WASTEWATER

Phosphorus removal at a sequencing batch reactor plant

Flow distribution improvements at the Stamford Water Pollution Control Facility

Installation of screw press for solids dewatering at the Westerly Wastewater Treatment Plant

Beginning anew—a wastewater treatment system design for Orleans
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On the cover: Depiction of influent flow from Plainville’s sequencing batch reactor fill pipe
Page 64: Measurement unit conversions and abbreviations
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The months of my term are flying by. Since the Annual Conference in January, things have been very busy. One focus of mine has been with the NEWEA/New England Water Innovation Network (NEWiN) collaboration. In February, we met with NEWiN Executive Director Marcus Gau (you may remember him if you attended the Innovation Pavilion at the conference) to discuss possible next steps in moving this relationship forward. Innovation Task Force Chair Howard Carter and Executive Director Mary Barry have been working out details, and an initial presentation was made at the April Executive Committee meeting. The discussions of a potential partnership are continuing, so stay tuned.

Another major focus for me was planning for the Spring Meeting at the historic Wentworth by the Sea in beautiful New Castle, New Hampshire. The Meeting Management Council and NEWEA office staff produced an outstanding program this year, and my request for nice weather was kindly answered throughout the conference. It was exciting to have New Hampshire Senator Jeanne Shaheen as our keynote speaker. There was also a facility tour of Portsmouth, New Hampshire’s upgraded Peirce Island facility. This 61 mgd (23.1 ML/day) facility, now under construction, will use biological aerated filter (BAF) technology for nutrient removal as well as feature many other upgrades; the total estimated cost is more than $80 million. On the Saturday before the Spring Meeting, our Young Professionals Committee engaged in another service project. This year’s project was in Dover, New Hampshire, rehabilitating a bioretention basin that has successfully removed pollutants in the Barry Brook watershed.

On March 21, the Plant Operations Committee held a specialty conference in Billerica, Massachusetts, where more than 70 attendees learned more about phosphorous removal in the Sudbury-Assabet-Concord River watershed. The conference highlighted phosphorous removal upgrades to the water resource recovery facilities within the watershed, and a presentation was made about the history, operation and maintenance, and ongoing impacts followed by an interactive roundtable discussion by facility leaders. Plant Operations Chair Tom Hazlett and the committee did a great job organizing an informative conference.

The senior management team has been busy attending state legislative events throughout New England. New England Water Works Association (NEWWA) President Dave Miller and I were fortunate to deliver the opening remarks in our home state at the New Hampshire Water Pollution Control Association’s event, which was once again well attended. NEWWA’s WEF Delegate Fred McNeil deftly orchestrated an informative “Waters Worth It” agenda for New Hampshire legislators.

On the national government level, this year I attended my first D.C. Fly-in, and what a fast-paced event it was. The action started with our NEWEA kickoff lunch, sponsored by Massachusetts Congressman James McGovern, who offered us optimistic remarks regarding upcoming water funding. The NEWEA Government Affairs Committee and our state liaisons put together the congressional briefing and organized the all-important appointments with Senators, Representatives, and legislative staffs. NEWEA and NEWWA emphasized two key issues, one to provide adequate funding for water quality and a second to use sound science and research before imposing additional regulatory requirements on utilities. With respect to sound science, we might have slipped in one more issue, perfluoroalkyl and polyfluoroalkyl substances (PFAS), which have rapidly become a priority in our water profession; we desperately need our congressional leaders to help us cope with this emerging concern.

On a chilly April 12, the Operations Challenge and Plant Operations committees jointly hosted an Operations Challenge training day at the West Warwick, Rhode Island treatment facility. This year 40 participants attended, and most participants also took advantage of the facility tour. With this training under their belts, this year five teams...

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(the most in a long time) competed tightly at the NEWEA Spring Meeting. Congratulations to all five teams on a hard-fought contest! The winning teams, from Rhode Island, Connecticut, and Maine, will represent New England at the national Operations Challenge event in Chicago in late September.

Finally, in case some of you are not yet aware, Linda Austin, our longstanding NEWEA administrator, will be retiring after the Spring Meeting. Ms. Austin recently said to me, “Ray, I don’t know if I can do this anymore after dealing with you!” So I guess I may be remembered as the president who drove her into retirement; I was hoping to accomplish something better than that. All kidding aside, while we will miss Ms. Austin sorely, we wish her many years of enjoyment in her retirement. In the meantime, Ms. Barry and the NEWEA staff have completed interviews, and a newly-hired office administrator, Ms. Cindy Avgarinas has begun taking over essential duties formerly performed by the irreplaceable Ms. Austin.

As always, thank you to all our members and volunteers for your hard work and enthusiasm; you are the essence of NEWEA, and it is a privilege to represent you all. I hope to see you at the Spring Meeting.
Environmental stewardship seems to be increasingly relevant in today’s news and pop culture. Leonardo DiCaprio becoming the face of clean water? A satirical rapper alongside an impressive list of Hollywood’s most famous celebrities creating a Billboard Top 100 song about protecting the Earth? A Silicon Valley company, impossible™ Foods, seeking to make environmentally friendly meat options more widely available and scoring an absolute success of its recent debut of the completely meatless impossible™ burger at burger King? It’s been nearly 60 years since Rachel Carson’s Silent Spring was published, and nearly 50 since EPA was created. Why has it taken so long for environmentalism to become more prevalent in American pop culture? I’ve always loved Joni Mitchell, and one of her staple songs holds true today. “Big Yellow Taxi,” released on the 1970s’ album Ladies of the Canyon paints a blunt picture: “Don’t it always seem to go / That you don’t know what you’ve got ‘til it’s gone / They paved paradise and put up a parking lot.” Of course, the parking lot of 2019 would (hopefully) be made of porous pavements with various stormwater best management practices (BMPs), but you get the idea. The recently issued Intergovernmental Panel on Climate Change report described a mass die-off of coral reefs as soon as 2040. Yes, 2040! In 2040 Gen-Xers will be of age to take a solo vacation to visit the Great Barrier Reef, and we’d be remiss to deny them the opportunity to capture the perfect Instagram, #blessed.

We certainly did not choose the most glamorous of professions when we entered this field. My father (also a wastewater professional) visited my first-grade class to talk about his profession. I will never forget the look on my classmates’ faces as he passed around a sealed jar of mixed liquor. They then proceeded to kindly refer to me as the “the poop doctor’s daughter” for the rest of the week. I believe that jar of mixed liquor would be better received today, amid the recent poop emoji fad. Teaching children about wastewater treatment from a young age is going to help shift the immediate guttural yucks! to more positive responses. Perhaps this is a stretch, but maybe the widespread availability of poop emoji keychains, pillows, and iPhone cases are inspiring the “poop doctors” of the future!

I may be partial, but what could possibly be cooler than curating the perfect home to over a million species of microorganisms and manipulating them to undergo targeted respiration processes to not only “remove” various pollutants from the liquid phase but then to also recover invaluable resources like nutrients and carbon. We strive to give (and cruelly take away) everything that these microorganisms need, and we make them work. With ever-lowering effluent requirements, we are pushing the capabilities of these organisms, some of which have been in existence since not long after the days of primordial soup. This Journal issue focuses on just this: wastewater treatment. The articles feature various aspects of planning, design, and construction of wastewater treatment projects around New England. Because this is a summer edition of the Journal, I close my message with a few eloquent words from a fellow climate change enthusiast and early 2000s’ rap royalty, Nelly: “It’s getting hot in here.” Although we’re not on stage rapping these lyrics in front of a sold-out arena, we as an organization are actually doing something about this! Whether you are a pipe designer lining old, leaky sewers, a sales representative selling advanced airflow control valves that deliver air to biological systems most efficiently, a process engineer installing that perfect FRP baffle wall to best manipulate bugs, or an operator prepping for another wet weather day at your facility, we’re all working collectively toward the same goal. Let’s make sure the next generation of meatless cheeseburger eaters and poop emoji lovers understand just how important our work is to the future of this industry and planet.

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EPA Announces Development of Water Reuse Action Plan

On February 27, 2019, at a water reuse workshop in San Francisco, EPA announced the development of a Water Reuse Action Plan that will leverage the expertise of both industry and government to ensure the effective use of the nation’s water resources.

“The nation’s water resources are the lifeblood of our communities, and the federal government has the responsibility to ensure all Americans have access to reliable sources of clean and safe water,” said David Ross, EPA assistant administrator for water. “There is innovative work happening across the water sector to advance water reuse, and EPA wants to accelerate that work through coordinated federal leadership.”

