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Contents

On the cover: The Greater Lawrence Sanitary District cogeneration building

Page 59: Measurement unit conversions and abbreviations

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

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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.

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

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

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

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- Download a membership application from **newea.org** by selecting—*Join Us/Become a NEWEA Member*
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2020 RATES ($)

Professional	185
Executive	355
Corporate	420
Regulatory	50
Academic	185
Young Professional	70
PWO	110
Dual	45
Student	15

Water Environment Federation
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President's Message

Jennifer Kelly Lachmayr, PE, BCEE
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Well, here we are six months into life during a pandemic. I know these have been difficult times for everyone in so many different and complex ways. What I am excited about is the energy and positive contributions coming from all of you in the NEWEA community during these most unusual times. As you know, this year's theme for NEWEA is Advocate, Act, Be the Change, and I am so motivated and energized by all the hard work and changes from our committees and NEWEA members. You inspire me. Here are some of the new ideas our committees are working on:

Workforce Development—With the object of teaming with local veterans' programs and underserved communities to engage, educate, and mentor potential water professionals, this initiative is continuing with great effort from Dan Bisson, Peter Goodwin, and Fred McNeill.

Diversity, Equity, and Inclusion Initiative—Hats off to Marina Fernandes, Isabella Cobble, and several others for working to evolve the old Humanitarian Assistance and Grants Committee to reflect the current conversations and needs in 2020. A draft vision is as follows: "The committee's vision is to ensure a welcoming climate for all members, where everyone feels empowered, valued, respected, and safe. Recruiting and retaining a diverse membership is a key priority."

Innovation Committee—This manifestation of our Northeast Water Innovation Network partnership is establishing monthly Reverse Pitch sessions highlighting the needs of New England communities and fostering conversations about how innovative start-ups throughout New England can address those needs.

Contaminants of Emerging Concern and Biosolids/Residuals PFAS Public Outreach Campaign—Janine Burke-Wells (past president) is spearheading this effort. See newea.org/pfas-campaign-partner for more information. Many opportunities exist to join these online programs and discussions.

Sponsorship Committee—Chair Brian Olsen has been working hard with his committee to evolve the sponsors' programs to fit the new digital/ remote world. Also, with a big hand from Mr. McNeill (NEWEA vice president) the sponsors will host a golf tournament on October 13, 2020, in New Hampshire. Many of us participated in the sold-out New Hampshire Water Pollution Control Association tournament in August. It was so wonderful to see everyone (at a distance).

Charitable Giving Task Force—Linda Carroll (past president) continues to engage members and non-members to contribute to this fund, which helps NEWEA secure a healthy future by identifying ways we can reach out beyond our traditional sources of income (memberships, sponsors/ advertisers/ exhibitors and conference/ meeting registrations) to attract financial contributions from individuals and partners.

Kate Biedron Task Force—Work continues to progress through this task force under the stewardship of Meg Tabacsko to develop the program (newea.org/kate-biedron-memorial-fund).

Events—Hats off to the Collection Systems Committee and the Watershed Management, Stormwater, and Sustainability committees for being among the first committees to hold their specialty conferences in the virtual space!

As mentioned in the summer *Journal*, NEWEA is moving all specialty conferences and the Annual Conference to a virtual format. In addition, we are exploring opportunities for online programing and developing programs that work with the new online working schedules. Finally, we are adding live and on-demand training.

So, if you are looking for something different to participate in, please get involved and you too can BE the Change.

From the Editor

The dog days of summer 2020 have brought about a few doomsday-esque scenarios to our world, country, and region (and with region, I'm not talking about Bruins goaltender Tuukka Rask's abrupt absence from the Stanley Cup playoffs). Millions of customers lost electricity from the wrath of Hurricane Isaias. Saturday, September 6, California wildfires caused by a pyrotechnic device gone awry at a gender-reveal party burned over 8,600 ac (3480 ha). Sunday, September 7, was the hottest day ever recorded in Los Angeles County, where temperatures reached 121°F (49.5°C). We remain heavily reliant on resources. This short, non-inclusive list of 2020's calamities points to the underlying need for our planet to reimagine not only the way we use energy but to identify and implement ways to recover and store energy.

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The Journal Committee selected Energy as the focus of this issue. Albeit a broad topic, we, as a committee, were eager to gather and share a highlight reel of the tremendous energy-conscious-centric work being done here, in our region. The first feature article is a triumphant result of harnessing the power of the food–energy–water nexus—all essential for human life, and all interconnected. Amid this pandemic, I know I've been unusually hungry. During the continuous loop of groundhog days, I often look forward to a "special" meal, maybe steak? Hundreds of doctoral dissertations are dedicated to evaluating, quantifying, and dissecting the various forms of energy and water used to produce said steak, but we still consume it. By the same token, electricity "costs" a whole lot of water, and we as an industry know how much expensive electricity goes into producing and treating our waters. These three resource-expensive "bare necessities" are usually discussed separately without note of how closely they relate. The Greater Lawrence Sanitary District has boldly made the connection by accepting food waste as a resource and flipping the script from "treatment and disposal" to "recycle and reuse."

The next feature article discusses implementation of ammonia-based aeration control (ABAC) in Westfield, Massachusetts. As a more advanced parameter-based control strategy compared to the baseline (antiquated) dissolved oxygen control approach, ABAC systems have become an increasingly attractive option at municipal water resource recovery facilities (WRRFs) as ammonia instrumentation technology improves, as effluent nutrient limits become more stringent, and as industry focus increases on saving energy through improved process control. The article highlights the facility's successful pilot study and explains its ultimate decision to implement ABAC as a permanent process control strategy. Another feature article investigates a full-scale demonstration of peracetic acid (PAA) at the Greater Augusta Utility District's wastewater treatment plant (WWTP). PAA has recently received much attention as a potential alternative to hypochlorite or UV disinfection. The District's experience proves that pilot efforts are necessary before adapting an alternative technology. The final standalone feature article suggests various avenues utilities can take to achieve energy neutrality and ultimately generate revenue through energy savings and production.

I had the pleasure of working with the (wait for it) energetic Energy Committee throughout the production of this issue. It was a joy to collaborate with Sharon Nall and her committee. As part of these efforts, the committee wanted to highlight case studies throughout New England to showcase regional facilities and agencies that operate with creatively accomplished energy production and conservation in mind. These case studies include Essex Junction Vermont's WRRF, Peterborough (NH) wastewater treatment facility (WWTF), Plymouth Village (NH) WWTF, South Essex (MA) Sewer District's WWTP, Massachusetts Water Resources Authority, and the Narragansett Bay Commission (RI). The Energy Committee also contributed an impactful Committee Spotlight piece, which features the history of the committee, recent initiatives, and important interdisciplinary efforts.

WEF's *Manual of Practice No. 32 ("MOP-32") Energy Conservation in Water and Wastewater Facilities* was published in 2009. I have worked alongside other energy-conscious professionals in our industry to revisit *MOP-32* by rewriting it from a more current perspective. What's changed from 2009? Considering that 2019 truly feels an eternity ago, I think it's safe to say that plenty has changed over the past 11 years. Many of the themes captured in the new *MOP-32* are reflected within the feature articles and case studies included in this issue.

Industry News

EPA, U.S. Department of Justice, and the City of Manchester have reached an agreement that will reduce sewage from the city's wastewater treatment systems into the Merrimack River and its tributaries

Agreement with U.S. Government, State of New Hampshire to Reduce Water Pollution from Manchester Sewer Systems

EPA and the U.S. Department of Justice (DOJ) announced an agreement with the City of Manchester to significantly reduce sewage from the city's wastewater treatment systems into the Merrimack River and its tributaries. The State of New Hampshire joined the U.S. government as a co-plaintiff on this agreement, which also resolves alleged violations of the Clean Water Act by the City of Manchester.

Under a proposed consent decree filed in the U.S. District Court for the District of New Hampshire today, the City of Manchester has agreed to implement a 20-year plan to control and significantly reduce overflows of its sewer system and thus improve water quality of the Merrimack River. The plan is estimated to cost $231 million to implement. The Merrimack River is a drinking water source for more than 500,000 people, is stocked with bass and trout for fishing, and is used for kayaking, boating, and other recreational opportunities.

"This agreement demonstrates a recognition by all parties of the importance of maintaining our clean waters," said Bob Scott, New Hampshire Department of Environmental Services (NHDES) commissioner. "NHDES looks forward to continuing to work with Manchester, both in terms of financing the projects and ensuring they are successful."

The settlement addresses problems with Manchester's combined sewer system, which, when overwhelmed by rain and stormwater, frequently discharges raw sewage, industrial waste, nitrogen, phosphorus, and polluted stormwater into the Merrimack River and its tributaries. The volume of combined sewage that overflows from Manchester's combined sewer system is approximately 280 MG (1,060,000 m^3) annually, which is approximately half of the combined sewage discharge volume from all communities to the Merrimack River.

Under the proposed consent decree, Manchester will implement combined sewer overflow (CSO) abatement controls and upgrades at its wastewater treatment facilities. These actions are expected to reduce the city's total annual combined sewer discharge volume by around 74 percent, from approximately 280 to 73 MG (1,060,000 to 280,000 m^3).

The two major components of the CSO abatement controls will disconnect Cemetery Brook in Manchester, the largest of the local five significant connected brooks, from the city's combined sewer system. Manchester will design and construct a new 2.5 mi (4.0 km) drain for Cemetery Brook from Mammoth Road to the Merrimack River to convey both the brook's and storm drainage flows. The city will also design and construct projects to separate the combined sewers for areas adjacent to the Cemetery Brook drain. These drainage and sewer separation projects will together address the largest drainage basin in the city and produce the greatest volume of CSO reduction.

The work under the proposed consent decree includes a new drain and sewer separation in the Christian Brook drainage basin, removing the third largest brook from the wastewater collection system. The decree also requires a CSO discharge monitoring and notification program, which will directly measure all discharges from six CSO outfalls estimated to be 99 percent of the city's total CSO discharge volumes. In any case of a CSO discharge, the city will have to provide initial and supplemental notification to the public, including public health departments and downstream communities. Notification will be done electronically, such as posting to the city's publicly available website, and through reasonable efforts to provide other notification.

In addition to the 20-year control plan, the proposed settlement also requires upgrades to improve the handling of solid waste at the wastewater treatment plant to reduce discharges of phosphorous.

In September 2019, EPA issued Clean Water Act permits to the cities of Haverhill, Lawrence, and Lowell, Massachusetts, under the National Pollutant Discharge Elimination System to reduce pollutant discharges from the three wastewater treatment plants and associated CSOs into the Merrimack River at 27 locations across the three cities.

EPA Addressing PFAS in New England

Aggressively addressing per- and polyfluoroalkyl substances (PFAS) continues to be a priority for EPA. EPA's PFAS Action Plan is helping states, tribes, and local communities across the country target PFAS reductions and protect public health.

EPA's New England regional office has been working with NHDES and scientists from EPA's Office of Research & Development (ORD) to help in New Hampshire's efforts related to PFAS contamination in the Merrimack area. In response to a request from NHDES, ORD initiated a project aimed at furthering New Hampshire's understanding of PFAS compounds in the environment as a result of ongoing air emissions from two facilities that use PFAS in their manufacturing processes. EPA has performed research-level analyses on air, water (ground/surface), soil, char, and dispersants, and this information has been used to help inform NHDES's efforts to develop an air permit for one such facility in Merrimack.

In September, EPA will hold a series of "state of the science" webinars and teleconferences for state and tribal partners across New England to provide updates on critical scientific issues related to PFAS.

Background on the PFAS Action Plan—As part of EPA's aggressive efforts to address these risks, the agency issued the PFAS Action Plan in February 2019. The Action Plan is the agency's first multi-media, multi-program, national research, management, and risk communication plan to address a challenge like PFAS. The plan responds to the extensive public input the agency received through the PFAS National Leadership Summit, multiple community engagements, and the public docket. The PFAS Action Plan outlines the processes and tools EPA is using to develop and assess the PFAS risk, and assist states, tribes, and communities in addressing their unique situations.

EPA Releases Financial Impact Tool to Help Water Utilities

EPA released a new tool to help water utilities assess the financial impact of COVID-19 on operations. Throughout the COVID-19 national health emergency—and as communities across the country reopen—water utilities have reliably provided safe drinking water and critical wastewater services. This new tool will help provide important information about the financial and operational health of water utilities, which play an integral role in protecting human health and the environment for our nation.

"It's important for water utilities to understand—as early as possible—how to carry out their responsibilities and plan reinvestment for their communities as local economies start to recover from COVID-19," said EPA Administrator Andrew Wheeler. "This tool will support the financial resilience of water utilities today and into the future by providing in-depth insight into how operations during COVID-19 have affected their financial standing."

"Water utilities and the water workforce have kept vital clean water services operating throughout this challenging time," said EPA Assistant Administrator for Water David Ross. "With this new tool, EPA is encouraging robust financial planning critical to sustaining the water workforce and the infrastructure needed to help protect public health and the environment every day."

Many water utilities expect revenue losses due to reduced commercial consumption, unpaid bills, and deferred or cancelled rate increases. Water utilities also anticipate increased costs for overtime, personal protective equipment (PPE) purchases, and increased demand on customer assistance programs. Developed by EPA's Water Infrastructure and Resiliency Finance Center, the Water Utility COVID-19 Financial Impact Tool leads water utilities through a series of questions to determine how their revenues, expenses, and cashflow have been affected. This tool will help water utilities understand their own financial health as they plan for ongoing operation and maintenance and capital infrastructure needs, including repairing, replacing, and modernizing aging infrastructure.

Note: All EPA industry news provided by EPA Press Office

Building Skills Helps Boost Operators' Knowledge

– Jackie Jarrell, PE, WEF President

Water Environment Federation the water quality people

An updated version of WEF's Skills Builder is available for operators to continue to refresh their knowledge. Here are a few changes:

- Quiz questions contained in fewer screens
- Updated design with easier-to-read text
- Site compatibility with mobile devices

To remain consistent with certifying bodies, all answers to Skills Builder questions follow the standard ABC format. There are no negative question stems (e.g., "Which of the following is NOT true") and no "all of the above" or "none of the above" answer options. All of the questions are related to ABC need-to-know criteria. Also included are references to each question to aid in further study. The prompts will even guide the user to the specific chapter of what book the question references, whether *Wastewater Treatment Fundamentals, Operation of Water Resource Recovery Facilities (MOP 11),* or *Activated Sludge and Nutrient Removal (MOP OM-9).*

The topics in the Skills Builder quizzes cover the knowledge operators must have to keep facilities running, from activated sludge to wastewater characteristics. The student can adjust the quizzes for a chosen skill level (Fundamental, Intermediate, or Advanced) and to include specifics such as whether to test for wastewater or laboratory knowledge. Each 10-question quiz takes about 10 to 15 minutes to complete and offers a chance to review and correct answers before submitting.

A group of dedicated WEF volunteers led the update of Skills Builder and will continue to maintain it. This group of experts will add to the Skills Builder question bank each month. Visit: wef.org/skillsbuilder/.

Remote Operations Challenge Competition

Water Environment Federation the water quality people

Operations Challenge, the high-energy teams-based skills competition that each year draws the global wastewater operations community's best talent to WEFTEC, will take on a remote format for 2020 to coincide with the digital WEFTEC Connect format. Teams of two will compete in abridged versions of the Process Control, Laboratory, and Collections Systems events beginning Monday, October 5.

Via video conference, Operations Challenge teams will compete in each event from their homes or workplaces using their own equipment. All teams will complete Process Control at the same time on October 5 and complete the Laboratory and Collections Systems events at pre-scheduled times over the following days. Event descriptions will be posted on the WEF Operations Challenge page.

Each team must be affiliated with a regional WEF Member Association. Because no WEF Member Associations have been able to hold regional qualifying tournaments this year, each may sponsor as many teams as desired for the WEFTEC Connect competition. This year's competition will feature two new divisions that accommodate first-time competitors as well as Operations Challenge alumni who have not competed in the last five years.

Registration for Operations Challenge 2020 cost $100 per team and was open until September 11.

House Passes NDAA Containing PFAS Provisions

– Contributions from Michael Bradley, WEF Intern

The U.S. House of Representatives on July 21 passed the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 (NDAA). Although the majority of the bill, H.R. 6395, is unrelated to the water sector, several provisions relate to the handling and cleanup of PFAS.

One provision requires the U.S. Department of Defense (DOD) to use a source of funding for PFAS cleanup that is separate from funding for the Military Munitions Response Program. Another provision requires DOD to expand its research base for finding PFAS-chemical alternatives for firefighting foam as well as how to better dispose of PFAS. Additionally, the bill includes several research grants. Other provisions include studying the quality of water and wastewater infrastructure on military bases and authorizing the construction of a wastewater treatment facility in Twentynine Palms, California.

A PFAS-related amendment to the bill was passed in committee. The amendment, offered by Rep. Slotkin (D-MI), required DOD to use the strictest of guidelines for remediation and removal of PFAS. The amendment passed on a party line roll call vote with no defections.

Several provisions also were added by amendments on the floor. Those agreed to by roll call vote are noted below with the vote breakdown:

- #248 proposed by Rep. Levin (D-MI) (with Rep. Tonko [D-NY], Rep. Khanna [D-CA] Rep. Kildee [D-MI], and Rep. Welch [D-VT]) places a moratorium on incineration of PFAS by DOD until the U.S. Secretary of Defense creates regulations for safe disposal
- #481 proposed by Rep. Levin (D-MI) (with Rep. Dean [D-PA], Rep. Posey [R-FL], Rep. Fitzpatrick [R-PA], and Rep. Kildee [D-MI]) requires public disclosure of PFAS testing on military bases
- #583 proposed by Rep. Delgado (D-NY) (with Rep. Speier [D-CA], Rep. Gallagher [R-WI], Rep. Kildee [D-MI], Rep. Welch [D-VT], Rep. Rouda [D-CA], Rep. Dingell [D-MI], Rep. Fitzpatrick [R-PA], and Rep. Pappas [D-NH]) requires manufacturers to disclose all discharges of PFAS over 100 lb (45 kg). It also adds several types of PFAS to the Toxics Release Inventory Program.

The bill was sponsored by Armed Services Committee Chair Adam Smith (D-WA) and named for the retiring Ranking Member of the U.S. House Armed Services Committee, Rep. Mac Thornberry (R-TX) who co-sponsored the bill when it was introduced. The final vote on the bill was highly bipartisan both in votes in favor and votes against; the final tally in the House was 295 yeas and 125 nays.

The House bill is likely to go to conference in coordination with the Republican Senate-crafted version S. 4049, which is being amended in the Senate.

New WEF Handbook Covers PAA Disinfection

Utilities have recognized the value of peracetic acid (PAA) as a wastewater and stormwater disinfectant for years, but limited education and design guidance have impeded its implementation. A new technical publication on the subject, *Peracetic Acid Disinfection: Implementation Considerations for Water Resource Recovery Facilities*, is now available for pre-order from WEF.

Aiming to bridge the PAA knowledge gap, the guide aids disinfection professionals, water resource recovery facility designers, resource planners, and regulators as they evaluate and implement PAA disinfection technologies.

"Over the last decade, peracetic acid has gained significant traction for use as a wastewater and stormwater disinfection technology due to its efficacy, cost efficiency, ease-of-use, and lack of chlorinated disinfection by-product formation," said Philip Block, co-author of the book and a member of the WEF PAA task force. "While numerous peer-reviewed publications exist on PAA and its use for disinfecting municipal wastewaters, there has not been a definitive, single-source guide for the wastewater professional."

The new publication provides a stepwise approach to PAA implementation, design, and regulation. Topics include:

- PAA chemistry and kinetics
- Disinfection byproducts
- Efficacy against contaminants of emerging concern
- Regulatory coordination
- Design and process control considerations
- Best practices for operations and compliance
- Implementation case studies
- Outlook on the future of PAA

Written by disinfection professionals, engineers, PAA manufacturers, regulators, facility owners, and operators with direct PAA project experience, this publication provides much-needed education on evaluating and implementing this technology. Its contents offer practical knowledge through case study examples of both small and large facilities to assist personnel with design, implementation, and day-to-day operations.

Putting the principles of sustainability and resiliency into practice—GLSD's organics to energy project

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ABSTRACT | The Greater Lawrence Sanitary District (GLSD) has developed and implemented an innovative project that captures the core principles of sustainability and resiliency. The project also shows that these are not just aspirational goals but also tangible principles that can be applied on a large scale to create major local and regional benefits. GLSD's Organics to Energy Project takes two materials that have traditionally been viewed as wastes—food waste and wastewater sludge—and converts them to a clean energy source. This energy will, largely, meet the energy needs of the GLSD facility. The project demonstrates the transformation of water reclamation facilities from a mission of treatment and disposal to one of recycle and reuse. As the value of nutrients and organics in wastewater, biosolids, and food waste is recognized and utilized" as a resource rather than a waste product, similar projects will become the norm instead of "cutting-edge. This paper provides an overview of the project, reports the benefits over the first few months of operation, and uses initial results to project this groundbreaking project's long-term environmental, economic, and resiliency benefits.

KEYWORDS | Climate change, resilience, adaptation, resilience planning, resilient design, wastewater utility

PROJECT BACKGROUND

Like many states, the Commonwealth of Massachusetts has banned disposal of food waste by incineration or landfilling. This new regulation resulted from a Solid Waste Master Plan by the Massachusetts Department of Environmental Protection (MassDEP) in 2010. Statewide goals identified in the plan include reducing solid waste disposal by 2,000,000 tons (1,800,000 metric tons) per year by 2020, reducing disposal of organics by 350,000 tons (320,000 metric tons) per year (17 percent of total solid waste reduction goal), and developing infrastructure to support organics diversion processes. A goal of developing 250,000 to 300,000 tons (225,000 to 275,000 metric tons) per year of processing capacity along with supporting organics collection infrastructure was set.

GLSD has long been an innovator in biosolids treatment and energy recovery. It operates one of the few anaerobic digestion facilities in New England with digester gas used as the primary fuel for a thermal biosolids drying operation and building and process heat. GLSD recognized that bans on disposal of food waste presented an opportunity to further its net-zero energy goal for its wastewater treatment facility. These organics can be used, along with biosolids, to augment generation of biogas within the anaerobic digestion facility as a fuel for renewable energy production.

GLSD completed an Organics to Energy Feasibility Study in June 2013 with specific goals in mind. The feasibility study evaluated the viability of expanding the digestion system to allow for co-digestion of biosolids and food waste. It also identified a need to add a new biogas fired cogeneration system to produce renewable energy (both heat and power) for use at the facility. The study found that the installation of a fourth anaerobic digester and utilization of the excess capacity for co-digestion of food waste would improve the facility's resiliency and reduce operating costs. As conceived, the project would greatly reduce or eliminate GLSD's reliance on utility-supplied power. Based on the results of this study, GLSD proceeded with design and construction of the project, with new facilities becoming fully operational in January 2020.

Figure 1. GLSD organics to energy project components

- A Digester #4
- B Waste Gas Burner
- C Digester Equipment Upgrades
- D Radiators and Chillers
- E Organic Waste Receiving Station
- F Organic Waste Receiving Tanks *(below grade)*
- G Organic Waste Pump Station *(below grade)*
- H Cogeneration Building
- I CHP Exhaust Treatment (Oxidation Catalysts & Selective Catalytic Reduction)
- J Siloxane Removal
- K H_2S Removal

THE PROJECT

The project added new infrastructure to allow for acceptance and conveyance of food waste material for co-digestion and use of the additional biogas generated. With the new system, biogas will continue to be the primary fuel for the thermal drying process and for providing digester and building heat. The increase in digester gas will also support a combined heat and power (CHP) system. The project's major elements include the following:

- Organic waste receiving tanks. Two new source-separated organic (SSO) receiving tanks provide approximately 238,000 gal (900 m^3) of storage. A pump/jet nozzle mixing system and SSO pumps mix and transfer the material to an existing sludge blending tank.
- Anaerobic digester No 4. A new 1.4 MG (5.3 ML) digestion tank adds digestion capacity. Similarly to the other three digester tanks, digester No. 4 uses draft tube mixers and a steel gasholder cover.
- Anaerobic digestion ancillary equipment. Additional equipment installed within the digester equipment building supports the new digester, including two digester recirculating pumps, one concentric tube heat exchanger (1.7 MMBtu/hr [1,800 MJ/hr]), and one hot glycol recirculation pump. Space for this equipment was provided in the digester building as part of the original digestion system design completed around 20 years ago.
- Biogas conveyance and waste gas burner. Additional biogas conveyance capacity was added between various biogas treatment systems and points of use, in addition to a second waste gas burner (flare). This allows the biogas conveyance system to handle the significant increase in gas production from SSO co-digestion.
- Hydrogen sulfide and siloxane treatment system. A high level of digester gas treatment is required to protect the CHP engines and exhaust treatment equipment from damage. The biogas cleaning system includes a fixed media hydrogen sulfide treatment system and a carbon media-based siloxane treatment system.
- Biogas pressure boosting. Treated biogas is boosted to between 3.5 and 5.0 psi (24 to 35 kPA) to accommodate the cogeneration engines and digester heating boilers.
- CHP engines. Additional biogas is used in reciprocating CHP generators with a capacity of approximately 3.2 MW. The power produced is fed to the site electrical system and can be net metered back to the utility grid. Heat from the engines and exhaust is captured to supply process and other on-site heating demands. The CHP engines are dual fuel burning engines and can also use natural gas.

