of Middletown, CT

Engineering Evaluation of Extension of Coventry Route 44 Sewer Service Area to the Bolton Lakes Regional WPCA Pressure Sewerage System
- Eric Hess, F.R. Mahony & Associates
- Henry Albro, F. R. Mahony & Associates
- Brian Curtis, Nathan L. Jacobson & Associates

Session 31
Utility Management: Leading Utilities into the Future

Moderators:
- Kevin Garvey, Wright-Pierce
- Don Gallucci, Weston & Sampson

Massachusetts Water Resources Authority Deer Island Treatment Plant Capital Improvement Plan
- Ethan Wenger, Massachusetts Water Resources Authority

Projects Approved! Now, How Do We Pay for It?
- Rebecca Saucier, Wright-Pierce
- Jason Randall, Plymouth Village Water and Sewer District
- Don Jutton, Plymouth Village Water and Sewer District

Understanding the Impact of Brewery Discharges and Effective Approaches for Consideration
- Michael Borchers, Arcadis
- Ben Pearson, City of Portland, ME

Leveraging Technology to Increase Efficiency and Welcome the Next Generation of Utility Employees
- Scott Medeiros, Woodard & Curran
- Dave Billips, City of Westfield, MA
- Francis Cain, City of Westfield, MA

Session 32
Youth Education: Is Stormwater One Word or Two? Getting the MS4 Word(s) Out

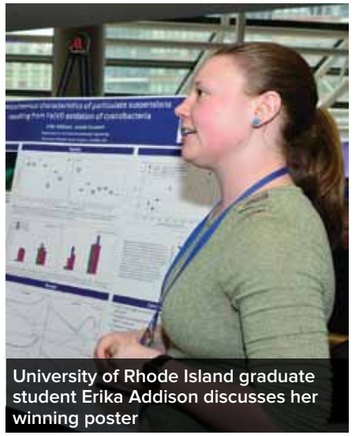
Moderators:
- Kerry Reed, City of Framingham, MA
- Elena Proakis Ellis, City of Melrose, MA

Outfalls and Outreach—City of Cambridge's Stormwater Management Program
- Andrew Goldberg, Kleinfelder
- Catherine Woodbury, City of Cambridge, MA

Public Awareness Through Youth Watershed Education—5th Grade Stormwater Curricula
- Dan Hoag, Worcester Polytechnic Institute
- Brendan Chipman, Worcester Polytechnic Institute
- Louis Doherty, Worcester Polytechnic Institute
- Connor Field, Worcester Polytechnic Institute
- Kerry Reed, City of Framingham, MA

Soak Up the Service II—Bioretention in Dover, NH
- Kate Roosa, Kleinfelder
- Danielle DiRuzza, Massachusetts Water Resources Authority
- Eliza Morrison, Wright-Pierce

Partnering to Bring Stormwater Education In and Out of the Classroom
- Meg Tabacsko, Massachusetts Water Resources Authority
- Danielle DiRuzza, Massachusetts Water Resources Authority
- Don Ciaramella, City of Revere, MA
- Kori O'Hara, City of Revere, MA



University of Rhode Island graduate student Erika Addison discusses her winning poster

Undergraduate Student Poster Board Competition

An Eco-Friendly Rechargeable Battery—Using Zero-Valent Iron to Power A Battery
- Benjamin Page, University of Vermont

Clarifier Hydraulics and Design
- Lily Orelup, University of Hartford

Tidal Flow Constructed Wetland for Water Reuse: Performance Evaluation and Microbial Population
- Madeline DuBois, Jeff Ling, Louiza Wise, Paul Yi—Northeastern University

Hawks Coastal Design: Sowams Road—Soil Bank Stabilization
- Maeve Drogalis, Vincent Neubert, Ali Abdul Sater, Ashley Bosse, Adrianna Cecere—Roger Williams University

Environmental Analysis of Industrial Cannabis Production
- Stephanie Salerno, Jacquelyn Valsamis—Worcester Polytechnic Institute