The Water Reuse Action Plan will seek to foster water reuse as important in integrated water resource management. EPA will facilitate discussions among federal, state, and water sector stakeholders and form new partnerships to develop and deploy the plan. A draft of the plan is scheduled for release and public review in September at the Annual WaterReuse Symposium in San Diego.

EPA actions are part of a larger effort to better coordinate and focus taxpayer resources on some of the nation’s most challenging water resource concerns, including ensuring water availability and mitigating the risks posed by droughts. This includes working closely with the U.S. Department of the Interior (DOI), the U.S. Department of Agriculture (USDA), and other federal partners to collaboratively address western water supply, resiliency, and other resource management challenges.

“The Department of the Interior is excited about forging this partnership with EPA so that we can leverage each other’s success and move forward on one path,” said Tim Petty, assistant secretary for water and science at DOI.

EPA will work across the water sector to develop an integrated management approach for our nation’s water resources. Compendium and Guidelines for Water Reuse, but the Water Reuse Action Plan is the first initiative of this magnitude that is coordinated across the water sector. Ongoing efforts by other federal agencies, such as the U.S. Department of Energy’s Grand Water Security Challenge, and by various non-governmental organizations dedicated to water resources management, will be coordinated and leveraged as part of the overarching strategy to advance water reuse.

Background
Water reuse—sometimes referred to as water recycling—may be viable for various applications, depending on site-specific conditions. Examples include agriculture and irrigation, potable water supplies, groundwater replenishment, industrial processes, and environmental restoration. In developing the Water Reuse Action Plan, EPA and its partners will evaluate these and other opportunities for reuse to identify the opportunities and challenges in the following areas:

- Technological improvements, including development, piloting, validation, and data considerations
- Regulatory/policy analysis at all levels of government, including considering public health and addressing barriers to progress
- Financial initiatives, including expansion and clarity in available funding mechanisms
- Performance requirements, including efforts to ensure the quality of reused water is appropriate for the intended purpose
- Access to water use and availability data, including the encouragement of watershed-based information sharing
- Outreach opportunities, including efforts to ensure public understanding of reused water as part of integrated water management

EPA has previously supported water reuse efforts, including development of the 2017 Potable Reuse Note: All EPA industry news provided by EPA Press Office.

River Flow Champion, Dr. Jackie King, Wins 2019 Stockholm Water Prize

Dr. Jackie King has been named the 2019 Stockholm Water Prize Laureate for her game-changing contributions to global river management. She has advanced the scientific understanding of water flows, giving decision-makers methods and tools to assess the full range of costs and benefits when managing or developing river systems.

Dr. King led the early development of the methods as a researcher at the University of Cape Town, funded by South Africa’s Water Research Commission. Later, she and colleagues Dr. Cara Brown and Dr. Alison Jeubert created ecosystem models to demonstrate the ecological and social implications of damming and de-watering rivers. This has enabled objective assessment of the cost of water-resource developments that could emerge linked to benefits such as hydropower and irrigated crops.

Dr. King of the award, “I find it humbling, energizing and very rewarding. I have never sought high-profile jobs but was happy to be a working scientist, free to say what I felt needed to be said. I am delighted that the silent voices of river systems and their dependent people are increasingly being acknowledged. We all lose if rivers become severely degraded due to poorly informed development and management. It does not have to be like that.”

Her commitment to raising awareness of the value of rivers and their importance for millions of people has made Dr. King highly regarded by academics and water managers globally. In its citation, the Stockholm Water Prize Nominating Committee notes that “Dr. Jacqueline King has, through her scientific rigor, selfless dedication, and effective advocacy, transformed the way we think, talk, and work with water as a flow of and for life.”

Dr. King is co-founder of, and principal researcher at, the Freshwater Research Unit, University of Cape Town, for almost four decades. She is now extraordinary professor at the Institute for Water Studies, University of the Western Cape and an independent consultant. As an aquatic ecologist she became influential in the recently established field of environmental flows. Her early research focused on South African rivers, but since the 1990s has moved into advising on river systems across Africa and Asia. As an aquatic ecologist she became influential in the recently established field of environmental flows. Her early research focused on South African rivers, but since the 1990s has moved into advising on river systems across Africa and Asia.

Dr. King’s work has been recognized with both the gold and silver medals from the Southern African Society of Aquatic Scientists and with South Africa’s Women in Water Award in the research category. She was also the 2016 recipient of the “Living Planet Award” from the World Wildlife Foundation for her work on river systems in Africa and Asia. Her academic work includes more than 100 refereed research papers, peer-reviewed books, international journals, and conference proceedings.

Dr. King’s early work influenced South Africa’s 1998 National Water Act and is increasingly guiding governments and institutions across the globe. First as a researcher and later as a consultant, she has worked in more than 20 countries and with governments of the Mekong, Zambezi, Indus, and Okavango river basins, among others.

“Governments developing their water resources understand the potential benefits but not necessarily the costs in terms of degrading rivers. We can now show these ecological and social costs at a similar level of detail to the benefits shown by planners. This is a new kind of information, not available until the last few years, that helps governments better understand the trade-offs involved in development as they decide on their preferred future,” reflected Dr. King.

Dr. King is clear that governments have the right to decide their own path to development. She strives to support them by providing transparent and accessible information so they can effectively assess their different options.

“Dr. King has helped decision-makers understand that healthy river ecosystems are not a luxury, but the basis for sustainable development,” said Stockholm International Water Institute’s Executive Director Torgny Holmgren.

The prize will be presented to Dr. King by H.M. King Carl XVI Gustaf of Sweden, patron of Stockholm Water Prize, at a Royal Award Ceremony on August 28, during World Water Week in Stockholm.

The Stockholm Water Prize, presented annually since 1991, is the world’s most prestigious water award and honors women, men, and organizations who have made extraordinary water-related achievements. All nominations are carefully reviewed by the world-leading water experts of the Stockholm Water Prize Nominating Committee. After the committee has selected a candidate, the Royal Swedish Academy of Sciences makes the final decision, which is confirmed by the Stockholm International Water Institute board of directors.

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EPA Administrator Wheeler Announces New WIFIA Loan Funding for Water Infrastructure Projects

Funding could leverage $6 billion in public and private investment for construction-ready projects to protect drinking water from lead and emerging contaminants, upgrade aging infrastructure, and promote water recycling and reuse.

On March 29, 2019, EPA Administrator Andrew Wheeler announced the availability of funding to provide an estimated $6 billion in Water Infrastructure Finance and Innovation Act (WIFIA) loans in 2019.

“For this round, we are prioritizing construction-ready projects in three areas: reusing and recycling water, reducing exposure to lead and addressing emerging contaminants, and updating aging infrastructure,” Mr. Wheeler said.

WIFIA loans are available to public and private borrowers for a wide range of drinking water, wastewater, drought mitigation, and alternative water supply projects. This year’s Notice of Funding Availability (NOFA) highlights the agency’s priority to finance projects that are ready for construction in the three key areas noted above.

The WIFIA program received $68 million in funding in the Consolidated Appropriations Act of 2019, which was signed into law on February 15, 2019. EPA will accept letters of interest (LOI) from prospective borrowers for 90 days after publication in the Federal Register.

To date, EPA has issued eight loans of around $2 billion in WIFIA credit assistance to help finance $4 billion for water infrastructure projects and create over 6,000 jobs. EPA has invited an additional 42 projects in 17 states and D.C. to apply for a WIFIA loan. These 39 borrowers will receive WIFIA loans totaling approximately $5.5 billion to help finance nearly $11 billion in water infrastructure investments and create 172,000 jobs.

**Brown University Students Awarded $15,000 EPA Grant for Innovative Technology Project**

On March 18, 2019, EPA announced $15,000 in funding for a team of Brown University students through its People, Prosperity, and the Planet (P3) grants program. The team is receiving funding to develop a sustainable technology to help address problems related to basic sanitation and drinking water for homes in tribal and disadvantaged communities.

“EPA P3 grants program supports the next generation of scientists and engineers,” Mr. Wheeler said. “These students are able to take what they learn in the classroom and apply it to real-world environmental problems that require innovative solutions.”

EPA acting Regional Administrator Deb Staro added: “This grant will enable Brown University students to further their critical research to find innovative ways to deliver clean water to Tribal and underserved communities. This funding demonstrates EPA’s commitment to support research at New England colleges and universities that seeks to address some of our most pressing environmental problems.”