Figure 1 shows the general layout for the upgraded biosolids and organics processing systems.

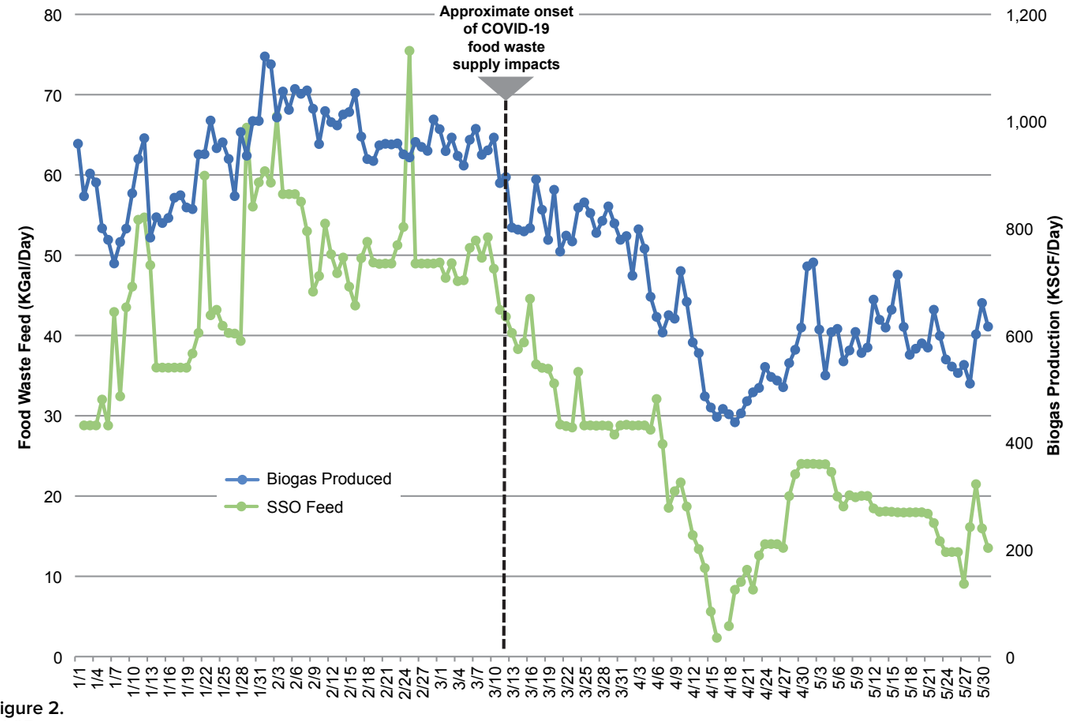

Figure 2. GLSD co-digestion system, 2020 food waste addition and biogas production

The cost to construct and oversee the project was around $31 million. Owing to the project's significant environmental and energy benefits, credits and grants were available to help fund the construction cost of the proposed facilities. Some $5 million in grants and $26 million in State Revolving Fund (SRF) assistance were committed to the project, with grant funding provided by the MassDEP, the Massachusetts Department of Energy Resources, the Massachusetts Clean Energy Center, and National Grid. Additionally, GLSD will receive about $1.6 million in SRF loan principal forgiveness from the MassDEP Clean Water Trust due to GLSD's Environmental Justice designation.

INITIAL RESULTS

Since January 2020, clean energy generated and the associated savings from the reduction of purchased utility power have been impressive, particularly given that many system components were still being optimized during this time. The mid-January to mid-March period was of interest, as regular food waste material deliveries were available following a slowdown over the holiday period and before COVID-related delivery interruptions. Highlights of period include the following:

- A strong relationship between food waste acceptance and increased gas production was shown. Gas production often exceeded 1,000,000 ft³ (28,000 m³) per day based on acceptance of around 50,000 gpd (189,000 L/d) of SSO (reference Figure 2). This is more than 3 times the volume of biogas typically produced prior to initiation of the co-digestion process. The additional biogas allows the CHP system to produce clean energy while maintaining biogas as the primary fuel for on-site thermal drying and the primary fuel for digester heating.
- The CHP system, using biogas as its primary fuel, can fully meet the treatment facility's power needs. Additionally, net metering offsets around 60 percent of the power consumption at the Riverside pump station (RSPS). The RSPS conveys virtually all of the flow to the treatment facility and represents around 30 percent of GLSD's power demand. As SSO acceptance increases, the GLSD treatment plant and RSPS are expected to be fully powered by this renewable energy source (see Figure 3).
- During this period, the CHP system operated at approximately 60 percent of capacity with generator operations limited by food waste availability. As the available supply of SSO increases, both generators should operate regularly, increasing the export of clean energy back to the local utility grid.
- The CHP system's typical recovery of between 4 and 5 MMBtu/hr (4,200 and 5,200 MJ/hr) of thermal energy under the current loading has offset the prior use of heat provided by natural gas-fired boilers to the digestion process and some building spaces. Future growth of SSO co-digestion and expansion of this heat recovery system will provide further opportunities for heat recovery.
- No negative impacts with biogas or Class A fertilizer pellets have been observed as a result of the co-digetsion operation.
- On average, approximately 50,000 gpd (189,000 L/d), or an estimated 210 tpd (190 tonne/d) of food waste organics have been diverted from landfills, with the potential to increase that to 90,000 gpd (341,000 L/d), or an estimated 380 tpd (345 tonne/d), of SSO. This would greatly reduce greenhouse gas emissions from landfills and further the goals of the MassDEP Solid Waste Master Plan.
- While operating as an emergency generator is not its primary purpose, the CHP system can operate during utility power outages; this operation has been successfully simulated in the field. This operational flexibility provides the GLSD facility with additional resiliency to withstand short- or long-term interruptions in utility power supply, provided that the supply of SSO material or natural gas can be maintained.

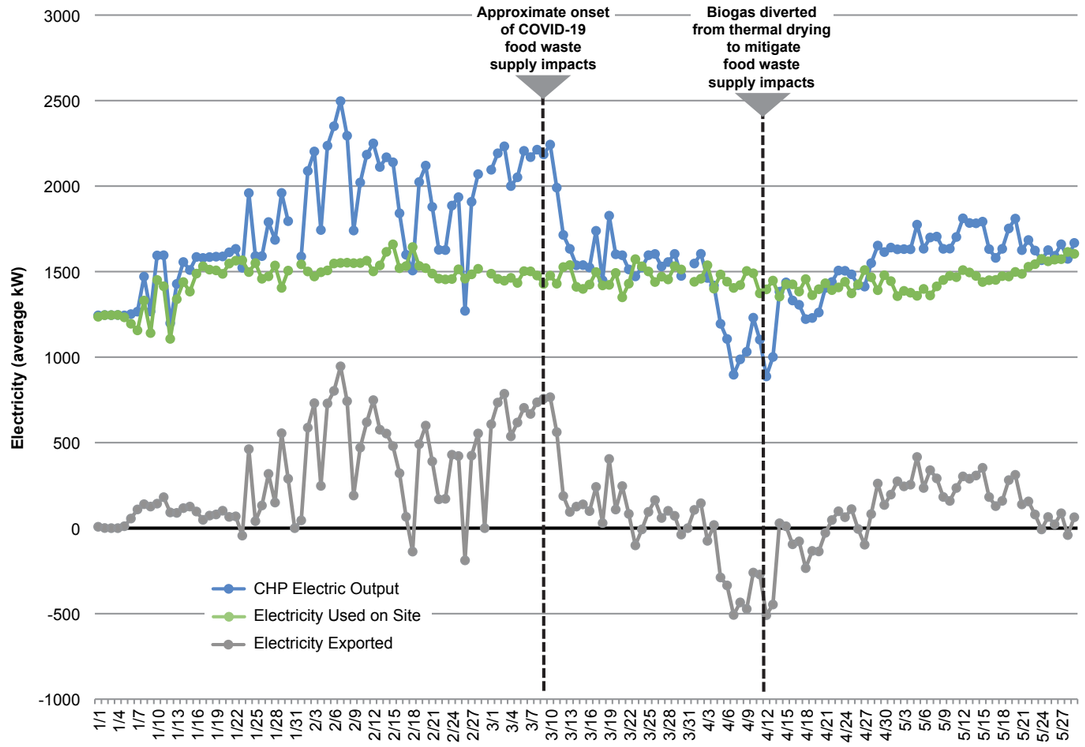

Figure 3. GLSD co-digestion system, 2020 electric power production and export

Figure 4 (next page) provides an overview of the production, use, and export of clean energy (power and heat) realized during the early months of system operation.

In sum, all anticipated benefits of the Organics to Energy Project have been demonstrated during the initial operating period. Some of these benefits are tangible and quantifiable. For example, the Alternative Energy and Renewable Energy credits, combined with meeting the energy demands of the treatment facility and some of the RSPS energy needs, save GLSD more than $2 million annually—while operating at only 60 percent of the CHP system design capacity. Future growth of SSO co-digestion will further expand the ability to export power and yield significant financial net-metering benefits. In other instances, the benefits are less quantifiable but real. Starting the generators and powering the facility during power outages, for instance, provides operational resiliency. By expanding the field of vision traditionally used to scope water reclamation projects, GLSD has developed and implemented a project that addresses not only a short-term need but will provide various long-term environmental, economic, and resiliency benefits to itself and the communities it serves.

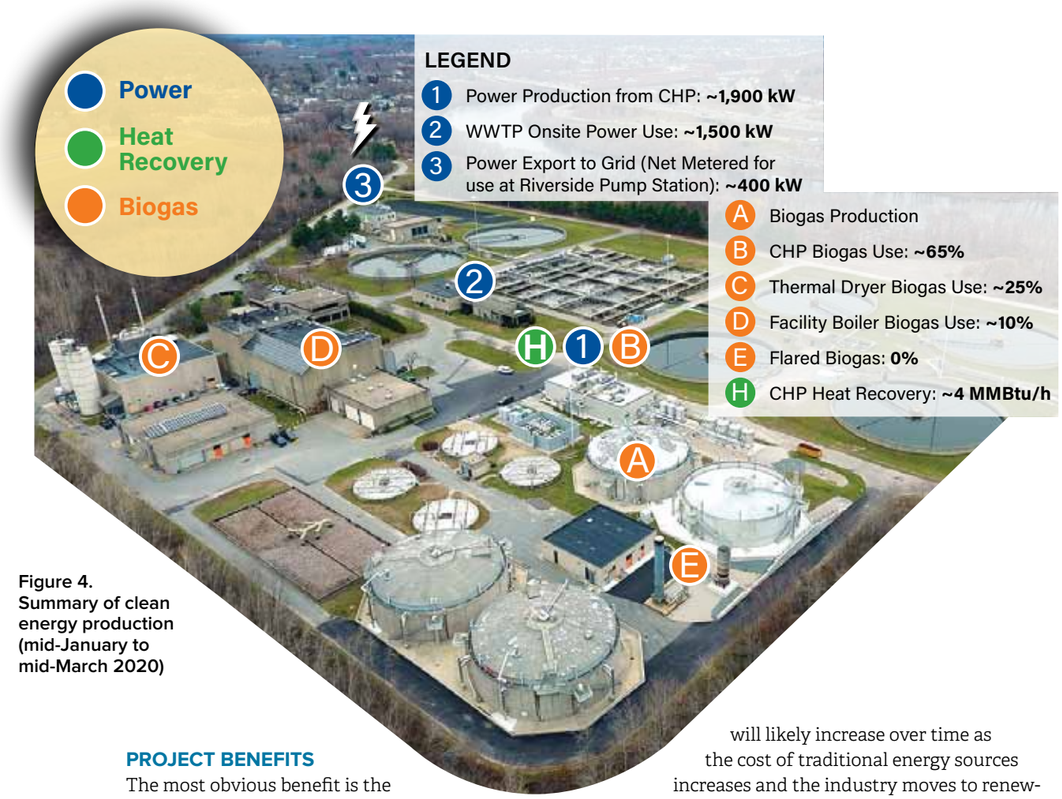

Figure 4. Summary of clean energy production (mid-January to mid-March 2020)

PROJECT BENEFITS

The most obvious benefit is the savings from buying less electricity from the grid. Based on initial operation, the system has proven it can supply enough power to operate the GLSD treatment facility. The system is expected to generate enough clean energy to meet the combined needs of the treatment facility and the RSPS in the foreseeable future—provided the volume of food waste organics is available. This will save around $2.5 million annually based on current energy prices. While the cost savings are the easiest benefits to quantify, GLSD and the region will benefit further from the following:

- Protection against future increases in energy costs
- Greater facility resiliency and operational flexibility, including the ability to use the CHP engines during a loss of utility supplied power (i.e., islanding)
- Ability to provide an important service to the commonwealth and to local businesses that collect and process SSO material
- Greater system reliability, as the additional digester tank volume added as part of this project will make it easier to clean digester tanks
- Major reduction in net greenhouse gas emissions compared to previous organics disposal practices

The project will provide a long-term net economic benefit to GLSD and its member communities that will likely increase over time as the cost of traditional energy sources increases and the industry moves to renewable energy sources. Furthermore, the resiliency benefits will continue to increase in importance as the impacts of climate change and extreme weather events become more pronounced. In these and other ways, the Organics to Energy Project is a model for a smarter, more resilient approach to infrastructure needed to meet the challenges of the next several decades.

ACKNOWLEDGMENTS

GLSD acknowledges the tremendous support and cooperation from MassDEP, the Massachusetts Department of Energy Resources, the Massachusetts Clean Energy Center, and the Town of North Andover in developing this project over the past several years. This support—both financial and otherwise—allowed GLSD to advance the project from an initial feasibility study to preliminary and final design on an accelerated schedule while managing the challenges associated with what is, in many respects, a first-of-its-kind project. Without this commitment to innovation and partnership in advancing the state of the art for sustainable approaches to water quality, energy, and environmental issues, the GLSD Organics to Energy Project would not have been possible.

Biogas is treated for H_2S and siloxane removal prior to beneficial use

ABOUT THE AUTHORS

- Cheri Cousens has been executive director of GLSD since 2014. Before joining GLSD, Ms. Cousens was executive director of the Charles River Pollution Control District in Medway, Massachusetts. This District manages a tertiary, 5.7 mgd (21.6 ML/d) wastewater treatment facility serving the towns of Bellingham, Franklin, Medway, and Millis. She previously was an engineer/industrial pretreatment program coordinator for the District for 11 years and began her career as an environmental engineer for CDM Smith. Ms. Cousens holds a Bachelor of Science in environmental engineering from Wentworth Institute of Technology, and a Master of Science in civil engineering from Worcester Polytechnic Institute. She is a licensed Grade 7-C wastewater treatment plant operator, treasurer for the Massachusetts Coalition of Water Resources Stewardship, and a director of the North East Biosolids and Residuals Association.
- Richard Weare is the capital projects manager of GLSD. He has managed the implementation of all capital projects at the District over the past 20 years, including construction of the anaerobic digesters and thermal drying facility.
- Benjamin Mosher is a vice president and Northeast water services technical delivery manager for CDM Smith in Manchester, New Hampshire. He has 20 years of experience in managing a diverse array of large-scale projects including multidiscipline wastewater treatment facility upgrades, biosolids digestion, and energy recovery. Mr. Mosher is a Professional Engineer in multiple states and an Envision Sustainability Professional. Mr. Mosher managed the GLSD Organics to Energy Project beginning with the feasibility study in 2012 through to completion of the full-scale design and implementation.
- Michael Walsh is a vice president and client service leader based in CDM Smith's Boston office. He has over 30 years of experience in the planning and implementation of major water reclamation and biosolids projects, including application of innovative water reuse, alternative energy, nutrient removal, and energy recovery technologies both in the United States and overseas. Mr. Walsh is a Professional Engineer in multiple states and an Envision Sustainability Professional. Throughout his career, he has been involved with multiple projects for GLSD, including serving as project officer for the Organics to Energy Project featured in this article.

Is ammonia-based aeration control worth the effort?

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ABSTRACT | Ammonia-based aeration control (ABAC) can be successfully implemented at smaller water resource recovery facilities (WRRFs). The authors conducted a pilot test at the 6.1 mgd (23 ML/d) water recovery facility (WRF) in the city of Westfield, Massachusetts, to demonstrate the benefits and impacts of ABAC. The objectives were to quantify the energy savings, understand impacts on biological nutrient removal, identify other process and maintenance impacts, and calculate a return on investment (ROI) of implementing ABAC. The Westfield WRF realized a positive ROI, but this will not necessarily be true for all smaller WRRFs. Importantly, the pilot test reinforced that successful implementation of newer technologies like ABAC needs ownership by the operators and must build on fundamentally sound process operations and control to fully realize the ROI.

KEYWORDS | Ammonia-based aeration control (ABAC), ammonia sensors, energy savings, process optimization, activated sludge, nutrient removal, return on investment (ROI)

INTRODUCTION

Ammonia-based aeration control (ABAC) is advanced process control beyond dissolved oxygen (DO) control for activated sludge systems. ABAC uses real-time ammonia concentration data to control the airflow delivered to aeration tanks. Doody et al. (2017) describe the two types of instruments that measure ammonia in an aeration tank:

- Analyzers using wet chemistry use a pump to withdraw a sample of the mixed liquor from the aeration basin; it is then filtered and analyzed with reagents using a gas sensitive electrode
- Probes using ion selective electrode (ISE) technology are submerged directly in the aeration basin

Various ABAC control schemes are used at WRRFs, including both feed forward and feedback control (Rieger et al., 2014; Doody et al., 2017; Anderson et al., 2018). The specifics of the control scheme can vary. For instance, either the absolute value or the rate of change of the ammonia concentration can be used for control. The ammonia value can control the speed of the blowers directly or can be part of cascaded loop control with DO and/or air flow values.

ABAC's main advantage over traditional DO control is the potential for energy savings. DO is needed to facilitate biochemical oxygen demand (BOD) removal and nitrification. Standard design and operating guidelines suggest a DO concentration of 2 mg/L should be maintained within aeration basins (NEIWPCC, 2016). However, in plug flow reactors, complete nitrification is often achieved for all or part of the day prior to the end of an aeration tank. The same level of BOD removal and nitrification often can be achieved at lower DO concentrations. Further, reducing the DO concentration low enough can slow the nitrification reaction, allowing the full aeration tank volume to be used while sending less air to the system. Monitoring real-time ammonia concentrations in aeration tanks provides more precise process control and reduced risk of effluent permit violations caused by incomplete nitrification (Rieger et al., 2014).

Additionally, lower DO concentrations in aeration tanks can improve biological nitrogen and phosphorus removal by reducing the amount of DO returned to anaerobic and anoxic zones via the return activated sludge (RAS) or internal mixed liquor recycle (IMLR). Lower DO concentrations in aeration tanks can also facilitate some simultaneous nitrification and denitrification. Enhanced denitrification leads to alkalinity recovery and reduced reliance on supplemental alkalinity, lowering the overall carbon footprint of the process.

Maintaining lower DO concentrations in aeration tanks, even for part of the day, can result in net energy savings. Aeration for activated sludge systems typically accounts for 50 percent of energy use at WRRFs (EPA, 2013). Thus, any reduction of air requirements for biological treatment reduces energy use. Real-world applications of ABAC have quantified typical aeration energy savings between 10 percent and 20 percent compared to DO control applications (Rieger et al., 2014; Doody et al., 2017; Anderson et al., 2018). Despite the benefits of implementing ABAC, few WRRFs smaller than 10 mgd (38 ML/d) use ABAC for control within the United States.

A pilot test at the 6.1 mgd (23 ML/d) water recovery facility (WRF) in Westfield, Massachusetts, evaluated potential benefits and impacts of ABAC. The primary pilot test goals were to understand the obstacles of implementing ABAC at a smaller municipal WRRF and to determine whether energy and chemical savings realized at larger facilities would apply to the smaller facility. Specifically, pilot test objectives were to quantify energy savings, understand impacts on biological nutrient removal, identify other process and maintenance-related impacts, and quantify a return on investment (ROI) of implementing ABAC. A grant from Massachusetts Clean Energy Center supported the project.

BACKGROUND

The Westfield WRF serves around 50,000 customers and treats wastewater from residential, commercial, industrial, and institutional sources within the city and neighboring municipality. Average daily flow is approximately 3.4 mgd (13 ML/d), and the design capacity is 6.1 mgd (23 ML/d). The Westfield WRF has 10 operations and maintenance professionals.

Liquid treatment consists of screening, grit removal, primary clarification, activated sludge, secondary clarification, disinfection, and dechlorination. The activated sludge system is configured in three plug-flow aeration tanks. These tanks contain three passes each and were originally designed to be fully aerobic with air supplied via fine bubble diffusers. Solids are thickened, dewatered, and hauled off site for incineration. Figure 1 shows the Westfield WRF.

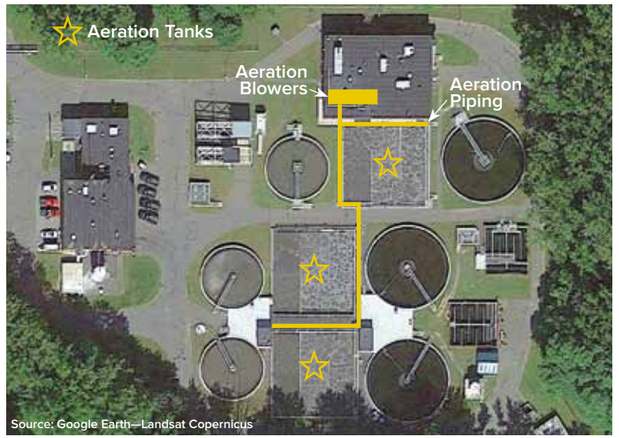

Figure 1. Westfield WRF

Table 1. Summary of NPDES permit limits and 2019 performance

Constituent	NPDES Permit Limits Winter	NPDES Permit Limits Summer	2019 Average Effluent Summer
Biochemical oxygen demand (BOD)	30 mg/L	20 mg/L	5 mg/L
Total suspended solids (TSS)	30 mg/L	20 mg/L	< 5 mg/L
Ammonia (NH3)	Report	3 mg/L	1 mg/L
Total nitrogen (TN)	Report	Report	8 mg/L
Total phosphorus (TP)	1.0 mg/L	0.46 mg/L	0.36 mg/L

The National Pollutant Discharge Elimination System (NPDES) permit limits at the Westfield WRF are more stringent in the summer. Table 1 presents Westfield WRF's NPDES permit limits along with 2019 performance.

The WRF was designed for seasonal nitrification and phosphorus removal via chemical precipitation with sodium aluminate to achieve permit limits. To mitigate the alkalinity loss due to nitrification, the Westfield WRF adds sodium hydroxide (NaOH) to the aeration tanks. To reduce operating costs associated with chemical phosphorus removal, operators converted the first aerobic pass in each tank to an anaerobic zone to promote enhanced biological phosphorus removal (EBPR). Denitrification of the nitrate recycled with the RAS is also achieved.

Blower and Aeration Control Upgrades

In 2016, the Westfield WRF completed a project to right-size its aeration blowers, which were too large, and to improve energy efficiency. Three, 125 hp (93.2 kW), high-efficiency, positive-displacement blowers supply air to the aerobic portions of the

aeration basins. The blowers discharge into a common air header that branches into air supply headers dedicated to each basin.