Impact of Locally Sourced Clay on the Bacterial Removal of Ceramic Water Filters
- Jacob Hunnewell, Zachary Shepard—University of Rhode Island

Kenya Nguluni Water Supply Project
- Abigail Laughlin, Emma Guertin, Alexandra Shea—University of Massachusetts Amherst

Engineers Without Borders—Ghana Project
- Laura Townsend, University of Massachusetts Amherst

Application of Mycoremediation to Reduce Escherichia coli in Runoff
- Tijana Cooley, Sofia Garcia-Carlin, Ojaswi Aryal—Smith College

Organism Diversity in Relation to F:M
- Nicole Kibbe, Hailey Kukowski—University of Hartford

Graduate Student Poster Board Competition

Pilot-scale Investigation of Water Quality in Intermittent Water Supply
- Mariam Alkattan, Dr. Emily Kumpel—University of Massachusetts Amherst

Tracking Algal Blooms: Does Chlorophyll Tell Us What We Need to Know?
- McNamara Rome, Ed Beighley, Varshini Reddy—Northeastern University

Distribution of Per- and Polyfluorinated Alkyl Substances (PFAS) in Wastewater Treatment Plants
- Elham Tavasoli, University of New Hampshire

Influence of floods, tides, and vegetation on sediment retention in Wax Lake Delta, Louisiana
- Elizabeth Olliver, Indiana University Bloomington

Electrochemical Advanced Oxidation Processes for Ammonia Removal in Wastewater Treatment
- Laura Siddon, Bridgette Charlebois—University of Massachusetts Amherst

Temporal Toxicity in Hydraulic Fracturing Wastewater from Black Shale Natural-Gas Wells in the Appalachian Basin
- Mina Aghababaei, University of New Hampshire

Food Waste in Anaerobic Digestion
- Usha Humagain, University of Maine

Evaluating Opportunities to Increase the Effectiveness of Permeable Reactive Barriers for Biological Treatment of Nitrogen
- Veronica Gonsalez, Paul Dombrowski, C. Andrew Ramsburg—Tufts University

Evaluating Potassium Ferrate Performance in Drinking Water Treatment at Pilot Scale: Decreasing DBPs, Iron, and Manganese
- Nicolas Duenas, University of Massachusetts Amherst

Physicochemical Implications of Cyanobacteria Oxidation with Fe(VI)
- Erika L. Addison, Joseph E. Goodwill—University of Rhode Island

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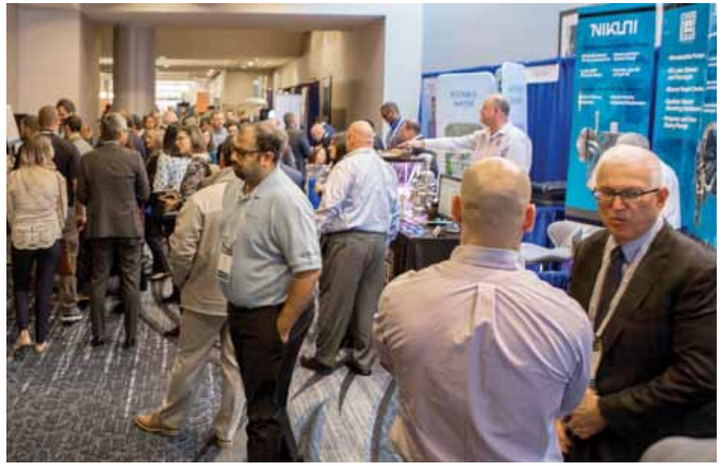

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Flowserve Pump
FlowWorks
Ford Hall Company
Franklin Miller Inc.
Fusion Environmental Solutions
GA Fleet - Fleet Pump&Service
Gabriel Novac & Assoc.
GEA Westfalia
GeoTree
Green Mountain Pipeline Services
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HACH Flow Group / JWB Co.
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Hazen and Sawyer
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High Tide Technologies
Hobas Pipe USA
Holland Company
Howden
Hubbard-Hall Inc.
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Infra Pipe Solutions Ltd.
Integrity Municipal Systems / BAU Hopkins
Invent
ITpipes
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J&R Sales and Service, Inc.
JWB Company
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Sealing Systems, Inc.