The P3 competition challenges students to research, develop, and design innovative projects that address a myriad of environmental protection and public health issues. The Phase I teams will receive grants of up to $50,000 each to fund the proof of concept for their projects.

The Phase I recipients will attend the TechConnect World Innovation Conference and Expo in Boston on June 17–18, 2019, to showcase their research. They can then apply for a Phase II grant that provides funding up to $100,000 to further the project design.

These students, who represent the future workforce in diverse scientific and engineering fields, are following in the footsteps of other P3 teams. Some of these teams have started businesses based on ideas and products developed through their P3 project. In 2018, a previous P3 Phase I awardee from Oklahoma State University (OSU) transformed the research into a business plan and won the Queen’s Entrepreneurs’ Competition with its startup business plan for Contraire, a predictive analysis control system designed to provide near real-time wastewater test measurements. Among 15 other teams, OSU pitched its business plan to a panel of Canadian business leaders and received multiple inquiries from investors.

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Three themes emerged from the forum. First, participants set out to discuss the science behind phosphorus removal and recovery to find out how much we know and don’t know about the process. Second, the forum turned an eye toward future markets and drivers. This discussion also focused on the value proposition of phosphorus recovery, including products (phosphorus, biostabilized valuable metals), services (eutrophication prevention, meeting discharge limits), and global drivers (food products, energy to mine mineral phosphorus). Third, the forum provided an opportunity to look at a broad overview of the environmental effects of phosphorus recovery.

PHOSPHORUS 101

Phosphorus is an essential mineral for growth. However, phosphorus runoff and deposition in water bodies can cause aquatic dead zones that choke off oxygen to plants and wildlife. This leads to a unique conundrum where there can be no life without phosphorus, yet too much has disastrous effects. Furthermore, global supplies are dwindling, and we are facing a potential crisis if renewable sources are not developed. A balance must be struck between efficiently using phosphorus while simultaneously unlocking the process dynamics of a WRRF. Each facility has its own unique characteristics which must be understood for optimal performance. Getting people talking the same language by engaging in open, free-flowing dialogue to examine the past, present, and future of biological phosphorus removal topics and set the agenda for years to come.

The Microbial Database for Activated Sludge (MiDAS), a program started at Aalborg University in Denmark, aims to learn more about these and other organisms by mapping the microbial diversity present in wastewater treatment systems worldwide. Getting people talking the same language by learning more about what options are present at WRRFs can help select for the most efficient and effective microorganisms. Likewise, models frequently are used to help optimize WRRFs, plan for upgrades, and design new facilities. However, the limitations of these models came to the forefront of the modeling discussions as presentations addressed different approaches to unlocking the process dynamics of a WRRF. Each WRRF is a unique system with specific parameters and influent; as such, there exists no one-size-fits-all approach to modeling or treatment. Two approaches highlighted during the forum were suggested for overcoming modeling challenges. One recommends modeling individual units within a system, while the other seeks to develop a predictive system relying on process metabolites. Both models are viable options and the presentations set up a further discussion on how to use information gleaned from a model and put it into practice.

The discussions highlighted one universal truth: the key to all good models is more data to better understand process dynamics. As we get to know more about the intricacies of these systems, models will become more accurate.

VALUE PROPOSITIONS

Forum participants also examined the value proposition of phosphorus recovery. One of the current pain points in widespread phosphorus recovery is that turning these value propositions into reality requires overcoming current technology bottlenecks and improving industry business models. The key to success is broadening the current value potential of bioP from only recovered products to the entire ecosystem. When discussing the barriers for real-world application, several ideas were put forth. These included implementing real-time population sensing, developing cheaper and simpler instruments that can be used by utilities of any size, and incorporating phosphorus recovery in all industries such as food reduction and waste recycling. Additionally, work must be done to develop regulations and incentives that help promote resource recovery while simultaneously educate the public and increase awareness about the potential value. Overall, the tone of the session was optimistic, and attendees agreed that the research and ideas currently being developed were building a much-needed knowledge base which will soon be translated to implementation at WRRFs.

ADDRESSING ENVIRONMENTAL EFFECTS

The forum also provided an opportunity to look at the environmental effects of phosphorus recovery. Representatives from utilities and government entities who have successfully addressed phosphorus concerns in their regions provided insight on replicating their successes. All panelists agreed that clearly defining regional problems is the first step in beginning to address them, science alone can’t fix all problems. The buy-in of local communities is essential to connect. Also, involving key, trusted members of a community can further promote public acceptance. Overall, a clear message tackling a well-defined problem that community members can engage with is the best way to quickly and efficiently get projects completed locally.

MORE TO COME

All participants reconvened at the end of the forum to summarize and discuss the best ways to approach phosphorus removal and recovery now and in the future. Throughout the next few months, the forum’s steering committee members plan to summarize the event thoroughly and release outcome reports. They aim to capture the entirety of the forum, the current state of the phosphorus removal and recovery science, what recovery needs to look like in the next 50 years, and what research needs to be tackled to meet those needs. In the meantime, the forum’s complete, 42-page technical program can be accessed online at wef.org/forum.
Phosphorus removal at an SBR plant

PAUL MORAN, PE, Tighe & Bond, Inc., Westfield, Massachusetts

ABSTRACT | In 2015, the town of Plainville, Connecticut, received a National Pollutant Discharge Elimination System permit requirement to reduce effluent phosphorus to an average seasonal load of 3.49 lb/d (1.58 kg/d), which is equivalent to 0.16 mg/l at the design flow of 2.6 mgd (9.8 ML/d). Five years earlier, Plainville’s water pollution control facility was upgraded for nitrogen removal with sequencing batch reactors (SBRs). A phosphorus removal planning study and design was completed. This paper focuses on four challenges presented by the SBRs and how each challenge was addressed, including the following: 1) dosing chemical in batches; 2) equalizing the flow for stable post-secondary treatment; 3) addressing the potential for double decants; and 4) conducting validation testing to verify equipment selection. The design has been completed, and bids were opened in May 2018. Construction is anticipated to be completed in 2020.

KEYWORDS | Sequencing batch reactor (SBR), phosphorus removal, disc filter, chemical addition

INTRODUCTION | The town of Plainville, Connecticut, owns and operates a wastewater treatment facility (WPCF) that treats the town’s wastewater prior to discharge to the Pequabuck River. The WPCF is designed for a daily average flow rate of 2.6 mgd (9.8 ML/d) and a peak hour flow rate of 7.5 mgd (28 ML/d). The WPCF liquid treatment train includes preliminary treatment, primary treatment, secondary biological treatment using sequencing batch reactors (SBRs), ultraviolet disinfection, and post-aeration.

The WPCF was overhaul from 2006 to 2010. Before then, the WPCF used rotating biological contactors, secondary clarifiers, and mixed media filters. During that overhaul, these older processes were demolished and replaced with SBRs designed for biochemical oxygen demand (BOD), total suspended solids (TSS), and nitrogen removal. Since the town’s National Pollutant Discharge Elimination System (NPDES) permit at the time did not include a phosphorus limit, the WPCF upgrade did not include phosphorus removal.

In 2011, the Connecticut Department of Energy and Environmental Protection (CT DEEP) published its “Phosphorus Interim Strategy.” This included a proposed average seasonal phosphorus limit for the Plainville WPCF of 3.49 lb/d (1.58 kg/d), equivalent to 0.16 mg/l at the design flow of 2.6 mgd (9.8 ML/d), or 0.011 mg/l at the permitted flow rate of 3.8 mgd (14 ML/d). For comparison, the historical seasonal average phosphorus load was approximately 29 lb/day (13 kg/d), meaning an 88 percent reduction was required. Based on correspondence with CT DEEP, the town selected a design phosphorus target of 0.10 mg/l to be conservative in case future limits were lowered. In 2015, the town’s NPDES permit was renewed, implementing the 3.49 lb/day (1.58 kg/d) phosphorus limit that had been proposed in 2011.

SBR Basics | SBRs provide combined aeration and clarification in one tank. In Plainville, four SBRs are used, with one SBR always being filled. The SBRs were sized and designed for BOD, TSS, and nitrogen removal. Each SBR can treat up to 300,000 gal (1.1 ML) of wastewater in each batch, holding an additional 760,000 gal (2.3 ML) of mixed liquor suspended solids (MLSS) below the low water level. Each SBR comprises fine bubble diffusers, a mixer, a decanter, an analog level sensor, a backup high level switch, and a dissolved oxygen (DO) sensor.