At the same time, the DO-based aeration control system was updated. Each basin's air header has an automated control valve, air flow meter, and a manual control valve. Each train has an *in situ* optical DO probe at the end of the second pass that measures DO concentration, which is used to control blower speed. The automatic control valves are modulated to distribute the air between the basins based on the DO concentration. The control logic is written with most open valve control, which aims to minimize the system air pressure to save energy. Control setpoints, deadbands, and step adjustments can be changed, and operators monitor performance through the Westfield WRF's SCADA system.

Initial Ammonia-Based Aeration Control Trial

In the late summer of 2017, the Westfield WRF operators added an ion selective electrode (ISE) ammonium probe to the aerobic zone in Train 1. An ISE-style probe was preferred over reagent analyzers because the ISE probes are immersed within the mixed liquor without the need for liquid reagents, which can freeze in winter temperatures. A specific brand of ISE ammonium probe was selected to ensure compatibility with the brand of existing instruments and controllers at the Westfield WRF.

The SCADA programming was updated to include another control loop to raise or lower the DO setpoint based on the probe's measured ammonia concentration. Once nitrification was established in the spring of 2018, the Westfield WRF began to run the system with its updated aeration control scheme based on the ammonia probe measurements. While this period was not part of the official pilot test, it led to several insights, including the following:

- The ISE ammonia probe was initially at the end of the aeration basin (at the end of Pass 3). When the Westfield WRF is fully nitrifying, ammonia concentrations at this location are typically less than 1 mg/L and outside the probe's accuracy range. In the summer of 2018, the probe was relocated upstream to the center of the aerobic portion of the aeration train (at the end of Pass 2) to measure higher *in situ* ammonia concentrations (within the optimum range of the probe) and obtain better ABAC control.
- The Westfield WRF maintains the probes with routine calibrations and has an annual service contract with the probe supplier. Despite these efforts, there have been instances where the accuracy of the probe has drifted. Since the Westfield WRF has only one probe, it was decided to maintain DO as the primary control parameter and investigate permutations of ABAC coupled with DO control to maintain maximum process stability and avoid potential permit violations and deleterious environmental impacts.

Diffuser Upgrades

In March 2019, the Westfield WRF operators replaced the membrane diffusers along the bottom of Aeration Basin 1 to improve overall oxygen transfer efficiency within the system. Because of this upgrade, data from prior years could not be used as a direct comparison for the ABAC pilot testing period.

METHODOLOGY

The ABAC pilot test occurred between June 2019 and October 2019. Testing was divided into two phases: 1) a DO control mode to establish baseline conditions, and 2) the ABAC mode. Operational impacts of ABAC mode at the Westfield WRF were quantified, including DO concentrations, energy use, and chemical use. Additionally, overall nutrient removal performance and other operating and maintenance impacts were tracked during the pilot test.

Baseline—DO Control Mode

The pilot test plan included one month of operation in DO mode to establish a new baseline to compare to the ABAC mode results. Between June 17, 2019, and July 15, 2019, the system was operated in DO control mode with a fixed DO setpoint of 2 mg/L. These concentrations were measured in real time by *in situ* optical DO probes at the end of the second pass in each of the three aeration basin trains and reported to both the SCADA system and the programmable logic controller (PLC)-based DO control system. The SCADA system logged the data continuously while the PLC-based DO control system used the DO concentration in the control loop.

Demonstration—ABAC Mode

Because the Westfield WRF has only one ISE-ammonium probe, it was decided to continue with an ammonia feedback control loop to the DO system rather than use direct control. In ABAC mode, the operator sets an ammonia concentration setpoint via the SCADA system. The ammonia probe measures the ammonia concentration and compares it to the setpoint to determine whether changes in DO setpoints are required. If the ammonia concentration exceeds the setpoint, the system will increase the DO setpoint, and if it is lower than the setpoint, the system will decrease the DO setpoint. Upper- and lower-bound DO setpoints are also programmed into the system.

Throughout the ABAC mode period, tuning parameters for the control system were re-evaluated based on performance. Overall, adjustments were minor and included modifications to the ammonia trim settings and valve adjustment timing tuning.

Data Collection

Throughout the pilot test period, water quality data, probe maintenance efforts, operational parameters, and chemical and energy use were monitored to assess piloted control strategy performance. The data collection plan included the following:

- SCADA system data was exported and analyzed, including real-time ammonia and DO concentrations from the probes, blower speeds, header pressures, valve positions, and airflows
- Influent, primary effluent, and final effluent 24-hour composite samples were monitored for BOD, total suspended solids, total nitrogen, ammonia, and total phosphorus. The samples were analyzed both by a third-party contract laboratory and the Westfield WRF in-house laboratory. Twenty-four-hour composite effluent samples confirmed system performance. Sampling frequency aligned with the Westfield WRF's permit requirements and included daily and weekly collection frequencies.
- Chemical addition quantities of caustic soda and sodium aluminate
- Weekly ISE-ammonium probe cleaning and calibration results
- Operational data such as solids retention time (SRT) and sludge settleability

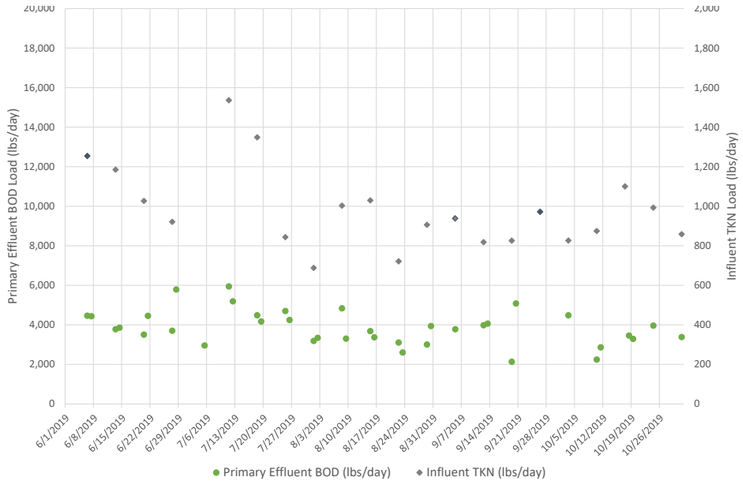

Figure 2. Primary effluent BOD and influent TKN loads during pilot test period

Energy Use

Energy use during each pilot mode was calculated based on Adiabatic principles (see Equation 1).

Operations

Throughout the pilot test period operations were kept consistent by maintaining a stable SRT and keeping a constant number of trains in service. Primary effluent BOD and influent Total Kjeldahl Nitrogen (TKN) sample results remained relatively uniform as shown in Figure 2.

Aeration Tank Profiles

DO concentrations were measured, and grab samples were collected at eight points along the aeration basin and analyzed for ammonia, nitrate, and ortho-phosphate using a spectrophotometer during the pilot test. Figure 3 illustrates the grab sample collection locations along the length of the tanks. The DO and ammonia probes are located approximately in Area 5.

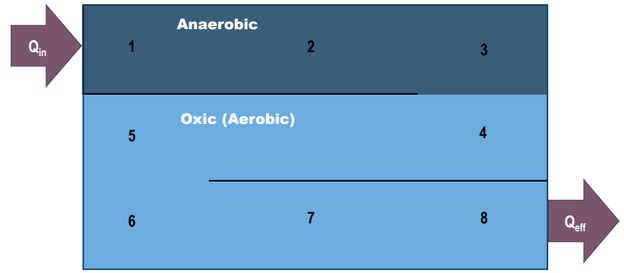

Figure 3. Aeration basin profile grab sample collection locations

Equation 1

$$kWh = brake\ horsepower\ of\ the\ blower * \frac{0.746 \frac{kWh}{hp}}{motor\ efficiency * VFD\ efficiency}$$

Where: motor efficiency = 95% and VFD efficiency = 97% and

$$brake\ horsepower = \left(\frac{CFM * 0.01542 * inlet\ pressure PSIA * \left(\left(\frac{14.7 + header\ pressure\ PSIG}{inlet\ pressure\ PSIA} \right)^{(0.283)} - 1 \right)}{blower\ efficiency} \right)$$

Where: blower efficiency varies between 65% - 70%, and inlet pressure = 14.7 PSIA

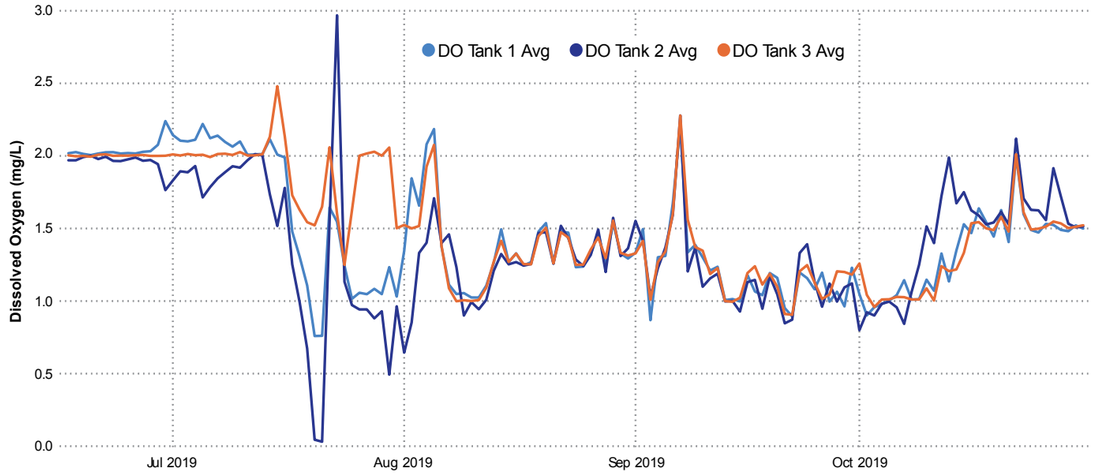

Figure 4. Dissolved oxygen concentrations pilot test period (June 17– October 31, 2019)

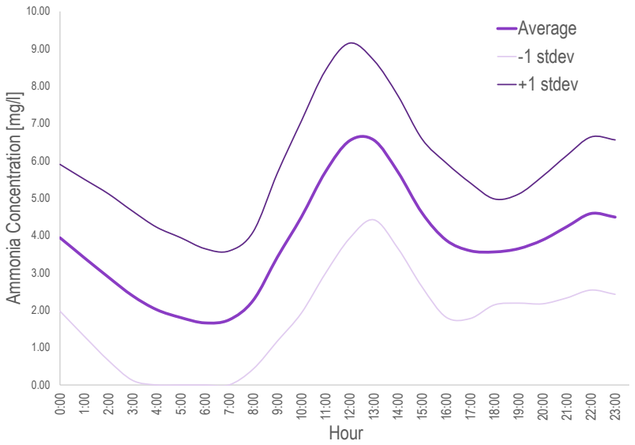

Figure 5. Ammonia concentration trend from probe for September 2019

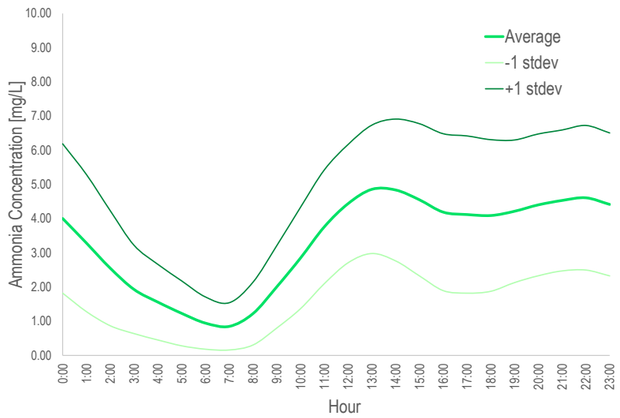

Figure 6. Ammonia concentration trend from probe for October 2019

RESULTS

Unstable Aeration Control Period

Before the start (in mid-July) of the ABAC pilot test period, the quantity of air supplied by the blower was controlled based on average DO concentrations from DO probes in the three trains. As shown in Figure 4, this resulted in variability in the DO concentrations among the trains.

In mid-July, when the DO setpoint was lowered by the ABAC control loop, the differences became more pronounced and resulted in unstable control that negatively affected performance. The Westfield WRF worked with its SCADA contractor to update the control scheme, and the system re-stabilized in mid-August. The ABAC pilot test was restarted on August 12, 2019, and ran through October 31, 2019. DO concentrations averaged closer to 1.4 mg/L in ABAC mode versus 2 mg/L during the DO control mode baseline.

Changing Influent Load Dynamics

A major industrial discharger to the Westfield WRF ceased operations on September 30, 2019. While changes to influent loads based on the Westfield WRF's 24-hour composite samples (Figure 2) were not readily apparent, it did change the dynamics within the aeration basins. Figures 5 and 6 show the average daily ammonia trend measured by the ammonia probe for September 2019 and October 2019, respectively. Because of the lower peak nutrient loading, the ammonia control loop was rarely triggered in October, and the system remained operating primarily in DO control mode.

Therefore, the comparison between DO control mode and ABAC mode was based on the following periods when operational conditions were stable and representative:

- DO control baseline data was collected between June 17, 2019, and July 15, 2019
- ABAC control data was collected between August 12, 2019, and September 30, 2019

Energy Savings

Figures 7 and 8 show the average daily blower energy use during the pilot test baseline period from June 17, 2019, to July 15, 2019 (Figure 7) and ABAC period from August 12, 2019, to September 30, 2019 (Figure 8).

The average daily blower energy use was calculated using Equation 1. The average daily blower energy use was 1,780 kWh for the DO baseline period and 1,510 kWh for the ABAC period.

The DO baseline period comprised 29 days (29 samples), and the ABAC period comprised 50 days (50 samples). Each day is considered an individual sample within the pilot study period. The average daily blower energy use values were compared to determine if they were statistically significantly different using the student's two-sample t-test with correction for unequal sample size, at a significance level (alpha) of 0.05. The actual aeration energy reduction of 15 percent was calculated to be highly statistically significant at the given alpha (the p-value of the test was 4.00 E -8). This indicates that the energy reductions are unlikely to be caused by random variations in Westfield WRF operation and lends credence to the effectiveness of the ABAC operating mode.

Figure 9 shows the average diurnal energy use comparison between the DO control baseline period and the ABAC mode period. Throughout most of the day, energy consumption was lower in ABAC mode. Energy consumption during ABAC exceeded the average of DO control mode for only a short duration in the afternoon when the diurnal peak load was received by the aeration basins. This condition usually persisted for less than three hours.

Chemical Savings

Operating in ABAC mode reduced the amount of sodium hydroxide needed for the secondary process by 20 percent, as shown in Figure 10. Approximately 250 gal (946 L) per day of sodium hydroxide was added during the DO baseline period, and only 200 gal (757 L) per day was added during the ABAC period. However, no savings accrued from sodium aluminate usage as that need was not reduced during the pilot test when the system was operating in ABAC.

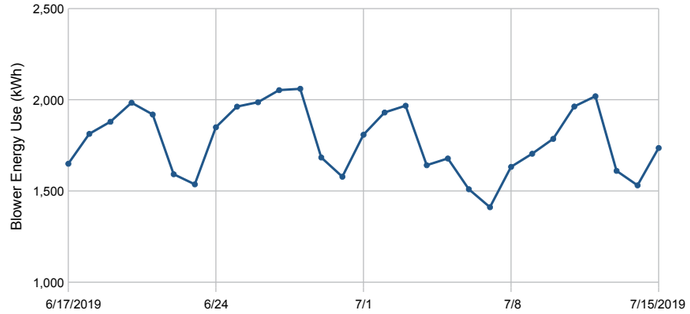

Figure 7. Pilot test baseline, DO control mode—blower energy use

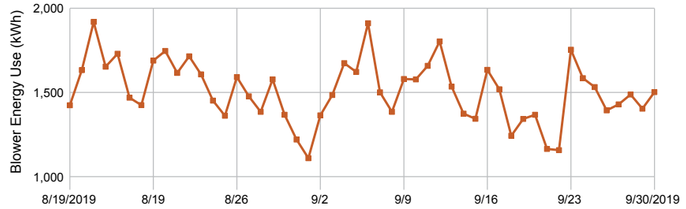

Figure 8. Pilot test ABAC mode—blower energy use

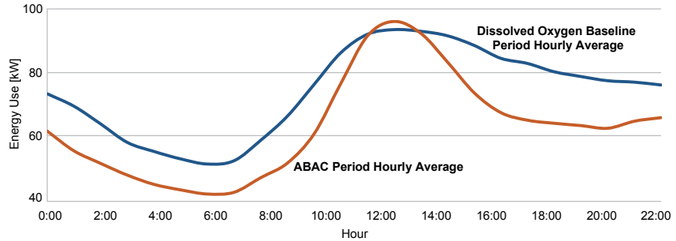

Figure 9. Average blower energy consumption by hour during pilot test periods

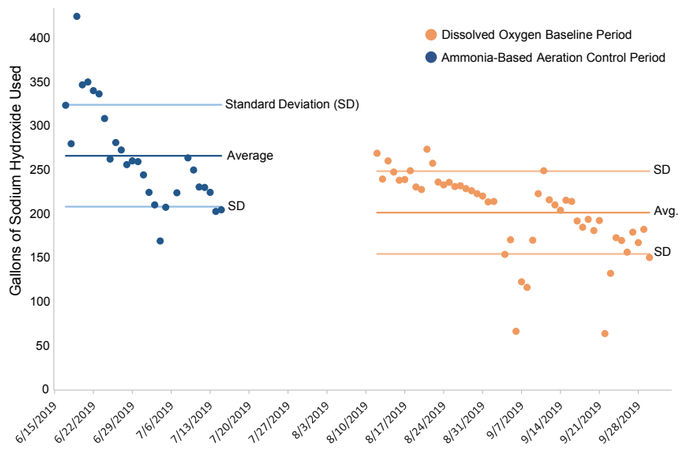

Figure 10. Sodium hydroxide use during pilot periods

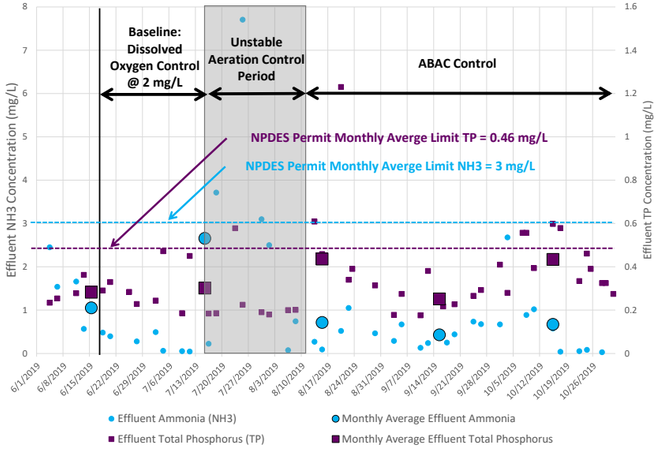

Figure 11. Effluent ammonia and total phosphorus

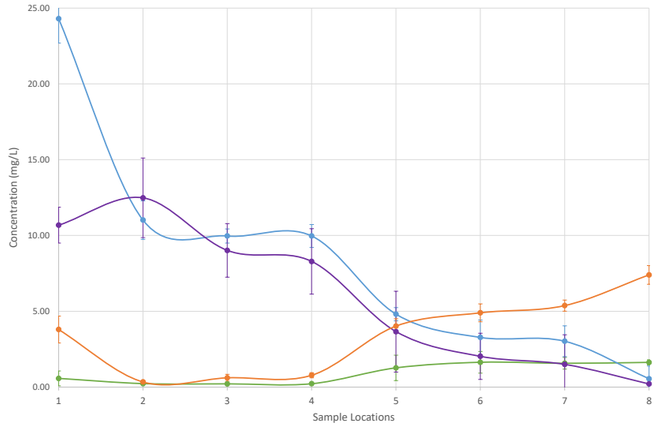

Figure 12. Average pilot test sample location constituent concentrations

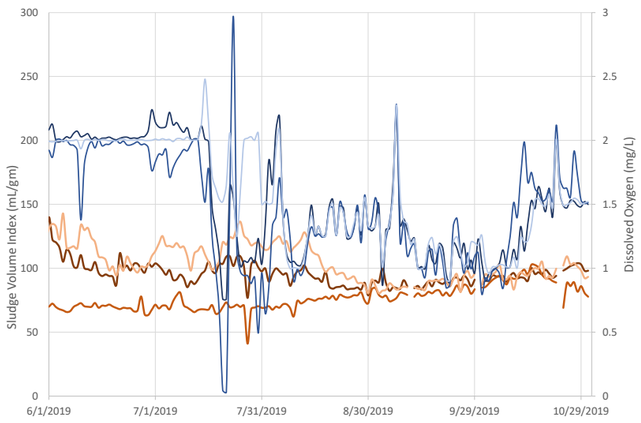

Figure 13. SVI versus dissolved oxygen concentrations in aeration trains

Impact on Nutrient Removal

Twenty-four-hour composite effluent samples confirmed system performance. The Westfield WRF continued to meet its NPDES permit requirements, including phosphorus and ammonia limits, throughout the pilot study, as shown in Figure 11.

Aeration Tank Profiles

Constituent concentration profiles along the lengths of the aeration basins were developed from samples taken on three Monday afternoons: July 1, July 8, and July 15. Figure 12 summarizes the chemical profile results measured within Aeration Basin 1.

Figure 12 illustrates what is expected in this type of nutrient removal system, including a reduction of nitrate (which is returned to the head of the aeration tank in RAS) in Area 1 of the anaerobic zone, phosphorus increase in the anaerobic zone, and low DO throughout the anoxic/anaerobic zone. In the aerobic zone, the concentration of ammonia decreases as nitrate increases, and the concentration of phosphorus decreases.

DISCUSSION

An aeration system energy reduction goal of 10 percent to 15 percent was targeted at the start of the pilot. The pilot achieved this energy savings goal while also meeting the NPDES phosphorus and ammonia permit limits. The actual aeration energy reduction averaged 15 percent. The average DO concentrations while operating in ABAC mode were 1.4 mg/L, while average DO concentrations operating in DO control mode were 2.0 mg/L.

When operating in ABAC mode, the Westfield WRF experienced no major negative impacts on solids handling and the operational mode did not increase odor production. Sludge settleability also remained relatively consistent throughout the pilot. In fact, the sludge volume index (SVI) in the three trains converged following the updates to the aeration control system in mid-August, as shown in Figure 13.

Despite minimal impacts on process performance, the Westfield WRF operators and their pilot test partners collected and analyzed data to confirm how the ABAC process was performing. The Westfield WRF also engaged its SCADA programmers to collect the required data from SCADA and then implement changes to the control scheme based on the data analysis. This learning curve and initial investment during startup and tuning would be expected for any WRRF implementing ABAC (or any new control scheme).

Return on Investment

Table 2 summarizes the ROI for implementing the ABAC pilot test at the Westfield WRF.

The ROI is about seven years and was calculated based on the following:

- Cost of the ammonia probe and replacement parts, calibration, monitoring, and maintenance (The probe was plugged into an existing controller and no additional wiring was needed.)
- Cost of SCADA controls upgrade to incorporate an ammonia loop into the aeration control system, monitoring, and tuning
- Data analysis and pilot test support
- Blower energy use savings
- Chemical addition savings with pH/alkalinity control

When the Massachusetts Clean Energy Center grant amount of $50,000 is credited to the capital cost, the payback period drops to three years.

The ABAC system cost will vary based on the size and complexity of the aeration system (number of tanks, automatic valves and associated flow meters, existing SCADA control logic, and instrumentation). ABAC implementation requires a facility to automatically modulate airflows to the aeration tanks via automatic control valves and blower airflow controls. Facilities without this level of automation already will require an additional investment to put these components into place in addition to the ammonia probes and control logic.

CONCLUSIONS

Based on the results of this pilot test and the calculated ROI, ABAC was successfully implemented at the Westfield WRF. The Westfield WRF plans to continue using the piloted ISE ammonium probe for process monitoring and ABAC.