Chris Hubbard points out a product advantage

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Seepex Inc.
Shea Concrete Products
Shelter Works
SmartCover Systems
SNF Polydyne
SP Kinney Strainers
Spencer / BAU Hopkins
SPIRAC
Spire Metering Technology
Sprayroq, Inc.
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YSI

2020 Awards & Recognitions

U.S. EPA REGION I NEW ENGLAND AWARDS

Wastewater Treatment Plant Operation and Maintenance Excellence Award
- Westborough, Massachusetts Wastewater Treatment Plant—represented by Ken Gagnon and Jeff Gamelli
- Cranston, Rhode Island Water Pollution Control Facility—represented by Earl Salisbury
- Newport, Rhode Island Wastewater Treatment Facility—represented by Tom Ciolfi and Marcelo Taveira
- Presque Isle, Maine Utilities District—represented by Frank Kearney

Wastewater Treatment Plant Operator of the Year Excellence Award
- Paul Desrosiers, Narragansett Bay Commission

Wastewater Trainer of the Year
- Wayne Graham, Vermont Rural Water Association

WEF MEMBER ASSOCIATION AWARDS/RECOGNITIONS

WEF Life Membership
- Edward F. Quann
- Dennis M. Geran
- Henry S. Albro
- Frank Underwood
- Robert Sheldon
- Eugene Forbes

Quarter Century Operator
- William Norton
- Joseph Madigan
- Ray Weaver
- Frank Cavaleri
- Jennifer Nicholoson

Public Communication & Outreach Program
- Meg Tabacsko

Emerson Distinguished Service Medal
- Jeanette Brown

Ralph Fuhrman Medal
- Paul Dombrowski

Arthur Sidney Bedell
- Travis Peaslee

Laboratory Analyst Excellence
- Carmen Krzesik

WEF Service
- Frederick J. McNeill

William D. Hatfield
- Jeffrey Kalmes

Operations Challenge Division II Process Control
- Franken Foggers

Operations Challenge Division II Laboratory
- Ocean State Alliance

Student Design Competition
- Margaret Keefe, Marcus Brunelle, Kestral Johnson, and Brendan Curran

New members—WEF Quarter Century Operators' Club (L-R): Joseph Madigan, Frank Cavaleri, (WEF President Lynn Broaddus) William Norton, Jennifer Nicholoson, E. Ray Weaver

NEWEA award recipients: 1. Paul Dombrowski, Clair N. Sawyer Award 2. Robin Leal Craver, Paul Keough Award 3. Rowland C. Denny, E. Sherman Chase Award 4. Phil Forzley, Committee Service Award

NEWEA RECOGNITIONS

Scholarship Recipients 2019

Undergraduate Student
- Alina Dess
  Northeastern University, Boston, MA
- Stephanie Salerno
  Worcester Polytechnic Institute

Graduate Student
- Charles Spellman
  University of Rhode Island

Student Design Competition
- Margaret Keefe, Kestral Johnston, Marcus Brunelle, and Brendan Curran
  Northeastern University, Boston, MA

Stockholm Junior Water Prize
- Brooks Ferguson and Colin Mulshine
  Greenwich, CT
- Marina Mohawass, Bangor, ME
- Benjamin Dwyer, Holden, MA
- Kavya Phadke Nashua, NH
- Brooke Newbury, Riverside, RI
- Esther Koo, South Burlington, VT

NEWEA acknowledged retiring officers and committee chairs

CHAIR	COMMITTEE
Gregory Kidd	Collection Systems Certification
Raymond Willis	Nominating
Dennis Vigliotte	Sponsor
Paul Casey	Exhibits
Amy Anderson George	Program
Rachel Watson	Contaminants of Emerging Concern
Travis Peaslee	Operations Challenge
Thomas Hazlett	Plant Operations
Natalie Sierra	Residuals Management
Kurt Mailman	Small Community
John Digiacomo	Collection Systems/Water Resources Council Director
Peter Garvey	Collection Systems
Sarah White	Industrial Wastewater
Jennifer Johnson	Watershed Management
Robert Fischer	Government Affairs