Since the influent flow is continuous and no flow equalization or storage is upstream, at least one SBR must receive flow at any given time. Under normal operation, the four SBRs are staggered such that one SBR is always filling and, ideally, one SBR is always decanting. Since a single SBR can receive up to only 300,000 gal (1.1 ML) in a batch, the maximum flow that can be received is limited by the number of cycles per day. The SBRs were designed for a 72-minute fill phase, resulting in a total cycle time of 288 minutes. This results in a maximum flow rate of 6.0 mgd (23 ML/d) among all four SBRs (less than the 7.5 mgd [28 ML/d] peak flow rate). The operators can adjust the phase times under various flow conditions to optimize treatment or for peak flow capacity. Each cycle contains the following phases:

- React Fill: Untreated water continues to enter the tank while the tank is mixed with no aeration provided. Denitrification occurs as microorganisms in the activated sludge metabolize carbon in the incoming wastewater.
- React: The tank is mixed and aerated cyclically. Oxidation of BOD and nitration take place. Denitrification can also occur if the oxygen is depleted when the aerators are off and sufficient carbon is available.
- Mix: The mixers and aerators are turned off, and the activated sludge is allowed to settle to separate the treated water from the microbiology responsible for treatment.
- Decant: The mixers and aerators are left off, and the decanter is lowered, allowing water from the top of the SBR to decant. During the last few minutes of this phase, some activated sludge is wasted from the bottom of the tank.

PHOSPHORUS REMOVAL APPROACH | In response to the new phosphorus limit, the town prepared a phosphorus removal plan that included a desktop screening of phosphorus removal approaches, an analysis of technology alternatives, and jar testing of chemical coagulants.

Phosphorus removal generally consists of two broad steps: First, dissolved phosphorus must be converted into a solid, and then the solid must be removed. Conversion to a solid can be accomplished either chemically by reacting with a chemical coagulant or biologically by incorporating the phosphorus into biomass. A chemical coagulant reacts with the dissolved phosphorus and forms a precipitate. Biological phosphorus removal happens to some extent in every activated sludge process due to microorganisms using phosphorus as an essential nutrient, and this can be greatly accelerated using enhanced biological phosphorus removal (EBPR) to facilitate the preferential growth of phosphorus accumulating organisms (PAOs). Once in solid form, phosphorus can be removed by primary clarification, secondary clarification, or a post-secondary solids removal process. The specific phosphorus removal approach will depend on the effluent total phosphorus concentration required.

Effluent total phosphorus as low as 0.5 mg/l can be reliably achieved using either chemical addition or EBPR, using primary and secondary settling to remove the solids. However, to reduce the effluent total phosphorus concentration as required by Plainville’s NPDES permit, all dissolved phosphorus must be converted to solids and the effluent solids concentration must be extremely low. To reach a target of 0.1 mg/l, post-secondary chemical addition and solids removal are required; this is generally coupled with upstream treatment to reduce the secondary effluent total phosphorus concentration down to 1.0 mg/l.

In Plainville, chemical addition was selected for the upstream treatment, with provisions for chemical injection in the primary clarifiers, in the SBRs, and in the sludge dewatering recycle stream. EBPR to lower total phosphorus to 1.0 mg/l was evaluated but was not considered sufficiently reliable in Plainville due to the limited size and cycle time of the existing SBRs. EBPR may be possible, however; it would compete with nitrogen removal—also a priority for the WPCF—for cycle time.
Several alternatives were considered for downstream treatment, including ballasted flocculation, deep-bed sand filtration, and cloth media filters, which are also referred to as disc filters. The analysis considered the advantages and disadvantages of each type of system, system costs, and operation and maintenance costs, specifically considering the performance requirements and system sizes needed in Plainville. The phosphorus removal plan recommended disc filters with a dedicated coagulation and flocculation system for post-secondary phosphorus removal.

Disc filter design varies significantly from manufacturer to manufacturer. Some manufacturers use an in-to-out flow pattern, which requires a separate bypass system to protect the filters but allows for a lower system profile. Other manufacturers use an out-to-in flow pattern, which allows bypassing to occur over the top of the filters without a separate bypass system but requires a taller building. In addition, both styles can be provided with stainless steel tanks, or they can be inserted into a cast-in-place concrete tank.

Rather than designing both systems for contractors to bid, a competitive pre-selection process was used early during design to select a disc filter manufacturer and tank material. This enabled the manufacturer and tank material to be selected based on both non-monetary factors and total life-cycle costs such as equipment capital cost, building and incidental costs, and operation and maintenance costs based on guaranteed chemical dosages. After selecting the disc filter manufacturer, the town required the manufacturer to perform a validation test using a pilot trailer to verify that its system would meet the performance requirements at the guaranteed chemical dosages.

THE CHALLENGE: SBRs While SBRs have several advantages, the presence of SBRs in Plainville introduced several design challenges to the phosphorus removal project, including batching chemical, equalizing flow, double decants, and validation testing.

**Batching Chemical**
In a conventional activated sludge system, coagulant is added constantly to the MLSS while it is flowing from the final aeration tank to the secondary clarifiers. Coagulant is simply flow-paced, which provides a constant and easily controlled coagulant dose. Mixing occurs naturally while the MLSS is conveyed from one process to another. The presence of the SBRs complicates this conventional approach. Since each SBR serves as both an aeration tank and a secondary clarifier in a single tank, MLSS does not flow from one process to the other. In addition, rather than a steady stream of MLSS that passes from aeration to settling, an entire batch is instantaneously switched from aeration to settling. One solution to this challenge would be to dose chemical upstream of the SBRs before flow is split to the individual SBRs. Doing so provides one dosing location with a steady stream that is easily flow-paced. However, this would mean that coagulant is dosed before the aeration process, thus making the coagulant less effective and less efficient for several reasons:
- The coagulant would react with constituents other than phosphorus in the untreated influent prior to aeration.
- Since non-reactive phosphorus is converted to reactive phosphorus during aeration, the reactive phosphorus concentration at the SBR influent would be lower, requiring a higher concentration of coagulant to remove the same amount of phosphorus.
- Non-reactive phosphorus that is converted to reactive phosphorus during aeration would not be available for coagulation, which would have already occurred. Any newly converted reactive phosphorus not taken up by biomass growth would be passed on to post-secondary treatment.

To better mirror the optimal conventional approach at an SBR plant, the Plainville phosphorus removal design included a coagulant dosing system that doses directly to the SBRs at the end of the react phase. This avoids the disadvantages described above. Instead of dosing a steady stream of coagulant, each SBR would have its own batch volume of coagulant that doses directly to the SBRs at the end of the react phase. This avoids the disadvantages described above. Instead of dosing a steady stream of coagulant, each SBR would have its own batch volume of coagulant that doses directly to the SBRs at the end of the react phase. Each SBR would be filled over a short period of time, allowing the coagulant to react with the influent to provide coagulation prior to settling. The dosing process is controlled by the SBR control system and is set to optimize the dosing system based on experience.

**Equalizing Flow**
Each SBR currently overflows into the decant collection ‘box’ or well, a small structure open to the atmosphere. From here, flow is directed to the UV channel via a common pipe without any equalization. Each SBR decanting results in a constant flow to the UV system and post-aeration tank—all without the need for an equalization tank.

This control sequence was never able to be successfully tuned, however, and the operators have instead selected a constant efficient valve position. The decant now typically occurs in about half of the decant phase time depending on the valve setpoint and the batch volume. Once the SBR batch has been fully decanted, the downstream processes receive no flow until the next SBR decants. While this operating mode works satisfactorily for the UV system and post-aeration tank, cycling batches of flow through the proposed disc filters for phosphorus removal would be significantly more problematic. Post-secondary phosphorus removal down to the low level of 0.1 mg/L requires a finely tuned coagulation and flocculation pretreatment step. It is easily possible for the coagulant and/or polymer doses to be either too high or too low, so the chemicals must be reliably flow-paced. This requires a relatively steady flow through the rapid mix and flocculation tanks and any changes to occur gradually so that the chemical metering systems can also be adjusted gradually.

To overcome this challenge, the phosphorus removal system includes a flow equalization tank to collect the SBR decant in batches, and it is then pumped to the rapid mix tanks at a steady pace. A flow-meter on the pump discharge provides the flow signal used for flow-pacing the chemical metering systems.