Staff at the Westfield WRF are passionate about communicating the value of clean water, and they sought to become a local innovation showcase from which other operators can learn and to speed adoption of the ABAC technology more broadly. During the pilot test, the Westfield WRF hosted a successful Poo & Brew on October 16, 2019, which was co-sponsored by NEWEA and the Northeast Residuals & Biosolids Conference. Over 100 young professionals, operators, engineers, equipment suppliers, regulators, students, and public officials, including the mayor of Westfield, attended the event.

These results show that ABAC can be implemented at smaller WRRFs. However, the ROI for every facility will differ. While the ammonia probe is the cornerstone of ABAC, the overall control scheme hinges critically on a foundation of right-sized blowers, a stable aeration control system, and an air delivery system composed of modulating valves, DO probes, and diffusers that can deliver air where and when needed. Westfield WRF already had this foundation in place when it implemented ABAC, but other WRRFs may require greater capital investments. By implementing ABAC, the Westfield WRF also reduced the quantity of sodium hydroxide needed for supplemental alkalinity, a significant factor regarding ROI. A thorough ROI analysis that considers more than just the initial ammonia probe costs and the savings from energy reductions is important.

Table 2. Return on investment for WRF pilot project

Category	ROI
Baseline blower energy use[1]	1,780 kwh/day
Projected energy savings[2]	15%
Fraction of year nitrifying[3]	0.58
Unit electricity cost[4]	$0.125
Energy savings[2]	$7,000
Chemical savings[2]	$10,000
Annual cartridge and maintenance costs[5]	$3,500
Total annual costs and savings[5]	$13,500
Capital equipment/ SCADA cost[6]	$90,000
Simple payback	6.7 years

1. Based on Westfield SCADA Data
2. Calculated based on pilot test
3. Westfield WRF was not designed for year-round ammonia removal and cannot maintain nitrification during cold temperatures in winter. Based on past data, the WRF nitrifies approximately seven months out of the year.
4. City of Westfield
5. Based on current supplier service contract for probe, replacement cartridges, and cost for in-house probe calibration analytical supplies. Labor costs were not included for this project because no additional Westfield WRF staff were required.
6. Equipment and initial installation costs for a new ISE probe and accessories estimated to be $10,000 based on a quote provided by the probe supplier to the City of Westfield on April 20, 2018. One ISE ammonium probe is approximately $7,500. Related mounting equipment, cables, cleaning units, and one-year service warranty are approximately $7,600. Westfield added the probe to an existing controller, and no new conduit/wires were needed. SCADA modifications, data analysis and support during the grant period were based on the ABAC project cost of $75,000.

Toth et al. (2018) developed a methodology to assess control systems for fixed-bed activated sludge systems and found that while an ROI was possible using ABAC, operator skill also affects the ROI. This pilot study reinforces the importance of the operators in implementing ABAC successfully.

Advanced control strategies such as ABAC need ownership by the operators to fully realize the ROI. Westfield WRF operators needed time to become comfortable with maintaining the instruments, interpreting the data, and subsequently fine-tuning and optimizing the control schemes. The ammonia probe requires frequent calibration; Westfield WRF calibrates its probe every week. With buy-in from the operators to closely monitor and optimize their process, and a clear understanding of the fundamentals, similar-sized utilities can take steps that will achieve savings.

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ACKNOWLEDGMENTS

Special thank you to the City of Westfield for its support and assistance throughout this project, specifically Department of Public Works Director David Billips and the Westfield WRF staff. Thank you also to the Massachusetts Clean Energy Center for its grant support and to the Hach Company for its partnership on this project.

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Peracetic acid full-scale pilot study at the Greater Augusta Utility District

PHYLLIS ARNOLD RAND, Greater Augusta Utility District, Augusta, Maine

ABSTRACT | The Greater Augusta Utility District in Augusta, Maine, serves five cities and towns, operating an 8.0 mgd (30 ML/d) pure-oxygen, biological secondary treatment wastewater plant. For its permit-required seasonal effluent disinfection, the facility uses 12.5 percent sodium hypochlorite for effluent disinfection and 40 percent sodium bisulfite for effluent dechlorination. A renewal of the Maine Pollutant Discharge Elimination System permit lengthened the required May 15 to Sept 30 disinfection season to range instead from April 15 to October 31. Given concerns regarding crystallization of sodium bisulfite in chemical transmission lines during the colder portions of the revised disinfection season, the District began researching disinfection alternatives. One suggestion, provided by the District's Maine Department of Environmental Protection inspector, was peracetic acid (PAA). This article describes the steps leading to and the conclusions arising from a pilot study exploring the PAA alternative at the District facility.

KEYWORDS | Disinfection alternatives, chemical crystallization, peracetic acid (PAA), pilot study

INTRODUCTION

The Greater Augusta Utility District serves 4,828 wastewater customers in the communities of Augusta, Hallowell, Winthrop, Manchester, and Monmouth, Maine, via 142 miles (229 km) of piping, 13 pump stations, and 4 trunkline stations. The District operates an 8.0 mgd (30 ML/d) pure-oxygen, biological secondary treatment wastewater plant in Augusta, Maine. In 2019, the average secondary treatment flow was 5.0 mgd (19 ML/d), and the average primary-only treated flow was 5.8 mgd (22 ML/d)—primary-only treatment occurs only on occasions when that portion of plant flows exceeds the secondary system maximum of 12 mgd (45 ML/d).

The wastewater treatment plant generates pure oxygen for mixed liquor aeration in a covered reactor, has two 0.12 MG (0.45 ML) primary clarifiers, one 0.26 MG (0.99 ML) primary clarifier, and three 0.38 MG (1.44 ML) secondary clarifiers. The clarifiers can be taken in or out of service based on influent flows or maintenance needs. The District has a high-rate disinfection tank that treats that portion of the flow needing to be bypassed around the secondary system during excessive flow—influent flows above 12.0 mgd (45 ML/d).

The District uses 12.5 percent sodium hypochlorite for effluent disinfection and 40 percent sodium bisulfite for post-disinfection dechlorination.

COLD WEATHER DECHLORINATION CONCERNS

The District's renewed Maine Pollutant Discharge Elimination System (MEPDES) permit will reflect a revised disinfection period that includes "shoulder seasons." The new permit includes a disinfection season from April 15 to October 30. The former disinfection season was May 15 to September 30.

Average low temperatures in 2017, 2018, and 2019 for Augusta, Maine, from April 15 to October 31 ranged from 31.4˚F to 41.4˚F (-0.3˚C to 5.2˚C) (National Weather Service, Gray, Maine). An internet search of safety data sheets for 38 percent to 40 percent sodium bisulfite showed freezing points of 39˚F (3.9˚C) (Anderson Chemical Co, Litchfield, Minnesota) and 43˚F (6.1˚C) (Anchem, London, Ontario; Southern

The Greater Augusta Utility District's wastewater treatment plant

Ionics, Westpoint, Mississippi; Water Guard, Inc., Wilson, North Carolina). As the temperature of the chemical lines approaches 40˚F (4.4˚C), there is a growing risk of sodium bisulfite freezing and clogging lines, and "frozen" sodium bisulfite solution cannot generally be restored to liquid by simply re-warming the resulting crystals.

Given concerns about crystallization of sodium bisulfite in chemical transmission lines during the colder portions of the revised disinfection season, the District began researching disinfection alternatives. One suggestion, provided by the District's Maine Department of Environmental Protection (DEP) inspector, was peracetic acid (PAA).

PERACETIC ACID

PAA is a strong disinfectant that has been used for years in the food processing and water treatment industries. A clear, organic peroxide compound, it breaks down into acetic acid (vinegar) and hydrogen peroxide in water. As such, PAA introduces varying amounts of acetic acid into the wastewater effluent. This can increase the oxygen demand (BOD5 or CBOD5) in the effluent and may not be appropriate for systems already having BOD5/CBOD5 compliance problems. EPA approves the use of 15 percent and 22 percent PAA for wastewater disinfection.

PAA disinfection is unaffected by nitrite and ammonia concentrations. The Anson-Madison wastewater treatment plant (Madison, Maine), a lagoon wastewater treatment system experiencing high sodium hypochlorite demand due to nitrification problems, used PAA in place of sodium hypochlorite with great success. Discussions with Anson-Madison confirmed PAA was effective and showed little impact on its effluent CBOD5 results. The only drawback was the high cost; however, given the low amount needed there and the declining price of PAA, Anson-Madison determined the benefits outweighed the costs.

BENEFITS AND CHALLENGES OF PAA DISINFECTION

An EPA draft report entitled *Innovative Technology Assessment: Use of Peracetic Acid for Disinfection of Municipal Wastewater* lists the following benefits and challenges of PAA in wastewater disinfection, reflecting the experience of nine wastewater treatment plants:

Benefits

- PAA does not produce chlorinated disinfection byproducts (such as trihalomethane)
- PAA is an effective, consistent bacterial disinfectant despite varying wastewater influent characteristics
- Often, no chemical quenching (think "dechlorination") is needed to reduce PAA residual in treated effluent
- Effluent disinfected with PAA may be less toxic than chlorine-treated effluent, or at least the toxicity can be more easily controlled because residual PAA dissipates quickly
- PAA works well with wastewater UV disinfection

Challenges

- Maintaining adequate PAA residual in the contact basin and subsequent conveyances was difficult due to its quick dissipation, which could result in algae growth in these basins and conveyances
- Biochemical oxygen demand could increase in discharged effluent
- PAA solutions have a strong vinegar-like odor
- Compatible storage and piping materials are needed due to PAA's reactivity with certain materials
- PAA in-stream analyzers had to be cleaned daily or were taken offline due to algae growth
- Wastewater effluent appeared discolored or murky due to lack of "bleaching effect" when using sodium hypochlorite
- Algae growth in chlorine contact chambers (CCCs) due to the presence of acetic acid increased the CCC cleaning schedule

Chief Operator Jane Carroll transfers PAA totes to an onsite storage location

PAA chemical feed system

- Long permitting processes/stringent limits may be required by state environmental agencies
- State environmental agencies may raise concerns because there is no EPA-approved PAA test method

EFFICACY STUDY

The District collaborated with a nationally recognized chemical services firm to implement a three-month, full-scale pilot study using 22 percent PAA for effluent disinfection. The District favored an off-season pilot study so the pilot could be run full-scale and not interfere with the operation of the plant during the permit required disinfection season.

In September 2019, the District sent an unchlorinated effluent sample to the chemical firm for an efficacy study. The efficacy study was run to determine the dosage of PAA needed for effective disinfection. The study's recommended dose of 22 percent PAA was 2 mg/L with a minimum 40-minute contact time.

Pilot study expenses—full-scale peracetic acid pilot study*

Item	Unit Price	Ext. Price
Peracetic acid, 22%—Three, 330 gal totes	$18.07/gal@990 gal	$17,889.30
Coliform detection media packets	$7.25/pk@15 pks	$108.75
Peroxide test strips	$76.12/pk@1/pk	$76.12
Efficacy study—shipment of samples to California (est)		$300.00
Subotal Chemical and Analytical Expenses		$18,374.17
Chem supplier three-month trial equipment expenses:		
Shipment/return of equipment	$3,000.00	$3,000.00
Installation, setup, calibration	$3,000.00	$3,000.00
Equipment maintenance	$2,000.00	$2,000.00
Subotal equipment expenses		$8,000.00
Total Pilot Study Expenses		**$26,374.17**

*Expenses do not include District staff time.

FULL-SCALE PILOT STUDY

The District expected the pilot study to produce the following outcomes:

- No PAA residual in final effluent; therefore, no removal of residual ("quenching") with sodium bisulfite necessary
- No sodium bisulfite required (elimination of chemical freezing concerns)
- Chlorine-based disinfection chemicals eliminated; good for the environment
- Work with only one disinfection chemical, lessening process complexity and increasing safety
- Compliance with all effluent limits, including CBOD5 and *E. coli*
- Benefits would justify the costs

The PAA arrived onsite in 330 gal (1250 L) totes in early December 2019. The vendor's PAA flow-pacing equipment was tied to the District's effluent flow meter; however, this setup caused the effluent flow meter to malfunction, so the vendor's equipment was disconnected. Subsequent attempts were made to re-establish a connection, but this continued to be a problem. On January 6, 2020, the District commenced manually feeding PAA into the CCC on Monday through Friday. To conserve the costly PAA, the District shut off the feed over the weekends.

DATA GENERATION

PAA and hydrogen peroxide grab sampling coincided with the District's normal effluent compliance sampling schedule. The District used a benchtop chlorine analyzer and the analyzer manufacturer's patented reagents and methods for PAA testing. PAA tests differed from the routine total chlorine residual tests in two ways:

Expectations versus realities—following the study, the District compared its expectations to the realities of the pilot study

Expectations	Realities
No PAA acid residual in effluent	PAA residual in effluent raised concerns over future Maine DEP permit limits.
Elimination of sodium bisulfite = no chemical freezing concerns	Quenching residual PAA in effluent would require the continued use of sodium bisulfite.
Elimination of chlorine-based disinfection chemical and resulting effluent byproducts	PAA would eliminate chlorine disinfection byproducts in effluent.
Work with only one disinfection chemical	Sodium bisulfite would still need to be used with PAA.
Compliance with all effluent limits	PAA did not increase CBOD5 concentrations. PAA was effective as a bacterial disinfectant.
Benefits justify expenses	High cost of PAA versus sodium hypochlorite, added to the continued cost for needed sodium bisulfite, failed to reduce chemical expenses. Maine DEP would require costly whole effluent toxicity (WET) tests (estimated to cost $7,700 per WET test in 2019) in the first, second, and third quarters of the first year PAA is in use.

1. Instead of a three-minute waiting time after mixing the reagent with the sample, it was analyzed immediately
2. The result displayed on the analyzer screen had to be multiplied by a factor of 1.07 to obtain the PAA result

PAA use was suspended during most of February to conserve it until the vendor successfully installed compatible flow-paced chemical feed equipment. This suspension resulted in a minimal set of data for February (n=4). The flow-paced chemical feed equipment was successfully installed in late February.

Hydrogen peroxide analyses were conducted using test strips and a color comparator. A more robust and exacting test method exists, but the District's intent was to easily achieve a ballpark result and conserve staff time on the pilot study. Because the District's effluent clarity was very good, no visual interferences (cloudiness, color, particulates) affected the color comparator results. Intra-laboratory color comparator interpretations showed agreement among the analysts.

An average of 0.93 mg/L PAA residual was detected in the effluent grab samples (n=23). Toward the end of January, the District began recording the current contact chamber detention times whenever PAA grab samples were collected. The trending data showed that the reduction of PAA across the CCC was inversely affected by detention time and unaffected by changes in effluent temperature, pH, or CBOD5. Most *E. coli* results were within the District's daily maximum limit of 427 cfu/100 mL.

CONCLUSIONS

The District's staff were optimistic following initial research on using PAA for effluent disinfection. The exciting financial prospect was the potential for cost savings over current methods. The potential to reduce aquatic toxicity and eliminate chemical freezing concerns and disinfection by-products drew much interest from Maine's regulatory and wastewater treatment communities.

The chemical services firm estimated a total PAA use of between 5,778 and 10,000 gallons (22,000 L and 38,000 L) or 18 to 31 totes for the District's three-month trial. The cost for that quantity would have been prohibitive at between $107,336 and $184,856 for the 18 to 31 totes. Comparatively, in 2019 the District's cost for sodium hypochlorite and sodium bisulfite used in the CCC and the high-rate disinfection tank (used only during high flow events) for effluent disinfection and dechlorination was $19,488 for the entire year. To reduce the cost of the pilot, the District chose to run a more limited trial using only four totes (one tote was free).

While PAA can be an attractive alternative to chlorine-based disinfectants, the full-scale trial results at the wastewater treatment facility showed that the change in disinfectants would not be practical for this facility. PAA proved to be far more expensive than sodium hypochlorite, and it would not eliminate the need to use sodium bisulfite for effluent quenching.

ABOUT THE AUTHOR

Phyllis Arnold Rand is a Maine Grade 5B wastewater treatment plant operator and a Maine Class 2 drinking water operator. Her 31-year wastewater career includes work at two wastewater treatment facilities performing water quality monitoring and a position at Maine DEP where she was a wastewater permit writer. She is a NEWEA past president and former chair of the NEWEA Laboratory Practices Committee. She is currently employed as the water quality coordinator for the Greater Augusta Utility District in Augusta, Maine.

Revenue generation at wastewater treatment facilities through energy savings and production

JENNIFER MUIR, PE, JKMUIR, LLC, Rocky Hill, Connecticut

ABSTRACT | In times of tightening budgets and rising expenses, techniques for effective management of electrical usage can often be strategically utilized to lower operational costs, access government funding and utility incentives to support process upgrades, and even to generate ongoing revenue streams for water resource recovery facilities. Incentive and grant programs are available throughout New England, and careful leveraging of these funding sources, coupled with strategic manipulation of energy-intensive equipment and on-site power resources, can reduce capital and long-range costs while enabling timely plant equipment improvements. With available high-efficiency equipment and improved renewable source technologies, energy neutrality is no longer an unreachable goal, and with some ingenuity and forethought, instead of being major energy liabilities, facilities can become positive energy resources.

KEYWORDS | Electrical grid, energy savings, incentives, demand charges, load reduction, onsite generation

Evolving energy markets have created numerous avenues for generating revenue and bringing back much needed funds into water resource recovery facilities (WRRFs). Cost savings through energy reduction and on-site generation can be achieved through both low cost measures and larger capital investment projects. State and utility funding programs throughout New England can reduce capital project costs in reducing energy and improving electrical generation. This article will discuss alternative revenue streams and strategies to leverage energy conservation, electrical demand control, and renewable power projects at WRRFs.

Many WRRFs have explored energy efficiency to reduce energy usage. Finding and incorporating opportunities for energy conservation is the first step in reducing operating costs. The savings can then be repurposed toward future upgrades and asset replacement. Although large energy-efficiency projects can require creative and detailed solutions and thereby require a heavy financial investment, evaluation of unit processes and controls can reveal prospects for low-cost and even no-cost energy savings. These can include adding instrumentation, upgrading controls, adjusting set-points and parameters that minimize equipment run time, reducing operating pressures, cycling mixers, and optimizing ventilation rates.

In a recent pump station project in the Midwest, every 1 ft (0.3 m) increase in the wet well level elevation had the potential to generate $40,000 in annual energy savings. Before optimizing a system or experimenting with set-point adjustments, contacting the electric utility may be helpful. Strategic energy management at many utilities has given rise to incentive programs focused on operational adjustment—meaning that grant funding could be provided even if the project has little to no implementation cost! These incentives may not be as high as those offered for more capital-intensive projects but are still worth pursuing to increase revenue from the utility as a payment or credit on an electric bill. Most WRRFs are both eligible for and encouraged to pursue this financial benefit, since they pay into these energy conservation funds monthly on their electrical bills.

Major plant upgrades that require significant capital investment are an excellent opportunity to use electric utility incentive programs, which reward the selection of higher-efficiency equipment. Premium-efficiency HVAC and lighting have traditionally qualified for these programs. Other unit processes have also qualified and have been used to offset costs to implement variable speed pumping, aeration blowers, enhanced dissolved oxygen control, anoxic mixers, plant water systems, jockey pumps, mixed-liquor return pumps for nutrient removal, UV systems, odor control, and sludge handling. New England WRRFs that have taken advantage of major plant renovation to receive energy-efficiency incentive funding include Stamford ($400,000), Torrington ($300,000), and Southington ($220,000) water pollution control facilities (WPCFs) in Connecticut, and Marlborough WPCF ($170,000) in Massachusetts.

Key to obtaining this funding is quantifying the energy savings associated with facility upgrades and process modifications. A comprehensive energy audit is an excellent starting point for understanding baseline energy loads across the plant and identifying both low-cost operational adjustments and more capital-intensive improvement projects that reduce operating costs.

Data collection is crucial for a comprehensive audit. Both electrical demand readings and "stranded" data, such as flows and pressures, that are not available on SCADA or through installed metering, are needed. This field analysis can reveal wire-to-water efficiencies and quantify savings from the improvements. This is particularly true for pump systems, which, along with blowers, use the most energy at most WRRFs, due to high horsepower and continuous operation. Pump wear, ragging, sizing, and control issues can all be identified through field monitoring equipment, informing decision-making about pump replacement, rebuilding, maintenance, operation, and life cycle cost.

Most pump and blower systems include multiple units, with operation rotated to equalize run hours. Substantial discrepancies can, however, occur in the operating efficiency of individual units. For example, three identical aeration blowers installed at the same time were field tested for efficiency at a New England WRRF, with efficiency ranging from 58 percent to 71 percent. The variability provided direction on which units to run. With one blower typically in operation at a time, the recommendation was to maximize use of the two blowers with higher efficiency while minimizing the poorer performing unit. Making this operational change resulted in 500,000 kWh of savings annually, or about $90,000 in operating cost, which could then be used to replace or refurbish blowers.

Another opportunity to adjust operation and reduce cost is to interpret and optimize equipment operation, considering the complex electrical rate structures under which most WRRFs are billed. Although they can require time and effort to understand, specific charges to look for include on- and off-peak charges and demand charges. On-peak charges usually occur in daytime and are generally more expensive than off-peak charges (as they are intended to incentivize usage during lower grid demand periods). The demand charge is typically measured in kilowatts or kilo-volt-amperes and represents the facility's highest average 15- or 30-minute energy usage during the month. Demand-related charges have accounted for 20 percent to 40 percent or more of the total electric bill for water and wastewater facilities. This explains why some conservation measures that reduce usage (kilowatts per hour) may not provide as much on-bill savings as expected. Understanding these charges can reveal opportunities to operate equipment at different times of the day or manage peak demand to minimize on-peak and demand charges.

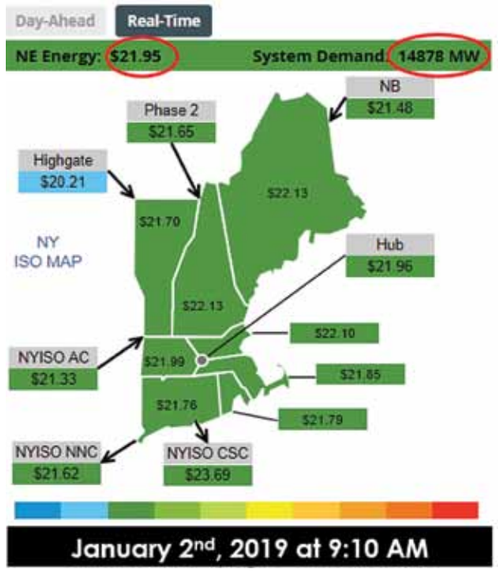
A Connecticut drinking water pump station implemented an operational strategy that took advantage of the billing rate structure, focusing pump run time during off-peak hours. Table 1 shows the charges at the facility.

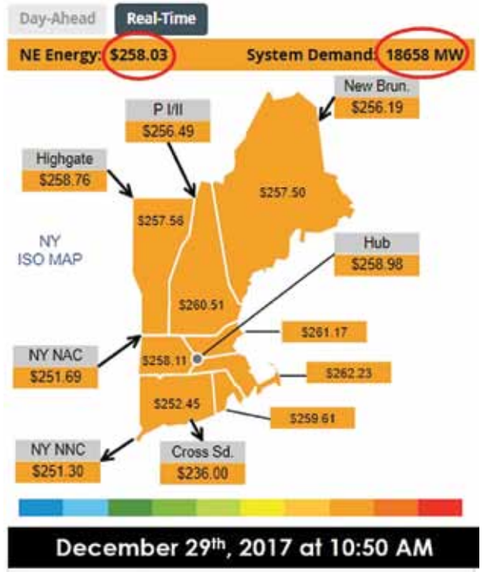
Table 1. Pump station case study electrical

Usage per Month	Off-Peak Cost	On-Peak Cost
16,535 kWh	$0.01181/kWh	$0.0466/kWh
81.5 kW	$0/kW	$16.96/kW
Total per Month	**$195**	**$2,153**

Operating the pumps during off-peak hours saved $1,958 per month, or $23,496 annually. While not all pump stations can fluctuate operation in this manner, an energy management strategy that reflects the billing rates provides a quick financial win, without investing in new equipment.