NEWEA AWARDS

NEWEA Operator Award

Connecticut
- Todd Wolowicz, Hartford, CT

Maine
- Alex Buechner, Biddeford, ME

Massachusetts
- Michael Delaney, Norfolk, MA

New Hampshire
- Noelle Osborne, Nashua, NH

Rhode Island
- Craig Danella, Coventry, RI

Vermont
- Robert Fischer, Barre, VT

Alfred E. Peloquin Award

Connecticut
- Virgil Lloyd, Manchester, CT

Maine
- Aubrey Strause, Portland, ME

Massachusetts
- John Murphy, Boston, MA

New Hampshire
- Mary Jane L. Meier, Concord, NH

Rhode Island
- Nick DeGemmis, Woodsocket, RI

Vermont
- Christopher Cox, Williamstown, VT

OFFICER	OFFICE
Raymond Vermette	President
Jennifer Kelly Lachmayr	President Elect
Frederick McNeil	WEF Delegate
Justin deMello	MA State Director
Virgil Lloyd	Vice President
Janine Burke-Wells	Past President

NEWEA AWARDS

Operator Safety Award
- Aram Varjabedian, Hull, MA

James J. Courchaine Collection Systems Award
- James Barsanti, Framingham, MA

Paul Keough Award
- Robin Leal Craver, Charlton, MA

Young Professional Award
- Danielle DiRuzza, Chelsea, MA

Public Educator Award
- John Lee, Walpole, MA

Biosolids Management Award
- Greater Lawrence Sanitary District, Lawrence, MA

Asset Management Award
- City of Westfield WWTP
  Westfield, MA

Energy Management Achievement Award
- City of Somersworth WWTP
  Somersworth, NH

Wastewater Utility Award
- Town of East Windsor
  East Windsor, CT

Committee Service Award
- Phil Forzley, Manchester, CT

E. Sherman Chase Award
- Rowland C. Denny, Hartford, CT

Clair N. Sawyer Award
- Paul Dombrowski, Holyoke, MA

Founders Award
- Howard Carter, Saco, ME

Elizabeth A. Cutone Executive Leadership Award
- Ned Beecher, Tamworth, NH

Past President's Plaque and Pin
- Janine Burke-Wells, West Warwick, RI

Upcoming Meetings & Events

NEWEA SPRING MEETING & EXHIBIT
May 31 – June 3, 2020
Fairlee, VT

COLLECTION SYSTEMS CONFERENCE & EXHIBIT
September 10, 2020
Boxboro Regency Hotel, Boxborough, MA

WEFTEC20
October 3 – 7, 2020
New Orleans, LA

NEWEA WEFTEC20 RECEPTION
October 3, 2020
New Orleans, LA

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

GMWEA MEETING & TRAINING CONFERENCE
May 21, 2020
Killington Grand Hotel, Kilington, VT

NWPCA AWARDS BANQUET
May 21, 2020

NHWPCA TRADE FAIR
June 12, 2020
Radisson Hotel Nashua, Nashua, NH

MAWEA GOLF TOURNAMENT,
June 17, 2020
Heritage Country Club, Charlton, MA

CWPAA ANNUAL SEWER OPEN GOLF TOURNAMENT,
June 19, 2020
Skungamaug River Golf Course, Coventry, CT

NEWWA SPRING CONFERENCE
June 22 – 23, 2020
DCU Center, Worcester, MA

CAWPCA SPRING WORKSHOP
June 26, 2020
AquaTurf, Plantsville, CT

NHWPCA ANNUAL GOLF TOURNAMENT
August 6, 2020
Beaver Meadows, Concord, NH

MEWEA FALL CONFERENCE & GOLF TOURNAMENT
September 17 – 19, 2020
Sunday River Resort, Newry, ME

NHWPCA FALL MEETING
September 25, 2020
Franklin WWTF, Franklin, NH

Due to the continually unfolding situation surrounding COVID-19 (Coronavirus), NEWEA and Affiliated State Association events have been postponed and/or are currently under review to reschedule. Stay up-to-date on event dates at newea.org/events/calendar.