To equalize flows under normal conditions, the minimum flow equalization tank volume was set to level out the flow curve through a single decant at all plant influent flow rates, from the minimum hourly design flow rate (0.1 mgd or 2 ML/d) to the peak hour design flow rate (7.5 mgd or 28 ML/d). For each scenario, the flow equalization tank begins to empty when the decant occurs. As the decant occurs filling the equalization tank, the filter influent pumps withdraw water at a rate that is set to equal the plant influent flow rate, thereby maintaining a steady flow rate throughout the decant. Since the decant happens faster than the filter influent pumps are withdrawing water, the flow equalization tank fills up. The maximum volume required for each scenario occurs when the decant ends and the net volume in the tank stops increasing and starts decreasing. This analysis is based on a maximum decant rate of 3.7 mgd (14 ML/d), which in turn is based on the capacity of Plainville’s SBR equipment and a review of the WPCF hydraulic model.

Figure 1 graphs the minimum required flow equalization volume at various influent flow rates using the above analysis. The required flow equalization volume is low when the forward flow rate is low, and it is also low when the forward flow rate approaches the decant flow rate. The storage volume reaches a peak when the influent flow rate is exactly half the decant flow rate (1.86 mgd (7 ML/d)). The minimum required working storage volume at this flow rate is 135,000 gal (500,000 L).

**Handling Double Decants**
If the 300,000 gal (1.1 ML) batch volume of a single SBR is filled in less than the fill phase time (72 minutes by design), the filter influent tanks can no longer accept additional flow. Further complicating this is that the operators can lengthen the SBR cycle to optimize treatment but possibly reduce the maximum treatment flow rate even further. Plainville’s operators typically use an 80-minute fill phase, reducing the maximum treatment capacity to 5.4 mgd (20 ML/d), which is well below the peak hour flow rate of 7.5 mgd (28 ML/d).

To avoid surcharging the primary clarifiers, the SBR control panel includes a ‘storm mode,’ which automatically shortens SBR phases to make room...
for the additional flow. In this mode, one SBR begins to decant early, while another SBR is still decanting. If the storm mode occurs for an extended period, two SBRs could begin decanting simultaneously.

This would result in an SBR effluent flow rate of 12 mgd (45 ML/d) for up to 72 minutes even though the WPCF influent flow rate is between 6.0 mgd (23 ML/d) [design max day flow rate] and 7.5 mgd (28 ML/d) [design peak hour flow rate].

If a flow equalization tank were designed with 235,000 gal (850,000 L) to equalize the flow as described above, it would fill after only 43 minutes of 12 mgd (45 ML/d) entering and 7.5 mgd (28 ML/d) exiting. As a result, to handle a double decant, either the post-secondary treatment process must be sized for much larger than the WPCF’s peak hour flow rate, or the equalization tank needs to be upsized to equalize a double decant. Plainville selected the latter.

To accommodate a double decant, the equalization tank size is determined by adding two batch volumes (500,000 gal or 1.9 ML total), and subtracting the post-secondary treatment process peak flow rate multiplied by the decant time (7.5 mgd x 72 minutes = 375,000 gal, or 28 ML/d x 72 minutes = 14 ML). The total required storage volume is therefore 235,000 gal (850,000 L).

Validation Testing

After pre-selecting the disc filter manufacturer, the selected manufacturer was required to perform a 15-day validation test using a pilot trailer to verify the equipment’s ability to meet the performance requirements. The presence of the SBRs complicated the validation testing procedure in two different ways.

First, intermittent effluent flow from the SBRs added to the test apparatus requirements. At a conventional activated sludge plant, a steady stream of secondary effluent can be pulled from the WPCF for testing. At Plainville, the SBRs decant in batches, resulting in intermittent effluent flow so there is no steady stream to pull from. In this case, a pilot scale flow equalization tank was set up. A pump was set up on a timer to fill the equalization tank while the SBRs were decanting. To simplify the controls, an overflow pipe was routed back to the withdrawal point, allowing the tank to be filled up quickly with no need to turn the pump off once the tank is full.

Second, the SBRs added significant complexity to the pre-treatment requirements. Since the disc filter design was based on an influent total phosphorus concentration of 1.0 mg/l, but the upstream chemical addition system needed to achieve this concentration was not yet in place, the validation test protocol required a pre-treatment step. Setting up a control sequence to batch chemical to each SBR at the end of the mix phase would be impractical for a short-term test, so the disc filter manufacturer provided a chemical addition skid and flow-paced the coagulant upstream of the SBR influent pump station, before splitting to the SBRs.

The chemical addition skid failed to achieve the intended pre-treatment. Several factors likely explain this. First, as described in the section discussing the batching chemical challenge above, dosing prior to aeration results in the non-reactive portion of the phosphorus being unavailable for coagulation, and it ends up passing through the tank.

This challenge was overcome by demonstrating that the disc filters could perform better than guaranteed, meeting the guaranteed treatment requirements even at significantly higher influent total phosphorus concentrations than intended. This required several additional days of testing and was more difficult than anticipated but was successful.

CONCLUSION

The Plainville WPCF design was completed in early 2018, addressing all the challenges presented by the SBRs. Bids were opened in May 2018 and came in under budget, enabling the town to award all bid alternates. The project was awarded for just under $11.2 million. The project is scheduled to be completed in 2020.

ACKNOWLEDGMENTS

The author thanks Joseph Alosso and the town of Plainville staff for the opportunity to work on this project and for explaining the everyday challenges they face, as well as the Tighe & Bond team, especially Stephen Segal and Frederick Mueller, for guidance and support throughout the design.

ABOUT THE AUTHOR

Paul Moran is a senior engineer at Tighe & Bond focusing on wastewater and drinking water treatment. He was both project manager and process design engineer for the Plainville WPCF phosphorus removal upgrade project from preliminary design (after the phosphorus removal plan was completed) through construction. He has a Master of Science in Environmental Engineering and a Bachelor of Science in Civil and Environmental Engineering, both from Worcester Polytechnic Institute.
Flow distribution improvements at the Stamford Water Pollution Control Facility

MATTHEW HROSS, PE, CCA, Hazen and Sawyer, Wethersfield, Connecticut

ABSTRACT | The Stamford Water Pollution Control Authority owns and operates the Stamford Water Pollution Control Facility (WPCF), an advanced wastewater treatment facility that uses a four-stage Bardenpho process to achieve biological nitrogen removal. The Stamford WPCF is a 24 mgd (91 ML/d) facility with a peak design capacity of 68 mgd (257 ML/d) and an annual average flow of 18 mgd (68 ML/d). Biological treatment facilities at the plant consist of two aeration basins and four secondary clarifiers. Effluent from the plant is discharged to Stamford Harbor, which is a tidally influenced body of water off Long Island Sound. Under conditions of high tide and/or plant flow, plant effluent must be pumped to Stamford Harbor.

KEYWORDS | Flow distribution, hydraulic model, pumping, return activated sludge (RAS), mixed liquor

INTRODUCTION

The Stamford Water Pollution Control Facility (WPCF) has experienced issues related to the distribution of primary effluent to the plant’s two aeration basins and distribution of mixed liquor to the four secondary clarifiers. Legacy flow-split mechanisms were difficult to adjust with individual secondary clarifiers varied significantly, especially when one of the other clarifiers was out of service. The Stamford Water Pollution Control Authority (SWPCA) evaluated flow distribution problems at the plant to determine improvements to address the ongoing hydraulic issues. Another issue at the plant was that while the return activated sludge (RAS) pumps provided adequate RAS pumping capacity, the configuration of the RAS piping caused operational problems. These problems included the lack of flow monitoring for RAS withdrawal from three of the plant’s four secondary clarifiers, not allowing for uniform withdrawal from each clarifier, and the lack of a reliable way to evenly return RAS to the two aeration basins. Although flow meters existed in the RAS discharge piping to each aeration basin, flows were manually balanced by plant operators based on aeration basin influent weir gates that regulate water levels through the process. Although the plant’s three effluent pumps were designed to deliver 34 mgd (101 ML/d) each, for a firm capacity equivalent to the plant’s peak design capacity of 68 mgd (257 ML/d), operation of all three pumps was required under peak-flow conditions.