Another electrical charge is the installed capacity (ICAP) tag. This charge is based on a facility's coincident demand—a facility's peak demand recorded during the ISO New England (ISO NE) annual system peak hour of the previous year. ISO NE is the New England entity that manages demand on the electrical grid. The ICAP charge may show as a separate line item on your electrical bill, or it may be bundled with other supply/generation charges. Because the demand during this system-wide peak affects billing for all of the following year, significant savings can be realized by reducing power consumption during this one short period. Programs are available that can help to predict the ISO NE peak





Figures 1a and 1b. ISO NE website screenshots

hour and notify customers of when to reduce peak loads to avoid unnecessarily high ICAP charges.

Developing an energy-based revenue stream can also be achieved through demand response programs, strategic battery usage, and renewable energy generation including solar, combined heat and power (CHP), and hydropower.

ISO NE continuously monitors the demand of the New England electrical grid, and the cost of electricity is updated every five minutes based on the power market. Figure 1 shows time-specific maps from the ISO NE website, where the real-time market conditions can be viewed.

As shown in Figure 1, the demand on the system and cost per megawatt of electricity varies greatly with both seasonal and daily load conditions. Higher load on the system requires increased use of older and less-efficient power generation plants that often cost more to operate. This typically occurs during peak hours each day from late morning to early evening. For this reason, there is a strong push to reduce and stabilize the load on the grid throughout the day, and financial incentives are available for facilities that can respond to these market conditions.

Initiatives to reduce load on the regional grid are utility and ISO led demand response programs. Facilities that enroll in these programs are notified of upcoming high grid demand and can choose to reduce their load during these events. Compensation is provided for participation, and payments are based on actual load curtailment achieved by turning off ancillary or non-critical equipment or switching to on-site generation of electricity.

Figure 2 presents the kilowatt load of a WRRF in Connecticut and the reduction achieved during a demand response event.

By reducing the load on the facility by 2,000 kW for over an hour, the facility received $80,000. Since the demand response program has been in place at this facility, it has received more than $180,000 in incentives for demand reduction in under two years.

Battery storage is an evolving technology that can increase capacity for load reduction. Battery technology has been improving rapidly for practical use in on-site energy storage. Lower implementation costs and return on investment have made battery installation increasingly viable; so too have incentive programs that reflect the value of these assets to the electric grid. Batteries can be strategically used during peak hours to shed a facility's peak load and respond to grid conditions. Stored energy can also be a part of a WRRF's load reduction when participating in demand response programs. Reducing grid dependence and increasing resiliency during outages are also potential benefits. Programs are also available that incentivize daily discharge of the stored energy to the grid during specific peak loading hours.

Battery storage can generate substantial revenue without much impact to plant operations or treatment performance. As these programs advance and more sites are enrolled, the unit payments offered are expected to change based on market conditions. However, some payment is expected to be available for the foreseeable future. Table 2 presents an example of potential revenue with daily load

Figure 2. Demand response event example

shedding programs offered by ISO NE, Eversource, and National Grid for a facility that sheds 100 kW of load using battery storage during peak hours throughout the year. Under this program, the stored battery power is automatically discharged to the grid each day during the peak grid demand period.

In addition to energy storage, on-site generation is increasingly popular for controlling power costs and creating revenue at WRRFs. The most prevalent form of on-site generation is solar power. Incentives and payment programs available throughout New England can offset the cost of a solar installation.

Unique ways of funding a solar project exist, including a power purchase agreement (PPA) or various lease agreements. Often these contracting methods place the responsibility for the solar array installation, operation, and maintenance on the developer, minimizing both upfront costs and risk to municipality or owner. Financial benefits can be in the form of reduced electrical power costs or annual lease payments for land used for the solar installation.

Another form of energy generation is CHP. Typically, CHP at a WRRF has been thought of as a system used with biogas produced from anaerobic digestion. While CHP systems can be fueled by digester gas, facilities can also use natural gas-powered CHP systems, taking advantage of incentive and grant programs as well as on-site power and heat generation benefits. Facilities with consistent heating load requirements are often good candidates for CHP systems.

For those facilities with anaerobic digesters, or those considering digestion to help manage solids, codigestion of organic (food) waste supports local waste diversion initiatives and greatly increases biogas production and associated electrical production. WRRFs across the country have incorporated these additional waste streams into their sewage sludge digestion processes to meet energy goals, reduce electrical costs, and minimize grid dependence. A recent nationwide survey of food-waste-receiving WRRFs documented the lessons learned. The recommendations included establishing specifications for organic waste stream characteristics, designing material handling equipment carefully, and developing effective contracts and communication with haulers and third-party preprocessing companies. While many facilities use the additional gas produced to generate more electricity and heat through cogeneration to be used on-site, opportunities exist to provide grid-quality gas to the local natural gas market. Driven by the Renewable Identification Number (RIN) market, the production of renewable natural gas can significantly increase revenue. In addition, numerous grant and funding sources are available in New England that support organics waste receiving and cogeneration at codigestion facilities. Local legislation and initiatives for source separation of organics and keeping food waste out of landfills can be a strong market driver, as waste haulers look for disposal sites for this diverted, but valuable, material.

Hydropower is another largely untapped technology for energy production at WRRFs. The technology has been continuously adapting to capture smaller head differentials, opening opportunities to a wider range of facilities. With head as low as around 6 ft (2 m), small hydro installations can be considered to offset plant energy consumption. As a renewable energy technology, the state and utility-based

Table 2. Battery load shedding incentives programs in New England

Program	5-Year Net Revenue
ISO NE	$9,758
Eversource CT & MA	$85,251
National Grid MA	$85,251
National Grid RI	$115,251

incentive can also be leveraged for these projects. Although not all plants have hydraulic conditions that support a small hydropower installation, the technologies available can be evaluated for site-specific feasibility.

To effectively monetize the energy produced on-site, net metering programs offered by many states and utilities in New England can be used. Through these programs the on-site energy production offsets plant grid usage, creating a direct on-bill monthly benefit. In some cases, net metering can be expanded to allow for energy produced at one location to offset energy at a different, separately metered location. This expanded benefit can be a major financial advantage for a renewable installation that produces more power than is used on-site.

Effectively managing electrical usage is an emerging strategy for lowering operational costs, funding process upgrades, and generating a continuous revenue stream for WRRFs. Incentive and grant programs are available throughout New England, and often multiple funding sources can be leveraged to reduce upfront costs and accelerate installation. The next frontier in efficient equipment and renewable technologies is available now, putting energy neutrality goals within reach. WRRFs can now position themselves as grid assets, taking advantage of local electricity market conditions while supporting regional carbon reduction initiatives.

ABOUT THE AUTHOR

Jennifer Muir has over 15 years environmental engineering experience and is president of JKMuir, an environmental engineering and energy consulting firm specializing in water, wastewater, and industrial processes. With Bachelor of Science and Master of Science degrees in environmental engineering from Massachusetts Institute of Technology, Ms. Muir is a specialist in the planning, design, and management of water and wastewater treatment facility projects, sustainability initiatives, and energy conservation improvements.

Energy efficiency and renewable energy

Case Studies

The NEWEA Energy Committee encourages its members to write about the great work they are doing in the field of energy efficiency and renewable energy. Examples of this work from facilities around New England are summarized in the following case studies. Some of these exemplify the benefits of implementing the recommended measures from comprehensive energy audits while also documenting related process improvement through better control and optimization. Others focus more on resource recovery, renewable energy, and the positive benefits of sustainability. The case studies offered here, compiled by five regional facility and agency sources, present elements of "all things energy related" that the NEWEA Energy Committee encourages.

1. Essex Junction, Vermont design with energy in mind

JAMES JUTRAS, EJWRRF Superintendent

Essex Junction Water Resource Recovery Facility (EJWRRF) is a 3.3 mgd (12.5 ML/day) advanced treatment facility owned by the Village of Essex Junction. The original facility was built in 1965 and has since undergone several modifications to meet the needs of the three communities it serves. Flows to the facility are received from the Village of Essex Junction and the towns of Essex and Williston.

In 2015, EJWRRF completed a $15.3 million, four-year design and refurbishment project, which had several key objectives focused on energy use, including the following:

- Improve energy efficiency
- Incorporate green elements
- Optimize sustainability
- Provide greater process control
- Improve phosphorus reduction measures required by the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL)

WRRFs are typically one of the largest energy users in small communities. Through innovative and sustainable energy-efficient measures as part of the refurbishment project, EJWRRF has reduced energy consumption to occasionally near net-zero using combined heat and power (CHP). It has done so while meeting design and permit compliance standards and providing a return on investment (ROI). The EJWRRF advances environmental education by demonstrating how an energy intensive process can achieve net-zero energy consumption by implementing simple cost-effective and innovative energy-efficient measures while also protecting the public health and the water environment.

Planning and engineering a design with energy conservation in mind met EJWRRF's process and performance objectives. Continuous and reliable energy improvement to benefit rate payers has always been a primary goal. Wise energy investments and attention to process control reliability have proven to be meaningful targets. An ROI while planning for future growth using right-sized equipment has saved capital investment dollars and reduced electricity usage.

These principles were easily incorporated into the design process by a facility team working with the design engineer and the state's energy conservation utility, Efficiency Vermont. EJWRRF staff and the design engineers incorporated these principles in all phases, only discounting concepts that did not meet a reasonable ROI of seven years.

A Green Elements meeting kicked off the design. A team of 16 operators, engineers, and concerned citizens convened to brainstorm conservation and alternative energy options. The following green elements were incorporated into the project design and final construction:

- Right-sized, premium-efficiency motors and pumps
- Premium efficiency lighting and transformers
- Adaptive aeration blower scheme (small, medium, and large blower sizes)
- Hyperbolic mixing (anoxic anaerobic processes)
- Tertiary filtration (10 micron cloth) for phosphorus removal
- Solar wall seasonal ventilation heat
- Ground source heat for administration building and headworks
- Ground source cooling for administration building
- Effluent heat recovery

Anaerobic digester complex with solar panels in foreground

105 kW methane cogeneration installation

Essex Junction WRRF overview

- Plant water pump sequencing strategy
- Capital planning for 10-year equipment evaluation
- 150 kW solar installation (Public–Private project)
- Anaerobic digestion with combined heat and power
- Enhanced SCADA system with facility HVAC energy management system (EMS) integration
- Flow equalization conversion to a weir-controlled device

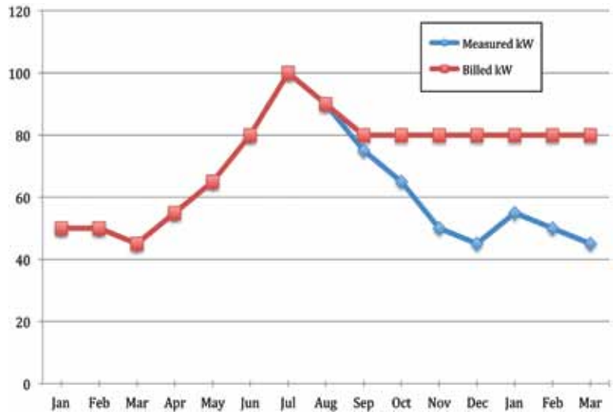
Energy conservation and process control are ongoing efforts. With the infrastructure investment made in the 2015 facility improvements, EJWRRF has a solid platform to enhance its energy profile. EJWRRF was again approached by the power utility and Efficiency Vermont to participate in pilot programs that include an Efficiency Vermont energy cohort to further optimize energy conservation opportunities and a Green Mountain Power Flexible Load Management (FLM) pilot. The FLM pilot is a demand site management program. Under the pilot, EJWRRF will temporarily load shift and load shed during the peak of the peak power times for the utility. This will involve using CHP to be grid neutral or to give power back to the grid during peak alert times without sacrificing process or effluent quality. FLM participation will reduce the demand ratchet that the utility charges. Details are still under development with SCADA modifications underway, leveraging existing equipment and processes while improving operational control.

Thoughtful planning generated a reliable design, allowed for effective process control, and reduced energy use. The Green Elements energy evaluation provided the basis for energy incentive grants to help fund the facility improvements. A recent energy audit supports that the EJWRRF energy investment has exceeded the goals of continuous energy improvement to the benefit of the facility and its users.

Demand Ratcheting

"A 'Ratchet Clause' is one common way for utilities to recoup the short term and extreme expenses they incur during the summer months when they have to supply more power due to air conditioning loads. Basically, a ratchet clause (or similar pricing strategy) can motivate clients to use power in a more consistent pattern throughout the year, which makes it easier for the utility to forecast and deliver energy based on more 'level' loads. If you notice that your 'Billed Demand' doesn't change from month to month, it is highly likely that you are 'ratcheted.'

"Here is how ratcheted demand charges are calculated: Basically, the utility notices when you set a 'new high' peak demand (any 15 minute period). If the ratchet is 80%, then going forward for the next 11 months, the utility sets a minimum billed demand for ~80% of the maximum recorded peak kW. Thus, as the figure below illustrates, even if you use a smaller amount of power during a succeeding month, you will be billed 80% of your previous peak. Note that ratchets typically vary from 50% to 100%, so it is good to know the ratchet level!"



Measured kW vs billed at 80% ratchet (started in July)

Power Factor, Ratchets and Your Electric Bill by Eric A. Woodroof, Ph.D., CEM, CRM Buildings Magazine June 2014. Source: https://www.profitablegreensolutions.com/post/2016/09/20/power-factor-ratchets-and-your-electric-bill.

2. NHDES energy-efficiency program for wastewater and drinking water systems

STEVE BOLLES, Process Energy Services
SHARON NALL, PE, NHDES Wastewater Engineering Bureau

The New Hampshire Department of Environmental Services (NHDES) energy-efficiency program for wastewater and drinking water systems is going strong. Following some right-sizing design standard changes in 2014, the NHDES energy-efficiency program really picked up steam with a grant from the U.S. Department of Energy (DOE). A partnership between NHDES and NHSaves, an energy-efficiency consortium of New Hampshire's four largest electric utilities, was born out of the U.S. DOE grant thanks to NHSaves providing the 20 percent financial match required.

The DOE grant made it possible for NHDES to contract directly with a local energy consulting firm that specializes in wastewater and drinking water process-level comprehensive energy evaluations (CEEs). The CEE program initiated under the DOE grant was well received by New Hampshire's municipalities. We are continuing the program using Clean Water State Revolving Fund (CWSRF) administrative funds and Drinking Water State Revolving Fund (DWSRF) set-aside funds.

Since initiating the CEEs in 2016, 41 wastewater CEEs and 16 drinking water CEEs have been conducted. The CEEs have identified an average of 30 percent potential energy use savings for wastewater systems and 23 percent for drinking water systems—all with an average simple payback of just three years prior to incentives. However, these savings will not help anyone if the recommended energy conservation measures are not implemented. To encourage the implementation, NHDES has kept its partnership with NHSaves strong to help maximize potential incentives from NHSaves for the energy measures identified in the CEEs. In addition to the NHSaves incentives, NHDES CWSRF started a 50 percent loan forgiveness incentive in 2019 to further encourage implementation of the energy saving measures.

As a proactive addition to the NHDES energy-efficiency program, NHDES further contracted with the energy consulting firm for the development of design guidance documents for both wastewater and drinking water. These documents will augment the NHDES design standards and recommend energy savings to assist design engineers and municipalities with designing energy efficiency into wastewater treatment facilities (WWTFs), pump stations, and drinking water systems. With incorporation into the initial project design, energy efficiency will be even more cost-effective and operationally compatible than "after-thought" measures. These guidance documents are being finalized for distribution and use.

As the NHDES energy-efficiency program matures, in addition to energy conservation measures identified in the CEEs, NHDES is also expanding efforts to assist WWTFs with implementation of appropriate and cost-effective renewable energy measures, such as solar arrays, solar walls, in-line turbines, and anaerobic digestion upgrades. This developing program helps WWTFs become more resilient and sustainable.

The following case studies describe the implementation completed and the resultant energy savings for two WWTFs that have benefited from the NHDES energy-efficiency program.

PETERBOROUGH WWTF ENERGY SAVINGS

The Peterborough WWTF is on Pheasant Road in Peterborough, New Hampshire, and treats an average flow of 0.50 mgd (1.9 ML/d) with a peak hour design capacity of 1.8 mgd (6.8 ML/d). The Pheasant Road influent pump station is adjacent to the WWTF site. The wastewater collection system also includes five pump stations.

All wastewater flow from the collection system is directed to the WWTF where flow passes through an influent screening system with a step screen and a washer/compactor before being directed to an aerated grit system. After grit removal, the flow is conveyed by gravity to one of the two sequencing batch reactors (SBRs). The SBRs are a fill-and-draw, suspended growth activated-sludge treatment process where wastewater is aerobically treated, settled, and discharged to a post equalization tank.

Over the years, the town has upgraded the WWTF to improve system reliability and efficiency. This included a partnership with a private company to install a solar photovoltaic (PV) array on 5 ac (2 ha) formerly used for the wastewater lagoons, pellet boilers for space heating, and VFDs and automatic controls for the process systems.

A CEE was conducted for the Peterborough WWTF in 2017 to identify potential energy savings. The energy use in 2016 was the baseline year for energy savings comparison.

Energy Measure Implementation

Over the last three years, the staff have reviewed, adjusted, and implemented the recommended measures to realize the savings shown in Figure 1.

Pheasant Road influent pump station

Wetwell blower

SBR blower system

Examples of the original CEE measures and alternative approaches developed by staff are summarized below. Nate Brown, the Peterborough WWTF superintendent, tracks the energy use monthly.

OM #2 Wetwell Blower Cycling—This measure originally recommended reducing the runtime for a blower used at the influent pump station that was installed to break up grease. The report suggested cycling the blower on and off while monitoring the effectiveness of breaking up the grease. Staff found that the blower diffusers were clogged and that the lack of air had not caused a problem with grease build-up. Instead of cycling the blower, WWTF staff shut off the unit to maximize savings.

OM #3 Odor Control VFD Adjustment—The headworks and septage areas are continuously exhausted with the odor control fan. The unit is rated for 4,000 ft^3/min (113 m^3/min) and has a 15 hp (11 kW) motor and a variable frequency drive (VFD). Normal operation is to maintain the exhaust fan VFD at 52 Hz to provide a continuous airflow. At this speed, the fan power draw is 5.2 kW. To optimize system operation, the report recommended reducing the fan VFD speed to 30 Hz for the cold-weather months. Although staff determined a slightly higher VFD speed of 42 Hz was suitable during cold-weather months, the adjustment realized 80 percent of the 18,396 kWh annual savings originally projected.

OM #4 Adjust Setback Schedule—The WWTF includes a building control system (BCS) that controls the HVAC equipment. During the CEE, it was discovered that the BCS was never fully programmed to provide occupied and unoccupied time settings. This measure recommended filling out the occupied/unoccupied schedule and reducing the unoccupied setting to 55°F (12.8°C) to provide additional savings. To fully use the low-cost pellet boiler-supplied hot water, the measure also recommended disconnecting a 9 kW duct heater. Staff disconnected the duct heater, upgraded the BCS set points, and simplified the HVAC system operation to improve system efficiency.

OM #5 SBR Blower Adjustments—To optimize the SBR blower system, the CEE report recommended adjusting several control system setpoints.

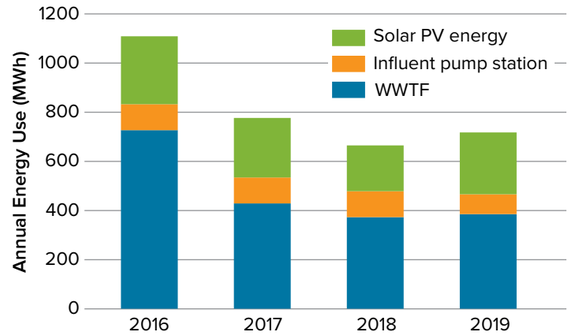


Figure 1. Peterborough WWTF and pump station—43 percent energy savings from 2016 to 2019

With the SBR system oversized for the existing flows and process loads, the proposed set points better matched the system equipment to process requirements.

WWTF staff worked with the manufacturer to adjust controls to fill the SBR tank to a higher level, reducing daily cycle times and equipment hours (and energy use), and improving effluent quality. In addition, mixer run time was reduced while the blower was operating since the blower provided mixing as well. This effort saved an additional 60,000 kWh annually.

These measures were all low- to no-cost measures resulting in instant savings. Peterborough achieved additional energy savings because of the willingness of staff to explore alternative approaches to develop the most cost-effective energy measure.

PLYMOUTH WWTF ENERGY SAVINGS

The Plymouth Village Water & Sewer District (PVWSD) WWTF is on Green Street in Plymouth, New Hampshire, and was constructed in 1977. The facility treats an average flow of 0.70 mgd (2.6 ML/d) and has a peak hourly flow of 4.05 mgd (15.3 ML/d). The wastewater treatment process includes preliminary and primary treatment, rotating biological contactors, and final clarifiers for secondary treatment. The effluent flow is chlorinated/dechlorinated and discharged to the Pemigewasset River.

Plymouth Village Water and Sewer District facility

The PVWSD installed a solar array in 2014 that has exceeded expectations for power production and represents approximately 30 percent of total plant power use. A CEE was performed for the PVWSD WWTF in 2017 to identify potential energy savings. The energy use in 2016 was the baseline year for energy savings comparison.

Energy Measure Implementation

Over the last three years, PVWSD staff have reviewed, adjusted, and implemented the recommended measures to realize the savings shown in Figure 2.

Jason Randall, PVWSD superintendent, developed a detailed plan for each measure. Examples of the measures are summarized below.

OM #3 Odor Control System Modifications—The odor control system for the PVWSD WWTF includes two package biofilter units. Each biofilter system includes a 5 hp (3.7 kW) odor control blower, a 1.5 hp (1.1kW) recycle pump rated for 20 gpm (76 L/m), and a 16 kW immersion heater. PVWSD staff researched a recommendation to reduce operation of the immersion heaters and evaluated how best to monitor the system operation. Instead of reducing the heater usage, staff disconnected the 16 kW odor control immersion heaters for both odor control biofilters. To ensure that no freeze-ups occurred during winter, staff monitored the biofilter temperature and airflow.

Headworks electric unit heaters

OM #4 Remove Clarifier Drive Heaters—The clarifiers included a heated protective structure for each drive unit. Disconnecting the heaters was recommended since the drives are designed to operate in cold weather climates. PVWSD staff implemented this measure and monitor the drives to ensure they do not freeze up during winter.

OM #5 Electric Heat Adjustments—Operating the headworks electric unit heaters at low levels (40˚F [4.4˚C]) was a recommended energy measure.

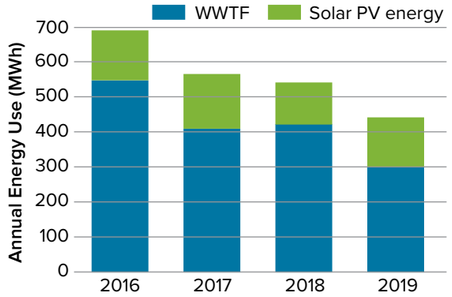


Figure 2. Plymouth WWTF—45 percent energy savings from 2016 to 2019

PVWSD went a step further by turning off the electric heat units in the headworks lower level, sludge pump room, and septage building (decommissioned). The headworks upper level heater was adjusted to maintain 40˚F (4.4˚C) in the winter. PVWSD staff also installed room temperature sensors connected to SCADA for each building/room. Following these changes, temperatures have remained above freezing (approximately 40˚F to 50˚F [4.4˚C to 10˚C]) in all areas.

OM #6 Adjust Generator Block Heater Thermostat—As recommended in the CEE report, the generator block heater temperature was reduced from 150˚F (66˚C) to about 100˚F (38˚C).

OM #7 New Controls for Propane Heating System Improvements—This measure recommended maintaining the process and maintenance areas at 50˚F (10˚C), with a timer override to raise the area up to a higher temperature for up to one hour. For the offices/lab and lunchroom, setback thermostat programs were recommended to reduce the room temperature to 55˚F (13˚C) during nights and weekends. PVWSD staff altered this recommendation by adjusting existing controls to 50˚F (10˚C) for all operations buildings and garages during the cold-weather months (with no timer control).

ECM #1 RBC Blower VFDs—The PVWSD WWTF lacked control on the sidecar blower system in the rotating biological contactor (RBC) treatment process. To solve this, PVWSD installed two VFDs and dissolved oxygen control/monitoring equipment on the sidecar blower system. PVWSD applied for a VFD incentive from the NHSaves program through its electric utility, New Hampshire Electric Cooperative, and received $3,400 to cover the cost of the two VFDs.