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

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

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

New Members November 2019–January 2019

Christopher D Kelley
Portland Water District
Portland, ME (PRO)

Michelle Vuto
EPA Region 1
Boston, MA (PRO)

Cooper Toulmin
CDM Smith
Boston, MA (PRO)

Thalia Aoki
Watertown, MA (PRO)

John M Michalski
Scarborough Sanitary District
Scarborough, ME (PWO)

Gilles St Pierre
Presque Isle, ME (PWO)

Charles W Harrington
Borden & Remington Corp
Fall River, MA (PRO)

John D Kuchinski
City of Lewiston
Lewiston, ME (PRO)

Robert Candor
Brighton, MA (YP)

Craig Danella
Veolia Water North America
Coventry, RI (PWO)

Nicholas De Gemmis
United Water WWTP
Westerly, RI (PWO)

Madison Gleason
Hazen & Sawyer
Middleton, MA (YP)

John Lee
Norfolk County Agricultural High School
Walpole, MA (ACAD)

Jeffery Leonard
Plymouth, MA (PWO)

Alana N Dougherty
Portland Water District
Portland, ME (PRO)

Jotham Lestrade
Massachusetts Water Resources Authority
Winthrop, MA (PWO)

Louis Mingoia
Massachusetts Water Resources Authority
Winthrop, MA (PWO)

Alexander Misiaszek
Windham, NH (PRO)

Brynn Mitchell
Upton, MA (STU)

Jamie Willey
Portland Water District
Portland, ME (POFF)

Robert Nixon
Buzzards Bay, MA (PWO)

Kim Rich
Portland Water District
Portland, ME (POFF)

Evan Raffi
Wakefield, MA (YP)

Kirk Westphal
Brown and Caldwell
Andover, MA (PRO)

Dean Brunt Jr.
West Haven, CT (PWO)

Warren Burnham
LAWPCA
Lewiston, ME (PWO)

Kellie Russell
Hamden, CT (PWO)

James Hall
Swansea, MA (PWO)

Monika Ingalls
Hoyle, Tanner & Associates, Inc.
Burlington, VT (YP)

Brigitte E Parady
Portland Water District
Portland, ME (YP)

Zachariah Lamoureux
Carlsen Systems, LLC.
Pascoag, RI (PRO)

Jason Maskaly
Norwich, CT (PWO)

Christopher Levesque
Metropolitan District Commission
Hartford, CT (PRO)

Lauren Mappa
Bridgeport Water Pollution Control Authority
Bridgeport, CT (PRO)

Katherine Shea
Springfield Water & Sewer Commission
Springfield, MA (PRO)

Brian Blais
Narragansett Bay Commission
Providence, RI (PWO)

Dean Martelly
Narragansett Bay Commission
Providence, RI (PWO)

John Farnsworth
Lancaster, MA (PRO)

Ronan Bates
Lowell, MA (STU)

Alina Dess
Boston, MA (STU)

Maere Dineen
Beverly, MA (STU)

Isabella Cobble
Tighe & Bond
Westwood, MA (YP)

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

Thank you

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- NEWEA Annual Conference
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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

Summer 2020—**Resiliency and Climate Change**

Fall 2020—**Energy Efficiency**

Winter 2020—**Stormwater**

NEWEA/WEF* Membership Application 2020

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

Personal Information (please print clearly)

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

Business Name (if applicable)

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

City, State, Zip, Country

Home Phone Number | Mobile Phone Number | Business Phone number

Email Address

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

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

Employment Information (see back page for codes)