APPROACH

Hydraulic evaluations of the facilities were performed using the flow conditions summarized in Table 1. The RAS flow is the rate at which settled solids are pumped (i.e., returned) from the secondary clarifiers to the head of the two aeration basins. RAS pumping facilities are typically designed to return approximately 100 percent of the design plant influent flow, which equates to 24 mgd (89 ML/d) for the Stamford WPCF. During normal plant operations, the RAS rate is often less than 100 percent of plant influent flow. Historical flow data provided by the SWPCA showed that the plant often operates the RAS rate at 70 percent to 75 percent of the plant’s influent flow.

The plant’s four-stage Bardenpho configuration, return activated sludge (RAS), is pumped from the thirdoxic zone of each of the two aeration basins to the anoxic zone at the head of each basin. As shown in Table 1, hydraulic capacities at the plant were calculated using RAS rates of 18 and 24 mgd (#8 and 91 ML/d), and a NRCY flow rate of 80 mgd (303 ML/d). Hydraulic profile calculations were performed using an Excel-based hydraulic model developed specifically for the analysis of treatment plant hydraulic profiles. Information about the existing facilities was acquired from record drawings of past construction projects and equipment operation and maintenance manuals and, where possible, was verified in the field. Critical elevations, such as invert and weir elevations, were verified with a field survey performed by a surveyor licensed in Connecticut.

Hydraulic profiles through a treatment plant are calculated beginning at the downstream end of the process and working upstream, with the downstream control point being the water surface elevation in Stamford Harbor at the plant outfall. The hydraulic profile calculations consist of a series of head loss calculations in each hydraulic element (pipe, channel, gate, weir, etc.) of the plant, with the head loss in each element influencing the element immediately upstream. The model consists of Excel spreadsheet modules for each type of hydraulic element that are linked to create a continuous hydraulic profile of the plant. The theoretical bases for the model’s hydraulic profile calculations are as follows:

- Head loss in piping consists of friction and minor losses. Friction losses are calculated using the Hazen–Williams equation. Hazen–Williams C-values are selected based on those typically found in pipes that have been in service for years. Minor loss k-values are selected using published values.

- Head loss in channels consists of friction losses and minor losses. Friction losses are calculated using the Manning equation and depend on the roughness of the channel as measured by the Manning n-value. The calculation for friction loss in a channel is an iterative solution, since the depth and velocity of flow vary along the length of the channel. Minor losses in channels are calculated similarly to those in a pipe.

- Gates and ports can be submersed (typical for sluice gates) or have free-surface flow (typical for a slide gate). Losses through gates and ports are calculated using the orifice equation, with orifice coefficients determined based on the geometry of the port.

- Weirs are often used to maintain a constant level in a process unit and can have different forms (sharp-crested, v-notch, etc.). Weir equations used in the hydraulic profile calculations vary based on the type of weir.

The equations used in the hydraulic profile calculations are widely accepted and have been used in many years. However, the accuracy of the results is affected by the selection of values for the coefficients used in the model. Some of these coefficients, such as the Hazen–Williams C-value, change over time. A 20-year-old pipe will not have the same C-value as a new pipe of the same material due to deterioration of the pipe wall or biological growth on the pipe walls. Conservative values were selected for the model that would predict the performance of older pipes.

The hydraulic evaluation aimed to identify hydraulic constraints (i.e., bottlenecks) in the plant that may affect plant performance by submerging critical hydraulic control points. Critical hydraulic control points are defined as those hydraulic elements where the water level is critical to flow or those points that, if submerged, could lead to significant process upsets. For the Stamford WPCF, Table 1 summarizes the locations and elevations of critical hydraulic control points.

RESULTS

The segment of the plant between each pair of hydraulic control points was modeled to predict performance under the plant’s design flow conditions, to determine the maximum hydraulic capacity of each segment, and to identify bottlenecks in

<table>
<thead>
<tr>
<th>Plant Flow Condition</th>
<th>Flow mgd (ML/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent</td>
<td>24 (91)</td>
</tr>
<tr>
<td>RAS</td>
<td>24 (89)</td>
</tr>
<tr>
<td>NRCY</td>
<td>24 (91)</td>
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</table>

<table>
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<tr>
<th>Peak Water Conditions</th>
<th>Flow (ML/d)</th>
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</thead>
<tbody>
<tr>
<td>Average</td>
<td>18, 24 (68, 91)</td>
</tr>
<tr>
<td>Peak</td>
<td>24 (91)</td>
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</table>

<table>
<thead>
<tr>
<th>Hydraulic Control Point</th>
<th>Location</th>
<th>Elevation (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Clarifier Effluent Weirs</td>
<td>21.80 (6.64)</td>
<td></td>
</tr>
<tr>
<td>Aeration Basin Effluent Weirs</td>
<td>17.92 (5.46)</td>
<td></td>
</tr>
<tr>
<td>Mixed Liquor Distribution Weir Gates</td>
<td>15.60 (4.75)</td>
<td></td>
</tr>
<tr>
<td>Secondary Clarifier Effluent Weirs</td>
<td>13.50 (4.11)</td>
<td></td>
</tr>
<tr>
<td>UV Channel Effluent Weir Gates</td>
<td>9.42 (2.87)</td>
<td></td>
</tr>
<tr>
<td>Mean Higher-High Tide</td>
<td>8.49 (2.59)</td>
<td></td>
</tr>
</tbody>
</table>

| 100-Year Flood | 10.74 (3.27) |

Table 2. Stamford WPCF hydraulic control points

<table>
<thead>
<tr>
<th>Control Point Description</th>
<th>Location</th>
</tr>
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<tbody>
<tr>
<td>Aeration Basin Effluent Weirs</td>
<td>21.80 (6.64)</td>
</tr>
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<td>Mean Higher-High Tide</td>
<td>8.49 (2.59)</td>
</tr>
<tr>
<td>100-Year Flood</td>
<td>10.74 (3.27)</td>
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Table 3. Maximum hydraulic capacities of plant segments

<table>
<thead>
<tr>
<th>Segment Description</th>
<th>Maximum Hydraulic Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mgd (ML/d)</td>
</tr>
<tr>
<td>Primary Clarifier Effluent Weirs to Aeration Basin Influent Weirs</td>
<td>RAS = 18 (58) RAS = 24 (79)</td>
</tr>
<tr>
<td>Aeration Basin Influent Weirs to Mixed Liquor Distribution Weir Gages</td>
<td>56 (212)</td>
</tr>
<tr>
<td>Mixed Liquor Distribution Weir Gages to Secondary Clarifier Effluent Weirs</td>
<td>63 (238) 63 (238)</td>
</tr>
<tr>
<td>Secondary Clarifier Effluent Weirs to UV Disinfection Effluent Weir Gates</td>
<td>57 (216) 51 (193)</td>
</tr>
<tr>
<td>UV Disinfection Effluent Weir Gates to Stamford Harbor by Gravity*</td>
<td>52 (197)</td>
</tr>
</tbody>
</table>

*Based on mean higher-high tide elevation in Stamford Harbor.

RECOMMENDATIONS

Primary Effluent Flow Distribution

During field verification of critical elevations to support the hydraulic model development, measurements of the aeration basin influent weirs revealed a variation in weir elevations of as much as ±3 in. (3.3 cm). Under the plant’s average-flow conditions, the depth of head above the weir weirs is small (less than 3 in. 7.6 cm) under average-flow conditions) compared to potential flow disturbances in the influent channel and was considered inadequate to ensure good flow distribution. A small error in the adjustment of one of these weirs could introduce significant flow distribution problems.

Mixed Liquor Flow Distribution

Mixed liquor from the two aeration basins is distributed to the plant’s four secondary clarifiers through four parallel flow paths, one to each clarifier. Each flow path consists of a mixed liquor distribution weir gate, clarifier influent center column with distribution ports, and an effluent v-notch weir around the perimeter of the clarifier. A primary distinction between the four flow paths is that influent to secondary clarifier Nos. 1 and 4 is conveyed through both open channels and buried pipes. The maximum hydraulic capacities of this segment presented in Table 3 are expressed as 4 times the current flow path. A ft 1 ft (3.2 m wide, 3 m long) open channel to secondary clarifier No. 3, pictured in the foreground of photo 1, was identified as the principal contributor to hydraulic limitations of this plant segment.