When the PVWSD staff recognized the impact of tight temperature controls, they took aggressive action not only to turn down the temperature set points but to eliminate electric heat for certain applications. These initiatives did not cause freezing during the winter or affect equipment operation, as they passively used the latent heat in the wastewater. All the measures implemented were low- to no-cost measures resulting in instant savings.

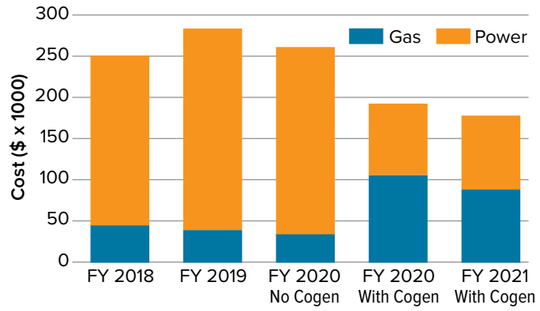
3. South Essex Sewerage District combined heat and power facility

DAVID MICHELSEN, SESD District Engineer

The South Essex Sewerage District in Salem, Massachusetts, constructed a 1,914 hp (1,427 kW) combined heat and power (CHP) facility at the District's wastewater treatment plant. Key features and results of the project are summarized below.

KEY FEATURES

- Heat generated by CHP will be used for year-round process needs and heating of the WWTP, with system efficiency exceeding 70 percent
- The CHP engine is powered with natural gas; the unit was provided in an aluminum enclosure
- Other features include Island Mode and Black Start capabilities should the site lose power
- The elevated project site provides additional resiliency and has a sound wall for noise control
- Changes were made to hot water piping to use the heat, and hot water circulating pumps and instrumentation and controls were added



Total SESD monthly average energy costs

Cost savings do not reflect $7,000 per month in revenue from sale of APS credits

PROJECT RESULTS

- The project was completed in February 2020 after a successful field test to verify unit performance
- Total construction cost, with several owner-added changes, was around $5.9 million
- The CHP unit will generate enough electricity to reduce the District's annual power use by 15,153,550 hp-h (11,300,000 kWh) per year. It will also generate approximately 14,000 alternative portfolio standard (APS) credits per year, from Massachusetts.
- After offsetting the costs of natural gas to power the CHP as well as annual operation and maintenance, the CHP will reduce the District's overall energy costs by $1 million per year
- Savings will be used to fund future capital upgrades to sustain the District's assets

SESD CHP engine

Exterior of CHP engine installation

4. Incorporating energy efficiency into MWRA facility rehabilitation projects

DENISE BREITENEICHER, MWRA Program Manager, Energy & Environmental Management

The Massachusetts Water Resources Authority (MWRA) is a public authority that provides wholesale water and sewer services to 3.1 million people and more than 5,500 large industrial users in 61 communities in eastern and central Massachusetts. More than 20 years ago, MWRA began its energy-efficiency efforts with facility audits and one-off projects such as lighting replacement, installation of variable frequency drives (VFDs) on pumps and HVAC fans, and operation and maintenance improvements. These energy-efficiency projects took advantage of state and utility energy-efficiency programs that offered generous monetary incentives and technical support.

As MWRA's energy efforts grew, it became clear that energy-efficiency measures were not uniformly integrated into the authority's large, multi-million dollar infrastructure improvement projects. A more comprehensive, consistent, and streamlined energy-efficiency program could be realized only if improvements were integrated into planned facility rehabilitation projects. MWRA learned several key lessons when making energy efficiency a standard component of facility upgrades.

Case Study No. 1: Ongoing Rehabilitation Project—Nut Island Headworks

An example of an ongoing rehabilitation project using the energy-efficiency SOP is MWRA's Nut Island Headworks in Quincy, Massachusetts. The upgrades include replacement of aging air handling units, exhaust and odor control fans, and the addition of VFDs and occupancy controls to the supply fans, exhaust fans, and odor control fans. A new automated building management control system package will automatically reduce the airflow to process areas under certain conditions. The expected annual electricity savings from these changes is 1,120,123 kWh, resulting in an expected annual savings of $134,415. This would lead to a positive net present value after seven years (after incentive payment), and a net present value of $1.6 million after 20 years.

Lesson No. 1: Integrate Energy Efficiency into Standard Operating Procedures

As a first step to incorporating energy-efficiency requirements into MWRA's facility rehabilitation projects, engineering and energy staff examined the major internal, trans-departmental processes that affect MWRA energy usage, subsequently developing standard operating procedures (SOPs) to ensure that energy conservation is integrated into all MWRA facilities and processes while aiming to maximize utility incentives. One SOP, "Engineering, Design, and Construction of New and Rehabilitated Facilities," defines staff responsibilities and roles when integrating energy-efficiency measures into rehabilitation projects. These responsibilities call for coordination among MWRA engineering and energy staff and the power utility, particularly early in the design process.

Lesson No. 2: Conduct an Energy-efficiency Audit of the Facility for Inclusion in the Design Phase

MWRA typically has completed a facility energy audit together with its utilities, and this document is given to the design consultant for review during preliminary design. The preliminary design defines the project scope, budget, and schedule, identifies key project components and features, and establishes the basis for the final design. Key processes through preliminary design include collecting data, performing fieldwork, and evaluating alternatives, all combining to ultimately recommend an alternative's design criteria.

During this process, the MWRA design engineer in charge of the rehabilitation project coordinates with energy staff to discuss energy-related aspects of the design. The engineer reviews the results of the previously completed energy audit to determine if any of the audit recommendations align with the work to be completed. The MWRA typically hires an engineering firm to conduct the design and related analyses, and as this preliminary design process proceeds, the consultant assesses the audit recommendations relating to energy conservation measures and aims to incorporate those consistent with the project goals into the design.

Lesson No. 3: Keep an Energy Journal

An energy journal is also required during the design process. The purpose is to chronicle the progress of the energy design through each milestone and, in the final design phase, document energy savings achieved through the design compared to the facility's current energy use. The journal also provides an associated cost-benefit analysis for each recommended energy-efficiency measure. The final journal is then submitted to the utility to use when evaluating the proposed energy-efficiency measures for custom incentives.

Once the design is complete, MWRA's senior management approves the recommendations, and the project is bid and awarded to a construction contractor; primary project oversight then shifts to MWRA's Construction Engineering Group. This group's role in the implementation of the energy-efficiency components is to document that the work was completed and to note any changes in the final installed project components that could have changed from the final design documents submitted to the utility.

Lesson No. 4: Be Patient

Not surprisingly, implementing this process has not been flawless. As a large water and wastewater utility, MWRA has many engineers overseeing a number of facility rehabilitation projects of all sizes. At first, because this was a new step in their established workflow, staff and their consultants faced a learning curve to fully implement the new process. Standard language was developed for design contracts to provide a starting point for MWRA's engineers. Making sure that language covered all the possible components of any particular contract was challenging because of the variety of facilities (for example, treatment plants, remote headworks, pumping stations, and combined sewer overflow facilities) and the scope of the rehabilitation. Similarly, the corresponding energy journals created for different projects varied based on the breadth of work to be completed under any one job.

Lesson No. 5: Include Energy-efficiency Benefits in Life Cycle Cost Analysis

Life cycle cost analyses are another decision-making tool to be used during an evolving facility rehabilitation project that involves energy-efficiency components. When engineering staff and management are reviewing the options evaluated in a design document, the lowest-cost option that meets specified criteria for the project is typically chosen. However, when looking at reducing energy use, cost may not be the only element to consider; for example, evaluations might include greenhouse gas reduction or long-term energy savings from the new equipment. Results of life cycle cost analyses may better represent all project costs compared to simple payback. As with other environmental benefits, monetizing greenhouse gas reduction is difficult. As a state authority, MWRA aims to assist Massachusetts in meeting its greenhouse gas reduction goals as outlined in the Global Warming Solutions Act of 2008. For example, there may be a slightly more expensive option that increases energy efficiency in a facility rehabilitation and thus reduces greenhouse gas compared to a less expensive piece of equipment that provides less energy savings and greenhouse gas reduction. Comparing traditional equipment that may cost less to equipment that provides a higher energy efficiency and emits less greenhouse gas is yet another challenge in designing facility rehabilitations.

Case Study No. 2: Completed Rehabilitation Project—Alewife Brook Pump Station

This rehabilitation project at MWRA's Alewife Brook wastewater pump station was substantially completed in March 2019, with the following energy-efficiency actions taken:

- Replaced single-speed exhaust fan with new VFD-driven fan so that ventilation setbacks could be achieved under appropriate conditions, with estimated annual electricity savings of 18,957 kWh, and annual fuel oil savings equivalent to 269,780,000 BTU (79,000 kWh) due to less outside air to be heated
- Replaced three 26 mgd (98 ML/d) wet weather pumps, driven by 100 hp (75 kW) motors, with three more efficient 37.5 mgd (142 ML/d) pumps (larger, to provide redundancy), driven by high-efficiency 200 hp (150 kW) motors controlled by VFDs
- Replaced four oil-fired boilers with two high-efficiency gas-fired condensing boilers as well as the indirect water heater with a high-efficiency tankless gas-fired heater for estimated annual savings of 572,180,000 BTU (167,700 kWh)
- Insulated the operating and screen room ceilings for an annual savings of 62,683,923 BTU (18,370 kWh)
- Replaced single-pane exterior windows and uninsulated doors with insulated energy-efficient windows and doors for an estimated annual savings of 48,432,564 BTU (14,194 kWh)

ACKNOWLEDGMENTS

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Thanks to the following MWRA staff involved in assisting with this article: Robert Huang, Energy Program Manager, Deer Island; Jonathan Sycamore, Senior Financial Analyst; David Pottle, PE, Program Manager, Engineering.

5. Narragansett Bay Commission

BARRY WENSKOWICZ, NBC Environmental Sustainability Engineer

13,410 HP (10 MW) SOLAR POWER SOLICITATION AND NET-ZERO PROJECT

The Narragansett Bay Commission (NBC) owns and operates Rhode Island's largest wastewater treatment facilities (WWTFs), located at Fields Point and Bucklin Point. Its Board of Commissioners adopted Resolution 2016:10 on April 26, 2016, that approved the purchase of three remote wind turbines in Coventry, Rhode Island, to augment three turbines installed at Fields Point in 2012.

The resolution specifically supported the goal to ultimately satisfy 100 percent of the facility power needs from diverse net-metered renewable sources such as wind, solar, and anaerobic digester biogas. Resolution 2017:05, adopted on March 28, 2017, approved two remote net-metered solar power contracts, each with a capacity up to 6,705 hp (5 MW_{ac}). The resulting request for proposals and qualifications (RFP/Q) was intended to bring NBC to its goal of 100 percent net-zero sustainable power use.

Prior to the award, NBC negotiated with three qualified proposers over a potential final contract that would utilize a no-money-down third-party net meter financing arrangement. The key contract items negotiated were net meter credit floor price, net meter credit discount rate, cost to maintain possession of renewable energy credits, access to data, and control over allocations. Long-term contracts were signed with the winning proposer in August 2017 for two solar projects (6,034 and 4,023 hp [4.5 and 3.0 MW]).

Implementation

The first project achieved a commercial operation date (COD) in December 2017 on farm-owned land, shown in photo. Its total power production is shown in red in Figure 1. Production from the onsite and offsite wind turbines owned by NBC is shown in blue and black in the figure.

Land under a portion of the solar modules at the second (4,023 hp [3 MW]) solar project was planned to be farmed to demonstrate compatible land use to the surrounding rural community. However, the town halted construction at this site. The developer agreed to amend the contract in October 2018 and provide power from a new wind turbine, in Johnston, Rhode Island, until the solar siting issues are resolved or power from another suitable solar site becomes available. The wind turbine achieved a COD in December 2018 and provides 74.6 percent of its power to NBC. Its NBC credit production, based on provided data, is plotted in green in the Figures 1 and 2.

Both contracts guarantee the net meter credits will be delivered or compensation will be provided by the entity that owns, operates, and maintains the assets.

Project Results

Figure 1 shows that overall production almost tripled in the last three years, increasing from 28 percent of use in 2016 to 76 percent in 2019. Efficiency improvements at the WWTFs have reduced average electric use and helped safeguard permit compliance during that time.

Up to 3,754 hp (2.8 MW) of other sustainable energy production is under consideration or development. NBC is on track to achieve its net-zero goal and satisfy its electric needs entirely from investments in local, cost-effective renewable energy production.

ELECTRIC VEHICLE CHARGING STATIONS

The governor of Rhode Island issued Executive Order 15-17 on December 8, 2015. It requires a minimum of 25 percent of new light-duty state fleet purchases and leases to be zero-emissions vehicles by 2025. NBC is not part of the state fleet; however, it embraces this mandate as an agency goal.

The Rhode Island Department of Environmental Management (RIDEM) recognizes NBC as an "environmental sustainability leader." This is based, in part, on NBC's renewable energy initiatives and participation in Ocean State Clean Cities Coalition. RIDEM encouraged NBC to apply for grant funds that had become available to install electric vehicle

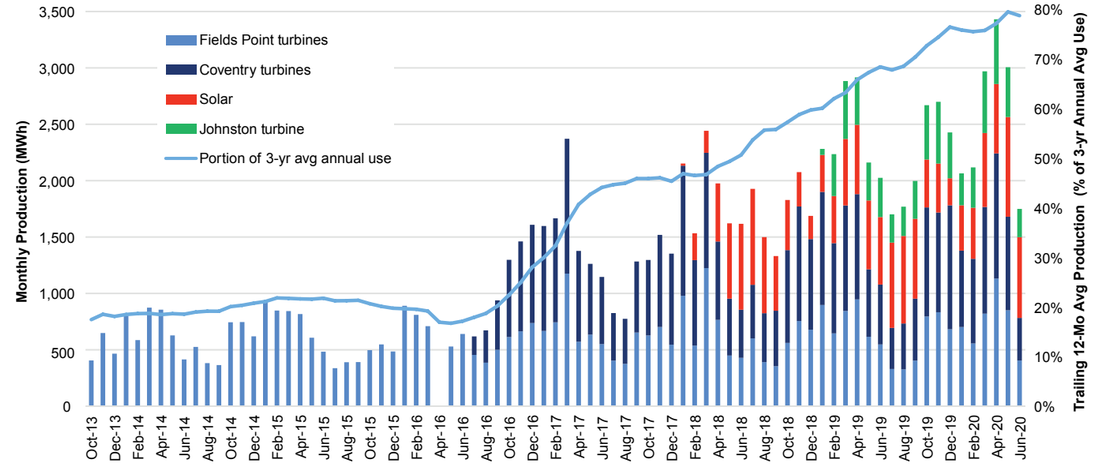


Figure 1. NBC sustainable energy production

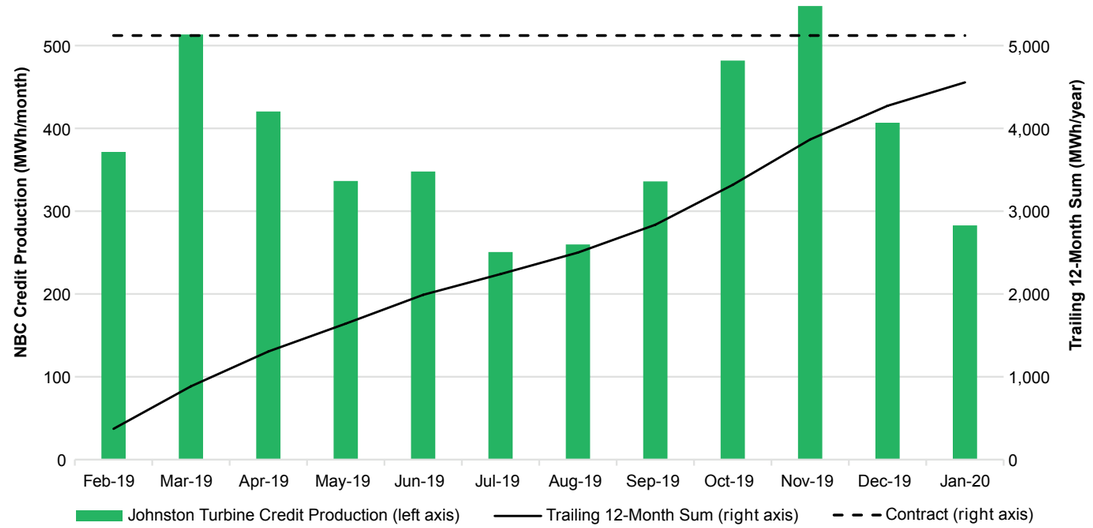


Figure 2. Johnston wind turbine

(EV) charging stations also known as EV supply equipment (EVSE). The funds were available through National Grid's Infrastructure funding and the Rhode Island Office of Energy Resources (RIOER) "Charge Up!" programs.

NBC Fleet Assessment

EVs can be more economical than fossil-fueled vehicles because they tend to cost less to operate and maintain. This needs to be considered with their typically higher purchase price when comparing 10-year costs of ownership.

Many NBC fleet vehicles are used for daily functions that are predictable and require moderate driving distances. This makes them potentially suitable for replacement with EVs. EVs can be driven many more miles than their fossil-fueled counterparts based on the same unit of energy delivered to them. Replacing a fleet vehicle with an EV also reduces fleet greenhouse gas emissions appreciably.

National Grid recognized NBC's fleet would benefit from receiving a free custom EV Fleet Study from its preselected consultant. The study used actual site data and recommended several vehicles most appropriate for being replaced by EVs in future.

Cost Projection and Procurement Approach

National Grid, RIOER, and others were contacted about EVSE as a first step toward securing the grant. NBC was referred to the Rhode Island Master Price

ESVE station

The EV ride and drive event

Agreement (MPA) and potential vendors. Through the competitive bid process, Rhode Island MPA-509 established the cost to purchase and install EVSE manufactured by the industry leader, which helped streamline procurement.

Grant

The most highly recommended vendor was established and experienced, and agreed to comply with the MPA. The vendor helped to determine the best location to install ESVE behind the gate at each wastewater treatment plant. Each would be used primarily for future fleet charging since safety and security concerns prohibited outsiders from accessing the property. The vendor helped secure grant funding totaling almost $60,000 for a pair of programmable dual-port ESVE stations that required significant new infrastructure.

Education and Implementation

NBC next educated staff about these and other matters and organized an EV Ride and Drive event. Fifteen attendees test-drove five models and had their questions answered, generating enthusiasm for the program.

Two ESVE stations have been installed. As EVs are incorporated into the future fleet, each charging station can be expanded to two at a fraction of the original cost to meet increased charging needs. NBC must comply with ongoing requirements of the grant-funded projects including obligations to service, maintain, and report on use of each EVSE.

NBC will buy its first EV in fiscal year 2021 to be used primarily for inspections. NBC is now investigating methods of purchase, either through Rhode Island MPA-563 or performance-based direct procurement.

Committee Focus

Energy *mission, history, and upcoming conference*

The energy field includes an incredibly diverse set of disciplines, and the NEWEA Energy Committee's topics have ranged from basic matters such as understanding a facility's electric bill to more complex approaches such as energy benchmarking, biomass energy production, efficiency upgrades, and carbon foot-printing. NEWEA's Energy Committee serves as an outreach group, enhancing knowledge of its members and others in the energy field.

The Energy Committee has three goals:

1. Lead NEWEA's policies on energy use and on-site energy generation
2. Inform NEWEA members and the public about the technical and regulatory aspects of energy use and conservation, including greenhouse gas emissions
3. Provide a forum for NEWEA members to share "lessons learned" from various energy projects

Four initiatives have been formed to meet these goals. The initiatives encourage the following:

1. Awareness of energy-efficiency (EE) and renewable energy (RE) technologies
2. Inclusion of EE and RE technologies in the design phase of construction and retrofit projects instead of adding the measures as an afterthought "fix"
3. Networking and facilitating connections between energy-efficiency funding sources and the communities and clients who can use these funding sources
4. Energy efficiency with awards and recognition, both through the Energy Award program and presentation opportunities at the Annual Conference and specialty conferences

ENERGY COMMITTEE HISTORY

In 2007, Arnie Bevins, then NEWEA president, and Mike Curtis, then Connecticut state director, often drove to the NEWEA office together for meetings, discussing the state of the industry. With energy costs escalating for so many wastewater utilities, Mr. Bevins thought the time had come for NEWEA to advance energy efficiency discussions through the creation of an Energy Committee. The Energy Committee was created at the June 2007 Executive Committee Meeting as an *ad hoc* committee. Mr. Curtis was officially listed as the Energy Committee chair. As his first order of business, he recruited Jason Turgeon, EPA Region 1's new "wastewater treatment energy guru" to join the committee, since Jason's primary focus was energy use in wastewater treatment and his involvement could increase collaboration with EPA. Mr. Curtis also made a call to the greater NEWEA community for members. He noted that the response to this call for committee support was robust and energetic. Many people joined and contributed to the initial Energy Committee's efforts, with typically 20 to 25 regular committee meeting attendees.

The committee initially focused on system upgrades with the first energy-related specialty conference in the fall of 2008 in Lowell, Massachusetts. Partly due to the success of that first energy-focused specialty conference, the Energy Committee became a standing committee in 2010, and Mr. Turgeon was named committee chair to succeed Mr. Curtis.

When Mr. Turgeon joined the committee, he observed that a "pretty good bunch of excited and enthusiastic people were willing to work hard to make this effort a success." He also noted that the committee covers an array of energy-sector facets, including the following:

- Energy audits
- Energy management
- Motor/equipment replacement upgrades
- Blower sizing, blower and pump controls
- Pumping and aeration strategies
- SCADA management for energy efficiency
- Waste to energy
- Waste management for energy minimization or reutilization
- Application of renewable energy sources into plant design
- Energy and sustainability as part of plant upgrade design and construction
- Net-zero energy goals

Mr. Turgeon added, "If it hinted at energy, [the committee] covered it." Over time, the committee has introduced the NEWEA community to all these energy-related concepts and technologies through conference sessions and specialty conferences. The Energy Committee has greatly expanded its presence at the Annual Conference, from its initial one energy-focused session to as many as four sessions in recent years. As both Mr. Curtis and Mr. Turgeon mentioned, the committee is populated by professionals seriously dedicated to helping NEWEA members work through energy-related projects.

JOINT SPECIALTY CONFERENCES AND COLLABORATION

The Energy Committee also recognized early on that it could benefit several other NEWEA committees and began a series of joint specialty conferences. It joined with the Residuals Management, Plant Operations, Sustainability, and Asset Management committees to host the following specialty conferences:

Energy Committee Specialty Conferences

- April 22, 2008—Lowell, MA
- November 4–5, 2009—New Haven, CT (joint with Residuals Management)
- October 19–20, 2010—Hyannis, MA (joint with Sustainability)
- May 15–16, 2012—Brattleboro, VT (joint with Plant Operations)
- May 7–8, 2014—Sturbridge, MA (joint with Plant Operations)
- April 11–12, 2018—Merrimack, NH (joint with Asset Management)
- May 10–11, 2021 (2020 conference postponed due to COVID-19)—Haverhill, MA (joint with Plant Operations)

As the Energy Committee has evolved and matured, topics such as the value of long-term sustainability during implementation of energy-related measures and process upgrades have gained increased attention. Taking this broader approach recognized the value of these efforts over the long term, and, as a result, helped create the separate Sustainability Committee.

The Energy Committee also serves NEWEA by informing members of viable, cost-effective methods to reduce energy use and recover energy whenever possible throughout the wastewater collection, treatment, and disposal process through collaboration with other committees such as Plant Operations and Residuals Management; this committee cross-pollination is especially important as industry conditions change. For example, energy use is a growing concern for solids handling and disposal, given contaminants of emerging concern combined with limited, high-cost solids (raw and stabilized sludge) management options. These changing conditions present renewed collaboration opportunities among the Energy, Residuals Management, Plant Operations, and Sustainability committees.