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

3. Focus Area Codes | Other (please specify

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

Sponsorship Information

WEF Sponsor name (optional) | Sponsor I.D. Number | ACQ. Code for WEF use only | WEF 20

Membership Categories (select one only)

		Member Benefit Subscription	Dues
☐ **Professional Package**	Individuals involved in or interested in water quality	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online*	$185
☐ **Young Professional Package**	New members or formerly student members with 5 or less years of experience in the industry and less than 35 years of age. This package is available for 3 years. Date of birth (mm/yy) _____	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online*	$70
☐ **Professional Wastewater Operations (PWO) Package**	Individuals in the day-to-day operation of wastewater collection, treatment or laboratory facility, or for facilities with a daily flow of < 1 mgd or 40 L/sec. License # _____	■ WE&T (including *Operations Forum*) ■ *WEF Highlights Online*	$110
☐ **Academic Package**	Instructors/Professors interested in subjects related to water quality.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *Water Environment Research* (Online)	$185
☐ **Student Package**	Students enrolled for a minimum of six credit hours in an accredited college or university. Must provide written documentation on school letterhead verifying status, signed by an advisor or faculty member.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *Water Environment Research* (Online)	$15
☐ **Executive Package**	Upper level managers interested in an expanded suite of WEF products/services.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *World Water* ■ *Water Environment Research* (Online) ■ *Water Environment Regulation Watch*	$355
☐ **Dual**	If you are already a member of WEF and wish to join NEWEA		$45
☐ **Corporate Membership** (member benefits for one person)	Companies engaged in the design, construction, operation or management of water quality systems. Designate one membership contact.	■ *WE&T* (including *Operations Forum*) ■ *Water Environment Research* (Print) ■ *Water Environment Regulation Watch* ■ *WEF Highlights Online*	$420
☐ **New England Regulatory Membership**	This membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, CT Department of Energy and Environmental Protection, ME Department of Environmental Protection, MA Department of Environmental Protection, NH Department of Environmental Services, VT Department of Environmental Conservation, and RI Department of Environmental Management		$50

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

Payment

☐ **Check or money order enclosed**
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For more information: 781.939.0908
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Depending upon your membership level, $10 of your dues is allocated towards a subscription to the NEWEA Journal.

NEWEA/WEF* Membership Application 2020

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

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

What is the nature of your ORGANIZATION?

(circle one only–required) (ORG)

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

2
Public/Private Wastewater Only

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

4
Industrial Systems/Plants

5
Consulting or Contracting Firm

6
State, Federal, Regional Government Agency

7
Research or Analytical Laboratories

8
Educational Institution

9
Manufacturer of Water/Wastewater/ Stormwater Equipment or Products

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

11
Public/Private Stormwater (MS4) Program Only

12
Public Financing, Investment and Banking

13
Non-profits

99
Other _____
(please specify)

What is your Primary JOB FUNCTION?

(circle one only) (JOB)

1
Management: Upper or Senior

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

3
Engineering and Design Staff

4
Scientific and Research Staff

5
Operations/Inspection Maintenance

6
Purchasing/Marketing/Sales

7
Educator

8
Student

9
Elected or Appointed Public Official

10
Other _____
(please specify)

What are your KEY FOCUS AREAS?

(circle all that apply) (FOC)

1
Collection Systems

2
Drinking Water

3
Industrial Water/Wastewater/ Process Water

4
Groundwater

5
Odor/Air Emissions

6
Land and Soil Systems

7
Legislation (Policy, Legislation, Regulation)

8
Public Education/Information

9
Residuals/Sludge/Biosolids/Solid Waste

10
Stormwater Management/ Floodplain Management/Wet Weather

11
Toxic and Hazardous Material

12
Utility Management and Environmental

13
Wastewater

14
Water Reuse and/or Recycle

15
Watershed/Surface Water Systems

16
Water/Wastewater Analysis and Health/ Safety Water Systems

17
Other _____
(please specify)

Optional Items (OPT)

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

Gender? _____
1 Female **2** Male

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

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

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

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

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