RAS Withdrawal and Distribution

Regardless of other improvements considered, flow meters were recommended in the RAS withdrawal piping from each secondary clarifier. Under existing conditions, only the RAS withdrawal from secondary clarifier No. 4 was monitored. The added instruments allow better control of individual clarifier RAS withdrawal rates and consistency of withdrawal from each secondary clarifier. Plant SCADA modifications were also recommended for automatic regulation of RAS withdrawal rates by modulating pump speeds to maintain a specific RAS flow path. Additional modifications were also recommended, including proportional RAS control, where the plant’s cumulative RAS flow path is calculated as a percentage of the plant’s influent flow.

The SWPCA elected to design and construct the recommended RAS withdrawal improvements, as well as the second alternative for improving RAS distribution to the two aeration basins. Figure 2 presents a schematic of the recommended RAS withdrawal and distribution configurations.

Final Effluent Pumping

Several potential modifications were considered to improve the firm capacity of the plant’s final effluent pumping system. One solution considered addressing the possibility that the trapped air in the discharge piping was restricting the maximum discharge capacity of each effluent pump. Under this solution, a new mixed liquor distribution channel and distribution box was recommended based on the hydraulic model development, measurements in Table 3. Figure 1 shows a plan drawing of the proposed distribution box, including the installation of a vertical mixer so that solids would be maintained in suspension and evenly distributed to the secondary clarifiers. Following the hydraulic evaluations of the plant, the SWPCA selected this second alternative for improving mixed liquor flow distribution. The SWPCA also favored this approach because it combines the mixed liquor effluent from both aeration trains and avoids running two separate activated sludge processes side by side with separate mixed liquor streams.
distribution withdrawal and Proposed RAS discharge configuration

2. Former effluent pump hydraulic profile developed in support of this work was lowered by approximately 5.8 ft (1.8 m). The effluent pump discharge piping centerline elevation slab of the basin structure that houses the effluent pump discharge piping was previously above the top elevation of each pump's discharge piping below the basin. It was not favored, it was recommended to lower the outcome by increasing wet well operating levels had to be reduced significantly. Since achieving this plant's existing effluent pumps, the pumping head was cost-prohibitive. effluent pumps with new units was considered but of discharge piping from each effluent pump. Another alternative that would have replaced the effluent pumps with new units was considered but was cost-prohibitive.

CONSTRUCTION AND CONCLUSIONS

Following design of the recommended and SWPCA-selected flow distribution improvements for the Stamford WFCF, construction commenced in February 2017 and was completed by the end of December 2017 at a cost of approximately $4.3 million.

Since that time, the plant has seen wet-weather flows as high as 98 mgd (364 ML/d). The SWPCA has been satisfied with the performance of the new mixed liquor distribution box shown in photo 3. Isolation of individual secondary clarifiers for routine maintenance and other activities has also been simplified, since plant operators must close only the associated slide gate in the mixed liquor distribution box. No other adjustments are necessary to maintain equal flow distribution when a secondary clarifier needs to be removed from service. Similarly, individual aeration basins can be taken offline without any other adjustments to maintain mixed liquor flow distribution to the secondary clarifiers.

The RAS withdrawal and distribution improvements have allowed the SWPCA to better automate the operation of its RAS pumps. Following the related plant SCADA modifications, the SWPCA can now rely on flow pacing of the RAS pumps as a function of influent flow. These improvements have reduced the plant operator attention required to maintain appropriate RAS distribution to the plant's two aeration basins. In addition, the SWPCA secured partial funding for the improvements from the plant's electricity supplier, through available energy-efficiency funding, by demonstrating a reduction in energy consumption associated with improved RAS pumping operations.

Plant operators report efficient pumping operations have also improved since the effluent pump discharge piping modifications. Photo 4 shows the modified effluent discharge piping after the improvements shown in Figure 3. In addition to increasing the discharge capacity of each effluent pump, related efforts during construction and startup optimized the SCADA and variable frequency drive (VFD) programming for the pumps. Previously, effluent pump operation during nighttime minimum flows coincided with high-tide elevations in Stamford Harbor required plant operators to partially open a sluice gate between the effluent pump wet well and the common effluent channel to which the pumps discharge. This operating procedure was employed because the effluent pump VFDs previously could not be turned down low enough to match nighttime minimum flows without excessive pump cycling. However, VFD speed caps were discovered during startup and programming that have since been modified to increase the usable speed range of the effluent pumps and VFDs. As a result, the effluent pump speeds can now be turned down low enough to meet nighttime minimum flows without requiring plant operators to partially open the sluice gate. As with the RAS withdrawal and distribution improvements, the SWPCA was also able to obtain partial funding for the final effluent pumping improvements from the electricity supplier through available energy-efficiency funding.

ACKNOWLEDGMENTS

The author acknowledges the following members of the Stamford Water Pollution Control Authority: William P. Brink, PE, executive director; Prakash Chakravarti, PE, supervising engineer; and Robert Pudelka, acting plant supervisor.

REFERENCES


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Matthew Hross is a senior principal engineer with Hazen and Sawyer. He has worked on a variety of municipal water and wastewater projects throughout New England and New York, and is experienced in the planning, design, and construction administration of municipal water and wastewater treatment facilities. Mr. Hross holds a Bachelor of Science in Civil Engineering from the University of Maine and a Master of Science in Environmental Engineering from the University of Massachusetts, is a Construction Specifications Institute-certified construction contract administrator (CCCA), and holds professional engineering licenses in Connecticut and Massachusetts.

Figure 2. Proposed RAS withdrawal and distribution modifications

Figure 3. Proposed effluent pump discharge modifications

| STAMFORD FLOW DISTRIBUTION IMPROVEMENTS | STAMFORD FLOW DISTRIBUTION IMPROVEMENTS | 3. Completed mixed liquor channel and distribution box

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Installation of screw press for solids dewatering at the Westerly Wastewater Treatment Plant

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NICHOLAS DE GEMMIS, Jacobs Engineering, Westerly, Rhode Island WWTP
KEVIN DAHL, Jacobs Engineering

ABSTRACT | Before 2018, the town of Westerly, Rhode Island, disposed of sludge generated at the wastewater treatment plant (WWTP) and septage received there as liquid sludge. The process required three to four trucks per day, something time-consuming for the plant operators, expensive, and disruptive to the surrounding roads and community. The town evaluated several alternatives for installation of a dewatering process to alleviate the issues with the disposal process. A screw press was selected as the preferred technology. Pilot- and bench-scale testing provided the necessary information to size the equipment and design the process. Construction began in May 2018, and the WWTP was processing sludge by October 2018. The project reduced disposal costs and truck traffic, and allowed operators to spend more time on other parts of the WWTP.

KEYWORDS | Screw press, copper, pilot test, sludge disposal

INTRODUCTION
The town of Westerly, Rhode Island, is an oceanfront community on the Pawcatuck River at the border of Rhode Island and Connecticut. The town owns the Westerly Wastewater Treatment Plant (NWTP) located at 89 Margin Street. The treatment plant has an average monthly flow rate of 3.3 mgd (12.5 ML/d) and serves approximately 16,500 customers. In addition to flow from the collection system, which includes nine pumping stations, the WWTP receives an average of 7,550 gpd (20,000 L/d) of septage collected from sections of the town and surrounding communities that are not sewered. The WWTP flow train starts at the headworks, which includes screening and grit removal. Flow from the headworks enters primary treatment consisting of two 50 ft (15 m) diameter primary clarifiers. Ferrrous chloride is added for control of copper and for odor control. Solids from the primary clarifiers are drawn from the center of the tanks and pumped to gravity thickeners. Secondary treatment includes an integrated fixed film activated sludge (IFAS) process followed by three 60 ft (18 m) diameter final clarifiers. The bioreactors are separated into anoxic and aerobic zones and include mixed liquor recycle. Waste activated sludge (WAS) is pumped from the final clarifiers to co-settle with primary sludge in the gravity thickeners. Flow from secondary treatment is disinfected using hypochlorite and dechlorinated using bisulfite. Figure 1 presents a simplified liquid stream process flow diagram. To reduce trucking volume, the blended, gravity thickened sludge was further thickened using a rotary drum thickener that discharged into thickened sludge storage tanks. Septage received at the plant was screened during discharge into two septic receiving tanks, and then pumped into the sludge storage tanks to mix with the blended sludge produced onsite. The contents of the storage tanks were pumped to tanker trucks for disposal offsite. The sludge handling and disposal process posed problems of expense and public relations concern that prompted a plan to upgrade the sludge handling facilities. Figure 2 shows a simplified solids process flow diagram for the system prior to the upgrade. The sludge disposal operation required filling three to four tankers per day with liquid sludge. This was time-consuming and expensive, and caused annoying heavy truck traffic in the neighborhood around the plant. The approximate volumetric and mass concentration mix of primary to WAS to septage was 53:35:12 and 58:38:5, respectively. Table 1 summarizes the production of biosolids at the plant prior to the upgrade.