ENERGY AWARD

During its tenure, the Energy Committee has seen every New England state develop programs to encourage energy efficiency, energy audits, grants, and other activities in collaboration with EPA Region 1, NEWEA, and the U.S. Department of Energy. These programs have also typically included audits and incentives through local utility providers as well as through some State Revolving Fund programs. The top efforts are recognized annually with the Energy Award presented at the Annual Conference. The past winners, since the inception of the Energy Committee, are as follows:

NEWEA Energy Award Winners

- 2010 Town of Enfield (CT) Water Pollution Control Facility
- 2011 Edgartown (MA) Wastewater Treatment Plant
- 2012 Freeport (ME) Sewer District
- 2013 Narragansett Bay Commission (RI)
- 2014 Veolia Water/Plymouth (MA) Wastewater Treatment Plant
- 2015 Saco (ME) Water Resource Recovery Department
- 2016 City of Keene (NH) Wastewater Treatment Plant
- 2017 Village of Essex Junction (VT) Wastewater Treatment Facility
- 2018 Town of Fairfield (CT)
- 2019 Howard Carter of Saco (ME)
- 2020 City of Somersworth (NH)

The Energy Committee thanks Mr. Bevins for his vision, Mr. Curtis for his follow through, Mr. Turgeon for his tenacity, Tom Schwartz for maintaining continuity, Charlie Tyler (who Mr. Curtis says helped encourage Denise Breiteneicher to enter the fray), Ms. Breiteneicher for her support, and Sharon Nall for continuing the enthusiasm. Finally, thanks to the Energy Committee for all the good work they have done over the years.

JOINT SPECIALTY CONFERENCE ON ENERGY AND PLANT OPERATIONS • MAY 10–11, 2021

NEWEA's Energy and Plant Operations committees will hold a joint specialty conference on energy efficiency, energy project developments, best facility operational practices related to energy, and energy project success stories.

The Greater Lawrence Sanitary District (GLSD) is scheduled to host the conference. The conference will include a detailed tour of energy and operational features GLSD has implemented at its wastewater treatment facility as it strives to reach net zero energy use status. The conference will also include a day of presentations from plant operators in all six New England states as well as an industry cohort of service providers, electric utility representatives, consultants, and engineering organizations.

A diverse subcommittee comprising members from NEWEA's Energy and Plant Operations committees helped plan this event. This subcommittee reached out across the ranks of professionals in these areas to identify examples of operational excellence and energy project implementation to highlight those best practices.

To broaden the educational and outreach opportunities, the conference will also have space for vendor and sponsor engagement. The Energy and Plant Operations committees look forward to seeing you at this conference, so save the dates now!

NEBRA Highlights

W4170 Rebuts EPA Office of Inspector General 2018 Critique of Biosolids*

The U.S. Department of Agriculture's (USDA) Multistate Research Committee, known as W4170, has completed a scientific rebuttal to EPA's Office of Inspector General (OIG) report issued in November 2018 titled "EPA unable to assess the impact of unregulated pollutants in land-applied biosolids on human health and the environment." The W4170 is the latest iteration of USDA research committees that have been studying the beneficial use of residuals to improve soil health and protect public and ecosystem health. This research has been going on for 45 years and helped establish current EPA biosolids management regulations found in 40 CFR Part 503.

Nicholas Basta, PhD, professor of soil and environmental chemistry, Ohio State University, helped lead the W4170 response

The 2018 OIG report criticized EPA for failure to assess 352 pollutants found in biosolids/residuals, including 61 considered acutely hazardous or defined as hazardous or priority pollutants under other federal environmental laws. Some of the list of pollutants came from EPA's own biannual review required under Part 503. The OIG report also cited 291 "unlisted" pollutants that, it claimed, EPA had not assessed. The report by W4170 addresses both the listed and unlisted pollutant exposure risks from beneficial reuse of biosolids and tries to put them in perspective.

The OIG report has been used as justification to discontinue beneficial reuse programs across the country. The W4170 research committee's response to the OIG report is a welcomed, albeit delayed, refutation of what EPA's Office of Water characterized in its initial response to the OIG report as lacking science and context as well as being alarmist and biased. EPA pointed out that the mere presence of the pollutants mentioned in the OIG report does not indicate risk. The W4170 response agrees, concluding: "The OIG report alleged that '…[EPA] lacked the data or risk assessment tools needed to make a determination on the safety of 352 pollutants found in biosolids…' Our review of literature showed that extensive data and risk assessment, some conducted by EPA, exists for the pollutants listed by OIG. In short, the above statement in the OIG is inaccurate and alarmist."

The W4170 report points out that—concentration-wise—there are other, greater sources of human exposure to almost all these pollutants than from their presence in biosolids/residuals. There were, however, several chemicals that, the W4170 report suggests, require further study, including several persistent pharmaceuticals. The W4170 report included extensive literature research/citations. The review of the unlisted chemicals was broken down into groups of chemicals such as antibiotics/antimicrobials, metals, brominated flame retardants, dioxins, pharmaceuticals, hormones, pesticides, and pathogens. The report also contains a section summarizing "PFAS: A Challenging Current Concern."

In the aftermath of the OIG report, the Water Environment Federation (WEF) organized a national biosolids meeting in November 2019 at which EPA was urged to reinvest in its biosolids program and increase regulatory oversight and compliance with respect to the Part 503 program. At that meeting, EPA acknowledged improvements were needed. Before the COVID-19 outbreak, EPA was planning a meeting with all the state and tribal biosolids coordinators, hiring additional staff to perform risk assessment, and fast-tracking this work. WEF has continued to host monthly meetings with EPA and various stakeholders such as the Water Research Foundation, the National Association of Clean Water Agencies, NEBRA, and other regional biosolids organizations to better coordinate activities to improve biosolids management and enhance opportunities for beneficial reuse.

*** More information on this topic can be found on NEBRA's web news page (nebiosolids.org/news)**

Industrial PFAS Contamination Found at Second Maine Farm*

In late July, the *Portland Press Herald* reported a second small dairy farm in Maine found PFAS contamination in its milk. The levels are among the highest reported in milk anywhere, with one test showing about 32,200 parts per trillion (ppt) PFOS and two others at about 12,700 and 14,900 ppt. Maine has a conservative protective screening level for milk: 210 ppt. The other farm that received much attention a year ago had significantly lower PFAS levels in its milk—as high as 1,420 ppt—so 10 times lower than this latest dairy farm. In both cases, such high levels of PFAS are likely from industrial waste or use of firefighting foam; municipal biosolids may or may not have conveyed them.

All biosolids contain some traces of PFAS, because these chemicals are used in myriad products in our daily lives and have been since the mid-1900s. Tests of milk and feed at other Maine and New England farms with years of use of biosolids have found mostly non-detects, with an occasional trace of PFOS well below the Maine screening value. The *Portland Press Herald* notes: "…McBrady, with the state agriculture department, said it is dangerous to paint all farms that used sludge with a broad brush because state testing has shown many do not have PFAS contamination issues."

NEBRA's fact sheet "PFAS and Biosolids and Septage on NE Farms" can be accessed for download at nebiosolids.org/pfas-biosolids

Maine communities have invested millions in capital and equipment to make high-quality biosolids products for farms and landscapes. Anaerobic digesters produce consistent biosolids that are in high demand by farmers because they improve soils and crop growth. In addition, the digesters generate renewable energy, reducing the wastewater facility's use of fossil fuels. Biosolids recycling mitigates climate change and is integral to the circular economy, making Maine communities more sustainable.

It is uncertain whether municipal biosolids contributed to the very high levels recently found. This farm was permitted by the Maine Department of Environmental Protection to use biosolids from 1985 to 2003, according to the Maine Department of Agriculture, Conservation and Forestry, and some biosolids were apparently applied during some of that period.

Following the discovery of PFAS contamination at this second dairy farm, State Representative Henry Ingwersen, from Arundel, proposed legislation to change the statute of limitations laws to allow landowners with PFAS contamination to sue the chemical manufacturers within six years of discovering the contamination. Existing law requires any such a lawsuit be filed within six years of when the pollution occurred. During an interview with the local television news station, Representative Ingwersen said that this PFAS contamination occurred decades before the discovery. He also acknowledged that "sewage plants and water treatments are just another victim of this pollution." According to the bill's proponents, Maine will be joining 37 other states with similar laws.

NEBRA Welcomes New Research Committee Chair

At the end of June, NEBRA's Board of Directors appointed Tracy Chouinard. PhD, PE, of Brown and Caldwell, to chair the Research Committee. Dr. Chouinard performed postdoctoral research for the San Francisco Public Utilities Commission (PUC) related to the PUC's water, power, and sewer divisions. She specializes in anaerobic digestion and biogas production. She presented on the topic of sludge rheology at the 2019 NEWEA annual conference. Dr. Chouinard takes over the research chair from Charlie Alix who remains on the board of directors and has played a major role in getting the new chair up to speed. Dr. Chouinard has developed a charge for the committee with plans to assist NEBRA members by creating a searchable database of research articles and abstracts. Other committee goals include an annual research-based feature article for NEBRAMail and an annual research webinar.

Tracy Chouinard. PhD, PE, of Brown and Caldwell

UPCOMING LUNCH & LEARN WEBINARS

DATE	TITLE	PRESENTER
September 25	The Science and Control of Odors Part 3	Michael Lannan, Tech Environmental
October 9	North East Digestion Roundtable #17 – Codigestion with Food Waste	Greater Lawrence Sanitary District
October 23	Biohubs & Other Biosolids Management Strategies in Australia	Peter Hillis, pH2O Consulting
December 18	State of the Region's Biosolids (year in review)	NEBRA Staff
January 8, 2021	North East Digestion Roundtable #18 – Vetting AD Feedstocks	Chris Muller, Brown & Caldwell

All sessions start at noon (EST) and last an hour. Check the NEBRA website for changes and updates, especially additional webinars as they get scheduled.

NEBRA Files *Amicus* Brief in New Hampshire Supreme Court but Case May Be Moot*

Following the promulgation of maximum contaminant levels (MCLs) for PFAS in drinking water by the New Hampshire Department of Environmental Services (NHDES) in 2019—some of the lowest proposed standards in the world—NEBRA filed an *amicus* ("friend of the court") brief in support of Plymouth Village Water and Sewer District and others in a legal action to stop the implementation of the new MCLs. The plaintiffs' main arguments were that NHDES failed to follow administrative procedures and did not adequately consider the costs and benefits of the new MCLs.

The Merrimack Superior Court recognized this and imposed an injunction on both the MCL regulations and the associated ambient groundwater quality standards (AGQS). When the case moved to the New Hampshire Supreme Court, NEBRA filed another *amicus* brief in late May in support of the plaintiffs' claims and the Merrimack Superior Court's injunction that was keeping NHDES from enforcing the new standards. Other parties also filed briefs, including the New England Legal Foundation, the Business and Industry Association of New Hampshire, and the New Hampshire Municipal Association. About the same time, the New England Ratepayers' Association released a report concerning the costs and benefits of the New Hampshire drinking water standards (neratepayers.org). As numerous stakeholders have commented in the past two years during MCL development, the costs of these very low standards will outweigh any measurable, marginal benefits of dropping the standards from the current 70 ppt health advisory level set by EPA to the new New Hampshire levels of 11 to 18 ppt for four different PFAS (PFNA, PFOA, PFOS, and PFHxS).

The New Hampshire Supreme Court, however, may not get to weigh in on the new MCLs. In June, the New Hampshire legislature resuscitated the concept of putting the MCLs and groundwater standards into law, creating bill HB 1264 (gencourt.state.nh.us) that included the MCLs and a $50 million program providing loans to municipalities and utilities to help defray some of the $267 million NHDES estimated will be needed to meet the new standards. That law was passed on June 30 and signed by the governor on July 23. Lawyers for the plaintiffs and the State (defendant) are providing arguments to the supreme court regarding whether there is anything further to litigate, now that the MCLs and AGQS are in law. Stay tuned.

MassDEP To Begin Stakeholder Process for Biosolids PFAS Regulations

Massachusetts Department of Environmental Protection (MassDEP) has invited NEBRA and other stakeholders to the stakeholder process related to PFAS regulations for biosolids/residuals. Two meetings are being planned for late summer and early fall. The invitation letter from Stephanie Cooper, deputy commissioner for policy and planning, stated "Given that residuals from wastewater and other sources are known to contain PFAS, and that land application of residuals could result in contamination of drinking water sources, food chain crops, or surface waters, MassDEP is building a comprehensive strategy to address PFAS in residuals." Although NEBRA has designated Executive Director Janine Burke-Wells as its official representative to the stakeholder process, several NEBRA board members plan to attend and participate. According to MassDEP, meeting topics are expected to include regulation of residuals in Massachusetts, available data and information on PFAS in residuals, long-term data needs, considerations for the residuals market in Massachusetts, and potential regulatory approaches for addressing PFAS in residuals.

In addition to the focus on biosolids/residuals, several Massachusetts facilities with expiring National Pollutant Discharge Elimination System (NPDES) permits have received draft permits requiring quarterly testing of effluent for the six PFAS being regulated in Massachusetts. The testing must begin "within six months after EPA's multi-lab validated method for wastewater is made available to the public on EPA's Clean Water Act methods program website, or two years from the effective date of the NPDES permit, whichever is earlier."

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

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

nebra
North East Biosolids & Residuals Association

Upcoming Meetings & Events

The Northeast Residuals & Biosolids Conference is going Virtual for 2020! Join us online to learn the latest trends in the management of biosolids and residuals. It is a *must* for all those involved in the challenge of managing biosolids and residuals.

This conference will address effective and sustainable strategies being used to plan, design and implement resilient projects and infrastructure in areas susceptible to a changing climate.
In addition, the conference will explore existing funding programs throughout the region as well as future financial opportunities that can bring a resilient project to fruition.

WEFTEC CONNECT (VIRTUAL)
October 5 – 9, 2020

NORTHEAST RESIDUALS & BIOSOLIDS CONFERENCE & EXHIBIT (VIRTUAL)
Every Thursday in October, 2020

ANNUAL FALL GOLF TOURNAMENT
October 13, 2020
Sagamore-Hampton Golf Club, North Hampton, NH

PLANT OPERATIONS— TECHNICAL SESSION & TOUR (VIRTUAL)
October 21, 2020,

NEWEA/NEWWA ASSET MGMT & IT WORKSHOP
November 17, 2020,
NEWWA Training Center, Holliston, MA

REACT: RESILIENCY INFRASTRUCTURE IN ACTION CONFERENCE & EXHIBIT (VIRTUAL)
November 19 – 20, 2020

NEWEA ANNUAL CONFERENCE & EXHIBIT (VIRTUAL)
January 24 – 27, 2021

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

NHWPCA TRADE SHOW
September 25, 2020, Radisson Hotel, Nashua, NH

MAWEA ANNUAL GOLF TOURNAMENT
September 30, 2020
Heritage Country Club, Charlton, MA

NERPCA PRETREATMENT WORKSHOP (VIRTUAL)
October 28 – 29, 2020

NHWPCA WINTER MEETING
December 11, 200
Peirce Island WWTF, Portsmouth, NH

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/min)
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)

The Stockholm Junior Water Prize

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

Since its inception in 1997 as an international award, the national Water Environment Federation (WEF), of which NEWEA is a regional member association (MA), has facilitated the U.S. SJWP. In 2001, a state competition was incorporated where state winners are selected and sponsored by MAs. Member association sponsorship of the state SJWP has been essential to the success of the program. Since NEWEA relies on affiliated associations from six states, as opposed to some MAs that only include one state, involvement on the state association level is also a key part of the SJWP program in New England. WEF organizes the national SJWP competition, and solicits electronic research paper entries for each state competition through wef.org/resources/for-the-public/SJWP/ and returns New England entries to NEWEA following the announced deadline. By having applicants apply directly through WEF's website, project presentations can be fairly ranked by local volunteer judges. The competition is open to public, private, or independent high school students in grades 9–12, who have reached the age of 15 by August 1 of the competition year, and who have conducted water-related science projects. More information and a link to the national application form can be found at newea.org/participate/students/. This year, applications were received from only three of the six New England states, so we have no winners to announce from the three remaining states. Please spread the word, so that we can recognize more of the great work of the brilliant students from all six of our New England states.

Thank you very much to the state associations for their continued support, as well as this year's dedicated judging panel: Carina Hart, Denis Cuevas, Lenny Young, Peter Lyons, Marylee Santoro, Tracy Chouinard, David Moering, Annalisa Onnis-Hayden, Charlie Tyler, Garrett Bergey, and Kara Cash. Also, a special thank you to Annalisa Onnis-Hayden for volunteering to transition into the role of NEWEA's SJWP coordinator starting with the 2021 competition.

U.S. Stockholm Junior Water Prize Winner Focuses on Oil Spills, Penguins

Innovative devices to help clean up oil spills won Washington high-school student Zoe Gotthold the 2020 SJWP national competition, the WEF announced in late June. Her project advanced to the international competition (a virtual event held in August) where she was awarded a special Diploma of Excellence while representing the United States in a field including 28 other countries.

Ms. Gotthold developed six prototypes to promote oil flocculation at the water's surface and increase the efficacy of traditional oil spill remediation techniques. She named her project for an animal that would benefit from her inventions: P.E.N.G.U.I.N.S: Promoting Emulsion Nullification Greenly Using Innovative Nucleation Surfaces (A Simple Solution to Oil Spill Emulsions).

"One of the most dangerous components of oil spills is the emulsion that forms between spilled oil and surrounding seawater: this submerged emulsion persists for years and is difficult to remediate," Ms. Gotthold explains in her project.

"This research identified polymers that could accelerate the separation of such emulsions, analyzed properties of these polymers, and then utilized those properties to prototype emulsion-destabilizing devices that promote oil flocculation at the oceanic surface, increasing the efficacy of traditional oil spill removal techniques."

Ms. Gotthold separated her experiment into five parts. First, she simulated an oil spill and analyzed the effects that 12 types of plastics had on emulsion time. Then, she tested the emulsion stability of six types of plastic and glass. After examining emulsion under a microscope, Ms. Gotthold determined that using plastic to remediate oil spills would not significantly affect marine life. Finally, she developed six prototypes, noting that polyethylene consistently decreases the emulsion speed of oil it encounters.

"There was no statistically significant difference between plants grown in plastic-exposed water and those grown in pure water, so this would be an environmentally safe solution if used in oil spill remediation," Ms. Gotthold writes.

The full study will be available soon on the WEF website. A three-minute summary is currently available on YouTube (youtube.com/watch?v=cedSzZcdqew).

This year's three New England state winners

Maine

Amara Ifeji
Bangor High School
Bangor, ME

Testing the Effectiveness of Mycorrhizae in the Phytoremediation of Heavy Metals from Stormwater

Heavy metals found in stormwater runoff threaten public health on an unprecedented scale. Each year, heavy metal toxicity accounts for 4.9 million global deaths and 9.3 million life years lost. Quantification methods for many metals are complex and require expensive instrumentation, training, and time. Therefore, phytoremediation has gained popularity for its cost efficiency and aesthetics. While phytoremediation has been thoroughly researched, the incorporation of arbuscular mycorrhizal fungi, which form symbiotic associations with host plants, to phytoremediation techniques, has been minimally explored. Herein, a filter incorporating both technologies is proposed. A 3x2x8 factorial experiment was implemented in which plants were watered with three concentrations of copper (0 ppb, 500 ppb, 1000 ppb), grown in two different soil types (mycorrhizal, non-mycorrhizal), and the N-size was eight. The concentrations of copper in the filtrates were analyzed using UV-vis spectrophotometry. P-values of 0.0184 and <0.0001 entailed a significant treatment effect where plants inoculated with mycorrhizal fungi had lower concentrations of Cu in their filtrates. Therefore, the inoculation of plants with mycorrhizal fungi is beneficial in removing noxious heavy metal contaminants from the environment.

New Hampshire

Shreya Nagri
Nashua High School South
Nashua, NH

Minimizing Microplastics: Using Biofilms to Degrade Microplastic Contamination in Water

Microplastics are a growing threat to Earth's water supplies from plastic waste, commonly caused by polyethylene terephthalate (PET) used in single-use containers. A gene encoding an enzyme that breaks down PET has been engineered into a plasmid expressed in *Escherichia coli K12* . This study explores the use of biofilms, collaborative communities of bacteria, for bioremediation of microplastic contamination in water. Trials were conducted using liquid cultures and biofilms of wild type and transformed *E. coli K12* to test their efficacy in breaking down PET from a single-use bottle. Area of PET was measured over time using ImageJ software developed by National Institutes of Health and the Laboratory Optical and Computational Instrumentation to track different time points over the course of the experiments. Results suggest that a PETase biofilm may accelerate the degradation of PET in solution, but future studies are needed to verify this finding. When comparing a biofilm of transformed bacteria against liquid culture, results also suggest that the biofilm was more effective. Future work includes repeating the experiments over a longer period of time to observe the long-term degradation of PET when exposed to the PETase bacteria in different forms.

Connecticut

Colin Speaker
Greenwich High School
Greenwich, CT

Enhancement of the Efficiency of Solar Water Disinfection Systems Using Riboflavin as a Photocatalyst

The availability of clean water is a major determinant of health and quality of life, affecting billions of people in the developing world. Solar disinfection (SODIS) supplies water to 4.5 million people, and greater efficiency is critical to those deprived of clean water when UV radiation is blocked by atmospheric conditions. Photocatalysts make these systems more efficient but have not proved to be cost-effective. An improved SODIS system was developed using riboflavin as a photocatalyst to enhance the antimicrobial efficacy of the UV radiation present in sunlight. The ability of 0.1% riboflavin to enhance the bactericidal efficiency of UV radiation against 10^5 CFU/ml of *Escherichia coli* was investigated in a plastic water bottle system as well as a higher output SODIS system with a compound-parabolic solar collector. Addition of riboflavin prior to UV irradiation enhanced disinfection by 50-fold in both systems. Riboflavin, or vitamin B2, is non-toxic and is an essential nutrient. These results suggest that riboflavin-enhanced SODIS could expand access to clean water efficiently and cost-effectively in the developing world.

New Members May – August 2020

Ian Kosnik
Silver Spring, MD (STU)

Sarah Dawson
Trumbull, CT (STU)

Anne Lamonte
Northeastern University
Boston, MA (STU)

Samantha Kinnaly
Peabody, MA (STU)

James Finnegan
Media, PA (STU)

Matthew Deluca
Aqua Solutions, Inc.
Middleboro, MA (YP)

Olivia Lafond
Woodard & Curran
Dedham, MA (YP)

Kristin Darby
Grenier Engineering
Waterbury, VT (YP)

Jeffrey Devine
Braintree, MA (PRO)

Kate Engler
Harvard, MA (STU)

Dennis Keough
O'Connor Corporation
Canton, MA (PRO)

Elizabeth Olliver
Acton, MA (YP)

Hanna Schenkel
Boston, MA (STU)

Emma Totsubo
Los Angeles, CA (STU)

Christopher Trudel
Town of Milton
Milton, MA (PRO)

Ana Martha Fernandes
Boston, MA (PRO)

Jamie Hawes
Duraflow
Burlington, ON (PRO)

Tracy Santoro
Denver, NY (PRO)

Sam Mikell
Williston, VT (STU)

Denise Prussen
Brookline, MA (YP)

Jacob Senecal
Bradford, VT (STU)

Christina Adams
Resource Management, Inc.
Holderness, NH (PRO)

April Sargent
Holderness, NH (PRO)

Rylan Farr
Apex Companies, LLC
South Windsor, CT (EXEC)

Charles Stone
Lowell, MA (PWO)

Keithe Merl
West Grove, PA (PRO)

Joseph Towle
Dover, NH (YP)

Terry Keller
Winter Harbor Utilities District
Winter Harbor, ME (PWO)

Taylor Corsano
Hingham, MA (YP)

Daniel Turner
Blue Whale Technologies
North Dartmouth, MA (PRO)

Richard Friesner
NEIWPCC
Lowell, MA (PRO)

Sadia Tamanna
Roxbury, MA (STU)

Emily Cole-Prescott
City of Saco
Saco, ME (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)

Maine State Director Report

by Jeffrey McBurnie
Jeff.McBurnie@casella.com

The Grateful Dead, looking to the past, had no idea of what lay ahead when they wrote "What a long, strange trip it's been." When I was writing an earlier article for the spring *Journal*, I may have had an inkling of something called coronavirus. Fortunately (or so I thought) it was half a world away and not something worthy of much of my attention. Now winter, spring, and summer have passed and what a short, strange trip it's been. Quarantines, lockdowns, overwhelmed ERs, personal protective equipment shortages, accelerated research of vaccines and cures, and financial chaos have become part of our daily conversations.

There will be no return to normal; there will be a new normal, and hopefully we will all be better because of this. One of our main goals as utilities and supporters of utilities is to build resiliency. We have shown our mettle and adaptability during this crisis, continuing to ensure the protection of public health and the environment.

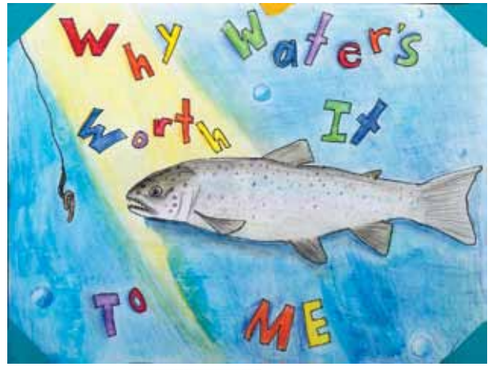
The state of Maine has been relatively unscathed during this crisis. While the impact to Maine is not insignificant health-wise or economy-wise, compared to most of the nation we have fared well. Maine's Governor Mills implemented a state of emergency plan early on and has slowly reopened the state as data indicated what activities could "return to normal." At the time of this writing, we have had nearly 4,000 positive cases and more than 100 deaths attributed to COVID-19; one death is too many. As things stabilize, the State continues to monitor the situation, with some attention to the possibility of a "surge" this fall or early winter.

While clean water utilities continued to perform their duties, some unfortunate disruptions occurred to operations for the Maine Water Environment Association (MEWEA). Several activities were canceled (Ski Day, Spring Conference, D.C. Fly-in) while others (Executive Committee meetings, Urban Runoff 5K, Clean Water Week Poster contest) went virtual. Even though our state government was essentially closed and the governor was granted expansive emergency powers, our MEWEA government affairs team was working on several issues of interest to the association and its membership, including fate and transport modeling of PFAS, statute of limitations for entities affected by environmental contamination, and PFAS designation as hazardous substances.

Our primary concern was how to continue to serve our membership's training needs. Because they are essential workers, we are conscious about not exposing our utility operators to risks that could put them out of work and thus disrupt utility operations. Ultimately our Fall Convention is being held virtually as a series of shortened webinars, typically one to two hours. We are still working on ways to support our loyal vendors who cannot present in person at our Trade Show. We are fortunate to have several top-notch training partners in Maine who have made sure ample training opportunities are available to water and wastewater operators. Kudos to the Joint Environmental Training Coordinating Committee, the Maine Water Utilities Association, and the Maine Rural Water Association for nimbly switching to virtual platforms to deliver exceptional training content.

Some may tire of hearing "We're all in this together," but when people start selfishly thinking otherwise, the battle is lost. As water professionals, we benefit from a wide network of local, state, regional, national, and international colleagues, all ready and willing to provide support and relief. This pandemic debacle is just another challenge—not unlike other past challenges—that we will weather and overcome. And that is only possible if we are all in this together. #WaterStrong

A Sampling of Maine 2020 Water Week Poster Contest Entries



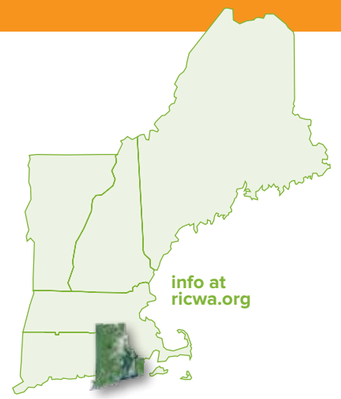
Top:
Gabrielle Davis, Gr. 6

Middle (L-R):
Kaitlyn Fortie, Gr. 6
Olivia Zadakis, Gr. 6

Bottom (L-R):
Naliyah Love, Gr. 7
Mary Jane Owens, Gr. 9

Rhode Island State Director Report

by Scott Goodinson
sgoodinson@narragansettri.gov



Greetings from the Rhode Island Clean Water Association (RICWA)—"Boy what a year 2020 has been!" The year started off great—this was going to be a great year! Just saying "2020" sounded great. Little did we all know a month or so later would begin what may become one of the worst years ever.

Rhode Island Governor Gina Raimondo was one of the nation's first to implement a state of emergency in the early stages of the coronavirus. In the beginning we were in lockdown mode for several weeks and over several months have been slowly reopening in stages. For a state of our size and population density, we have fared, and continue to fare, extremely well during this horrible pandemic.

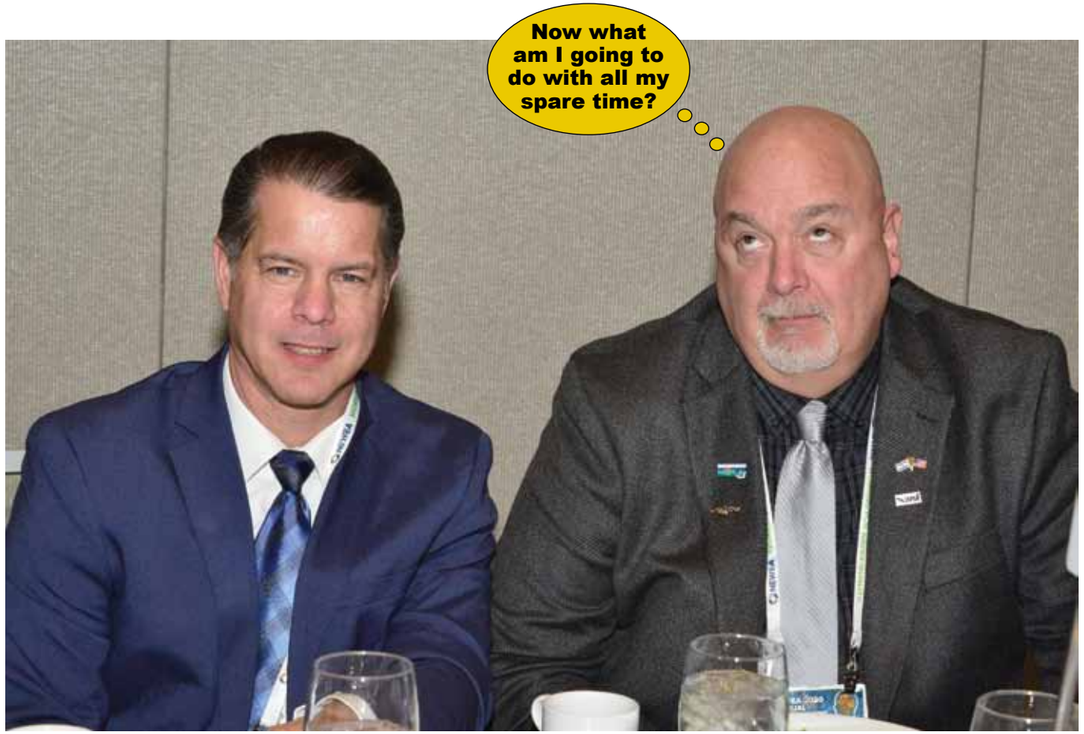
Not all is doom and gloom, however. The board held its annual scholarship giveaway, and four deserving recipients were selected. The association plans to provide at least two virtual training sessions before this year ends.

Fear, quarantines, masks, personal protective equipment, hand sanitizer, disinfectants—and don't forget to wash your hands 20-plus times a day. You may be able to work from home, but if you need to go to work, let me take your temp and ask you 13 personal questions every day; don't forget to stay 6 ft (2 m) away and, by the way, What the heck is a Zoom meeting? The gym is closed, and I need new pants because someone left them in the dryer too long. "OMG, did he just cough?" "Oh no, she just sneezed near me!" Am I going to get sick or worse? Can I get a test? Should I get tested? A new vaccine? Fake news? Real news? Protests, rioting, civil unrest, and dissension everywhere you look. Where is the world we once knew? Who do we go to for answers? What is the new normal? Whew—these are daunting, trying times for all of us!

Unfortunately, because of state COVID-19 restrictions and Centers for Disease Control and Prevention recommendations, RICWA had to cancel nearly all our scheduled 2020 events so far. After a long absence, the RICWA executive board finally held its first "virtual" meeting on July 14 to discuss the State of Rhode Island policy regarding how many people would be allowed for an association function. At the time, the number that could gather was limited and as a result the board canceled the then-upcoming Trade Show/Clambake. As with the other New England operator associations, the debate over whether to hold a group function depended on the shifting projections about what the state of the pandemic may be at the time the scheduled function would finally be held.

RICWA usually holds its annual golf outing in late June every year, and one of the discussions leaned toward having a golf outing in September, since Rhode Island was allowing up to 150 people for any outdoor event. However, after more consideration and learning more details about the new, stringent golf guidelines, it was decided not to hold the event.

Not all is doom and gloom, however. The board held its annual scholarship giveaway, and four deserving recipients were selected. The association plans to provide at least two virtual training sessions before this year ends; this would be the first time RICWA (as with many associations) attempted to use this method for training. To support our wastewater professionals at the start of this pandemic, RICWA emailed a survey to all current and past members (including those who have retired) to determine who could fill positions



RICWA President Peter Connell and State Director Scott Goodinson at the 2020 NEWEA Awards Banquet...goofing around...LOL!

at a wastewater facility in case it was short on staff due to illness. The response was remarkably positive, but as it has turned out, no treatment plants have needed emergency help...so far. One interesting remaining challenge will be how to handle elections (usually held at an in-person association meeting) of new officers for 2021.

In harmony with other New England states, RICWA submitted a letter urging our Rhode Island federal delegation leaders in Washington, D.C., to support water sector funding with any new coronavirus economic recovery package.

RICWA has also used this downtime to continue to revamp the website (ricwa.org), though it is still a work in progress.

Sadly, this will be my last *Journal* report as NEWEA's Rhode Island state director, as my three-year term will end in January. The journey has been absolutely amazing! The water professionals I have come to know and admire over the last several years will never be forgotten. I can honestly say the NEWEA Executive Committee, senior management team, other committees I served on, the Operations Challenge troops, vendors, and so many more people have all been wonderful. The office staff (Mary, Janice, Linda, Jordan, and Heather) have done an awesome job keeping us focused on the goals. I'll never forget the team leaders who have helped me during my role as the Rhode Island state director: a huge "thanks" to Janine, Charlie, Jenn, Ray, Jim, John, Matt, Sue, Bill, Fred, Adam, Paul, Phil, Virgil, Chris, Clay, Jay, Howard, Mac, and so many more. A special memorial shout out to Kate; though you are no longer here, your smile and shine will be with me and many others forever! A special thank you to Travis for all his help mentoring me into my new role as Operations Challenge chair and his years of tireless dedication and for being super-organized (something I need help with!). So many others have helped me these last three years; to all of you: Thanks, you will always be considered my friends!

Connecticut State Director Report

by Bill Norton
WNorton@fairfieldct.org

The new norm is cancellations, Zoom and teleconference meetings instead of in-person meetings, and the beat goes on. As we clean water and drinking water service people are "essential employees," we continue to provide clean water to our customers and return clean water to the environment during this extraordinary time of COVID-19.

The Connecticut Water Environment Association (CTWEA, formally the CWPAA) and the Connecticut Association of Water Pollution Control Authorities (CAWPCA) continue to meet virtually either through Zoom meetings or by conference calls. These calls focus on how best to get things scheduled, re-scheduled, or canceled for the rest of 2020. Things such as the Washington, D.C. Fly-In, NEWEA Spring Meeting, CTWEA Product Show, CAWPCA Spring Workshop, and Manager's Leadership Program have all been canceled.

The only certainty is that the CTWEA Golf Outing was held at the Skungamaug River Country Club in Coventry on August 14 (rescheduled from June 19). The registration was limited to 80 players, social distancing was encouraged, and hand sanitizer and face masks were given along with the usual golf tees and goodies. Our golfers had a great day on the course, and we raised $2,450 to support our Operations Challenge and $2,800 to help fund the CTWEA Scholarship Program (four $500 scholarships were awarded in June). The day finished with our hungry golfers enjoying a socially distanced, picnic-style meal under open tents.

Despite the pandemic, we have managed to continue trying to improve our industry's functions. As a result of CTWEA and CAWPCA petitioning the Connecticut Department of Transportation (DOT), cities and towns will now be fully reimbursed for "raising and/or adjusting of utility structures." In the past, municipalities were lucky to receive 25 percent or 50 percent of the costs in adjusting these structures. A DOT letter dated May 20, 2020, addressing "Utility Adjustment on State Maintained Highways—Maintenance VIP Resurfacing Program 2020 Construction Season," describes the reimbursement procedure and the methodology for municipalities to be reimbursed. Congratulations to the CTWEA and CAWPCA staffs for this accomplishment.

Sally Keating of the Hartford Metropolitan District and her committee continue to meet with Department of Energy and Environmental Protection staff to discuss changes and develop a Miscellaneous Industrial User General Permit (MIU GP). This new MIU GP will replace the General Permit for Miscellaneous Discharges of Sewer Compatible Wastewater.

In the coming months we will learn how we can meet and gather as individuals and organizations in what has become the "new norm" due to COVID-19. In the meantime, everyone please stay healthy and safe as we navigate our way through this incomprehensible time.

Picnic with social distancing

Massachusetts State Director Report

by Adam Yanulis
FAYanulis@tigheBond.com

Massachusetts has been experiencing many of the same challenges as other New England states during the COVID-19 pandemic. Safety of staff and the public while maintaining compliance have been at the forefront for all utility managers. Initially, many utilities developed staggered schedules to ensure coverage of key treatment and collection system infrastructure.

Over the past two months, however, many utilities have gone back to regular schedules and regular operations, but with a careful eye on coverage in case of illness. For the most part, hygiene and handling protocols already in place based on the normal hazards of working with wastewater seem to have been adequate to avoid widespread COVID-19 infection within our industry.

Since early March, the Massachusetts Department of Environmental Protection (MassDEP) (along with EPA) has been hosting weekly (recently stretched to bi-weekly) updates for wastewater utility managers and operators. These meetings have been well attended and important in establishing communication protocols developed by the MassDEP and EPA. MassDEP, working with Massachusetts Water Environment Association (MAWEA) and its members, used these meetings to develop plans and iron out supply issues for personal protective equipment distribution at the beginning of this pandemic. Operator certification issues have also been part of the weekly discussions and the board of certification of operators has held frequent (by conference call) emergency certification meetings to ensure that all facilities have adequately certified staffing ready to help maintain required coverage. MassDEP Commissioner Martin Suuberg and Assistant Commissioner for the Bureau of Water Resources Kathleen Baskin have continued to be excellent resources for utilities over the past several months.

MAWEA continues to hold virtual board meetings, and recently key personnel participated in a meeting of NEWEA-affiliated state associations, sharing issues and experiences with other New England state organizations. Most MAWEA events scheduled for 2020 have unfortunately been canceled including the scheduled March Trade Show and the June quarterly meeting (that is also the annual election meeting) usually held in Holyoke. Training continues to be important to the services we provide our members, and we are working with NEIWPCC to develop and ensure adequate virtual sessions for the fall, including a foreshortened (and lunch-less) virtual version of our fall quarterly meeting with technical and informational content on the afternoon of September 23.

With normal association fundraising activities on hold, some nervousness exists about budgets, but so far, MAWEA is solvent and performing its basic valuable services to members. In a show of optimism and following the lead of New Hampshire Water Pollution Control Association (NHWPCA) and Connecticut Water Environment Association (CTWEA), the MAWEA golf event has been rescheduled for September 30 at the Heritage Country Club in Charlton. To allow for adequate distancing, attendance will be limited to 20 foursomes (80 golfers), and we have our fingers crossed that the state pandemic guidelines will allow that size of outdoor gathering by then.

With the cancellation of our spring election meeting, MAWEA had to make special pandemic accommodations and hold its election by email notification of the membership, and the slate of officers, which is customarily approved by voice vote at the June meeting, was instead approved by consent of the membership through email communication. The MAWEA officers for FY 2021 (starting July 1, 2020) are President John Downey, President-elect Benjamin Smith, Past President Eric Smith, Treasurer Richard Nash, Recording Secretary Charles Tyler, MassDEP Representative John Murphy, and Directors Michael Burke, Rob Delgado, John Digiacomo, Robert Greene, Ken Harwood, Landon Kendricks, Jennifer Lichtensteiger, Peter Lyons, and Raymond Willis. We wish our officers and our membership health and success in the challenging year ahead.

New Hampshire State Director Report

by Steve Clifton
sclifton@underwoodengineers.com

In March, the federal and state government alerted the public to an outbreak of a highly contagious viral pandemic sweeping through China and starting up in the United States. Non-essential businesses were closed, social distancing was advanced, and frequent hand washing was promoted. The goal was to reduce the spread of the contagion enough so that the hospitals would not be overwhelmed with COVID-19 cases. Sadly, the dire predictions proved true, and we are now in the sixth month of this horrible event that has changed and affected everyone.

Water and wastewater professionals have been deemed essential, allowing work to continue under trying circumstances. For those who could work remotely, work from home became the norm as Zoom, GoToMeeting, and Microsoft Teams became the new language of the day to continue working. Plant operators adapted to the new structure differently, but it was business as usual for those charged with continuing to process clean water from the flow in sewage collection systems. Alternate shifts, closed gates, and cancellation of all outside events were instituted at most facilities. Visits to wastewater treatment facilities (WWTFs) to look at new equipment and transfer knowledge became hazardous, unusual events rather than the norm.

The apparent risk of contracting COVID-19 is no greater than that of any other biological hazard for wastewater operators, and the conscientious use of protections already in place should adequately address those risks.

Most New Hampshire WWTFs were experiencing dry weather flow, reduced flows from commercial businesses, and higher influent concentrations. Communities that would normally experience seasonal high flows and loads from tourism suddenly had a summer without these impacts, a most unusual experience not seen in my lifetime.

Some good news for operators was the proclamation that to date, the scientific community has found no evidence of viable COVID-19 virus in wastewater systems. Further, the apparent risk of contracting COVID-19 is no greater than that of any other biological hazard for wastewater operators, and the conscientious use of protections already in place should adequately address those risks. To reinforce these practices, WEF offered free access to "Biological Hazards at Wastewater Treatment Facilities," which is Chapter 8 of WEF's *Manual of Practice No. 1, Safety, Health, and Security in Wastewater Systems* (Sixth Edition).

New Hampshire Water Pollution Control Association (NHWPCA) Board of Directors acted decisively with online board meetings and delayed events, which progressed into further delays and canceled events. Our major event of the year, the annual Trade Fair, was scheduled for April and delayed until June and then again until September. In a COVID-19 world, September seemed ages away, but with the ongoing contagion, planning and scheduling has become a nightmare. Without the Trade Fair, our revenues gained to fund our newsletter, the Fish and Game Day event, the Legislative Affairs Breakfast, and many other typical funded uses will not be there into the next year.

To the credit of the NHWPCA Board, it continued to fund the quarterly publication of our newsletter, *The Collector*, even though funds are dwindling and revenue is nonexistent. The board felt that operators look forward to *The Collector,* and it would boost morale to show that as an organization we do not give up and lose hope.

Many businesses and vendors have stepped up and offered to waive refunds for events for which they have paid, even though the event may have been delayed or canceled. During this adversity, a different side of humanity is coming to the forefront, one that displays generosity in an uncertain economic future. We appreciate the sacrifices and see them as a sign that together we will make it through these difficulties and come out better for it.

NHWPCA Golf Tournament

In an otherwise barren summer events calendar, NHWPCA held its 31st Annual Golf Tournament on Thursday, August 6, 2020, at the beautiful Beaver Meadow Golf Course in Concord. Fred McNeill promoted the event and motivated members to attend. His hard work this year resulted in a great turnout and a lot of fun. More than 100 golfers participated under a blue bird summer sky at "The Beave." Enthusiastic golfers from several New England states flocked to support one of the first golf events of the pandemic season. After the round of golf, guests enjoyed a delicious Pandemic Picnic in an outside tent with a socially distant atmosphere. BBQ ribs, sweet sausage, Boston baked beans, and an assortment of sensational salads where shared by all during the awards ceremony. Sponsors provided $6,000 in prizes to support our wastewater first responders. The day provided a much-welcomed break from the ongoing pandemic.

NHWPCA Trade Fair

At this writing, our Trade Fair event is still proceeding and has been rescheduled for September 25 at the Nashua Radisson Hotel. The Fall Meeting, usually held in September, was canceled in favor of the trade show. The latest information can be found on our website, nhwpca.org. Please check there for all the latest updates.

Training Classes

Classes are now online when they can be scheduled. The June operator's exam was held over three days to allow for socially distanced small class sizes. Dick Emberley, John Adie, and Ken Kessler from New Hampshire Department of Environmental Services have been trying to maintain the ongoing training schedule. Updates and guidelines can be found at its website: des.nh.gov/organization/divisions/water/wweb/operator.htm.

December Meeting

This event is planned for December 11 at the Peirce Island WWTF in Portsmouth. Highlights of its new biological aerated filters to achieve BOD5 and nitrogen removal will be on display.

I end this report with a silent prayer that asks comfort for those who have suffered, those who have lost loved ones, and those who are out of work and are facing difficulties. Let us hope that, in hindsight, 2020 proves our worth as a people and as a nation.

The Squamscott River is a 6 mi (9.7 km) long tidal river in Rockingham County, southeastern New Hampshire

Vermont State Director Report

by Chris Robinson
crobinson@shelburnevt.org

To say that this year has been unusual is an understatement. Owing to the state's and country's response to COVID-19, our normal way of life this last six months has been significantly altered. We look forward to and are hopeful that 2021 will be the transition year back to normal.

The COVID-19 restrictions are taking their toll on Green Mountain Water Environment Association's (GMWEA's) operations. The spring and fall meetings were canceled, as was the George Dow Memorial Golf Tournament. This has significantly affected GMWEA's revenue stream. The board of directors (BOD) has taken steps to preserve our current funds. One step was to furlough our executive director for a few months.

All four *Don't Flush It!* brochures are available for download at GMWEA.org

In response to the epidemic, the Vermont Department of Environmental Conservation (DEC), Vermont Rural Water Association, and GMWEA reactivated the Vermont Water/Wastewater Agency Response Network (VT WARN) system. This emergency system was relaunched as a cooperative backstop to help in case facilities needed critical resources to continue to operate. These resources could include, among other assets, equipment or even substitute operators. The system is being hosted on the state's website.

Septage to wastewater facilities has increased noticeably in Vermont with the large increase of people working from home due to current circumstances, 55 percent of Vermonters being served by septic systems, and the elimination of land application of septage (due mostly to PFAS concerns). The effect of this septic load on treatment processes has forced the state to address the situation.

GMWEA has remained active and is continuing to work hard to meet member needs. This summer, the last of the Don't Flush It! brochures, "House & Garage Hazards," was successfully distributed. This latest brochure, along with the three previous brochures (Cloggers, Drugs, and Lawn & Garden), is available for download at GMWEA.org.

GMWEA also continues to offer limited training to members. This spring the Sacramento Wastewater Course was offered, and on September 23 and 24 a virtual stormwater training program is scheduled.

The GMWEA BOD held elections this spring via online voting. Below is the new slate of officers and the list of directors. I would like to welcome new BOD members Christine Dougherty, Joe Duncan, and Brian Ovitt. Until further notice all BOD meetings will be by remote attendance, but we look forward to meeting in person again soon.

GMWEA officers: President/Michael Barsotti, 1st Vice President/Eileen Toomey, 2nd Vice President/Wayne Elliott, Treasurer/Rick Kenney, Secretary/Amy Macrellis, Past President/Tom DiPietro, Director/Chris Robinson, Directors/Bob Fischer, Ryan Peebles, Christine Dougherty, Joe Duncan, and Brian Ovitt, Executive Director (on temporary furlough)/Daniel Hecht.

This will be my last report as NEWEA's Vermont state director, as my three-year term expires at the end of January 2021. I would like to thank all the folks at NEWEA who have made this experience so fulfilling. The professionalism, experience, dedication, and kindness of the NEWEA Executive Committee is second to none. Thank you for the opportunity; it was a great experience. Stay safe and stay well.

Thank you

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

NEWEA
WORKING FOR WATER QUALITY

Advertiser Index

Upcoming *Journal* Themes

Winter 2020—**Stormwater**

NEWEA/WEF* Membership Application 2020

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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*

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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

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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

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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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