To begin with its planned upgrade, the town first conducted an alternatives analysis to determine the appropriate technology, and the screw press selected for the process application at the Westerly WWTP.

TECHNOLOGY
Screw presses are a relatively new biosolids technology, and the screw press selected for the process had been used only in a few locations in the United States, warranting extra discussion regarding its application at the Westerly WWTP.

Technology emergence, growth, and development follow a life cycle. Figure 3 depicts one model of the technology life cycle, showing how the phases change with knowledge, experience with the technology, and successful application.

The technology life cycle consists of four phases, each with a unique focus:

1. Acclimatization—novel, dependent on perception of value added, marketability and strategic importance; risk focused

Table 1. Biosolids production prior to upgrade

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Average</th>
<th>Max Month</th>
<th>Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septage (lbs/d)</td>
<td>319</td>
<td>565</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Septage (0.5% solids) (gpd)</td>
<td>7,647</td>
<td>13,540</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blended Sludge (WAS + Primary) (lbs/d)</td>
<td>4,073</td>
<td>10,721</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blended Sludge (1.5% solids) (gpd)</td>
<td>29,412</td>
<td>76,571</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Biosolids Production (lbs/d)</td>
<td>4,392</td>
<td>11,040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Biosolids Production (1.3% solids) (gpd)</td>
<td>37,059</td>
<td>87,238</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Growth—understood, well documented applica-
tions and signs of transfer success; experience focused
3. Stability and maturation—growth rechecked at
the value-added plateau; new generation emerging
due to feedback and activity from innovation; cost focused
4. Lag phase—demise of technology support and
life span or emergence of next generation

Table 2 summarizes the life stage of various solids
management technologies as considered by the
design team. The table depicts innovative and accli-
matizing technologies that will either emerge with
promise or die based on application experience. In
many respects the growth of a technology is fueled
by engineers taking appropriate risk and obtaining
experience from new applications to achieve a
critical mass that allows the technology to stabilize
and mature.

PILOT TEST
A pilot test in July 2017 demonstrated polymer
dosage, hydraulic loading, screw speed, and cake
solids. Photo 1 shows the pilot test setup. Based on
the pilot testing and a mass balance analysis, two
presses were identified that would meet the facility’s
needs. One unit was smaller with less throughput,
requiring a longer run time to process the facility’s
daily sludge production. The larger unit with higher
throughput and a shorter run time. Table 3 presents
the press alternatives.

The town decided to proceed with the larger unit.
Limited plant staff made it more advantageous to
select a machine that could process the facility’s
sludge in a single shift. The smaller unit would
require 11 hours of run time to process the sludge
while the larger unit could process it in eight hours. The
solids balance showed that with effective dewa-
tering the number of truck trips needed to dispose of
the plant’s solids could be reduced from three to four
trucks per day to fewer than three trucks per week. The
WWTP’s National Pollutant Discharge
Elimination System (NPDES) permit includes an
Guysboro—Nat. Poll. Dischar. Stream

Table 3. Screw press alternatives

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Small Unit Value</th>
<th>Large Unit Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Units</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Production</td>
<td>kg DS/lv</td>
<td>253</td>
<td>344</td>
</tr>
<tr>
<td>Production</td>
<td>lpm</td>
<td>300</td>
<td>390</td>
</tr>
<tr>
<td>Run Time (assume five-day week)</td>
<td>Hr/day</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Feed Solids %</td>
<td>% Solids</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Cake Solids %</td>
<td>% Solids</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Capture Efficiency %</td>
<td></td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td>Screw Drive kW</td>
<td>kW</td>
<td>3.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Screw Speed rpm</td>
<td>rpm</td>
<td>0.1-0.7</td>
<td>0.1-0.7</td>
</tr>
<tr>
<td>Wash Water lpm</td>
<td>lpm</td>
<td>186</td>
<td>186</td>
</tr>
<tr>
<td>Wash Water kPa</td>
<td>kPa</td>
<td>345-552</td>
<td>345-552</td>
</tr>
<tr>
<td>Air Requirements m/hr</td>
<td>m/hr</td>
<td>6.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Air Requirements kPa</td>
<td>kPa</td>
<td>552</td>
<td>552</td>
</tr>
</tbody>
</table>

Testing showed that this optimal film-producing
polymer also effectively bound the copper in a 79 percent
removal rate in the screw press. The mass balance showed that
removing 97 percent of the copper in the sludge would
cause the plant’s effluent concentration to increase to
only 103 ug/l. This would allow the facility to remain
within the effluent limit while using a single-part polymer
feed system as required by the screw press design.

The pilot system was fed a blend of septage, primary
sludge, and WAS at 1.5 percent solids content. The
diameter, screw press speed, and hydraulic loading were varied
during the test. The press produced an average of 46.5 percent solids content
with ranges of 47-27 percent (photo 2). The average
polymer dose was 3.1 lbs active/dry ton (7 kg active/
dry tonne). Solids capture averaged 92 percent with
ranges of up to 98 percent. Based on these results,
the town proceeded with the polymer used during
the pilot testing.

DESIGN AND CONSTRUCTION
Once the technology was selected and the press
was sized, a location for the new screw press at the
plant needed to be identified. Although constructing
a new facility to house a new treatment process is
desirable because it does not restrict layout or space
for maintenance, the cost of new construction was
prohibitive and available spaces at the site were far
away from the existing solids processing infrastruc-
ture. Reusing existing infrastructure is generally
prohibitive, but in some cases it may significantly
reduce the cost of the project. Several options were
explored that used existing space no longer in active use.

• The rotary drum thickener was in the main oper-
ating building next to other abandoned thickening

Figure 3. Technology life-cycle model

Table 2. Technology life cycle

<table>
<thead>
<tr>
<th>Technology</th>
<th>Acceleration</th>
<th>Growth</th>
<th>Stability</th>
<th>Lag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity Belt Thickening</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screw Press</td>
<td></td>
<td></td>
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<tr>
<td>Rotary Press</td>
<td></td>
<td></td>
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<tr>
<td>Belt Filter Press</td>
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<tr>
<td>Vacuum Filter</td>
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<tr>
<td>Centrifuge Dewatering</td>
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<td></td>
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<tr>
<td>Recuperative Thickening</td>
<td></td>
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<tr>
<td>Acid-Gas Digestion</td>
<td></td>
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<tr>
<td>Temperature Phased Anaerobic Digestion</td>
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<td></td>
<td></td>
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<tr>
<td>Co-digestion</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dual Digestion</td>
<td></td>
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<tr>
<td>Auto-Thermal Aerobic Digestion</td>
<td></td>
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<tr>
<td>Thermal Hydrolysis</td>
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<tr>
<td>Thermal Drying</td>
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<tr>
<td>Class A Heat Treat System</td>
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<tr>
<td>Sludge Disintegration</td>
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<tr>
<td>Microsludge</td>
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<tr>
<td>Open Cel</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Lyso</td>
<td></td>
<td></td>
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<tr>
<td>Ultrasonics</td>
<td></td>
<td></td>
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<tr>
<td>Ostara</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Co-generation</td>
<td></td>
<td></td>
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<tr>
<td>Fuel Cell</td>
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<tr>
<td>Solar Photovoltaics</td>
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<tr>
<td>Gasification</td>
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<td></td>
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<tr>
<td>Biosolids Composting</td>
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</table>
time the tanks were offline during construction. Continuous tank availability is imperative for two reasons. First, if necessary, the plant can pump directly from the gravity thickener to a truck for disposal, although that process is slow and causes sludge to back up. More importantly the facility cannot dispose of septage without using the sludge storage tanks. Septage receiving is an important revenue source for the facility and restricting access to it is also difficult on the hauler.

The screw press requires a consistent flow rate to optimize performance, necessitating a positive displacement style pump. A grinder was provided to protect the pumps from clogging with rags. Plunger pumps were selected because plant operators had extensive experience with that style of pump, and suction lift capability was needed because the pumps were installed at grade and the tanks are below grade. The plunger style pumps selected offer a 25 ft (7.6 m) suction lift, which is more than adequate, and plunger pumps can also pass moderately large solids if the grinder fails. A bypass is provided in case the grinder has to be offline for maintenance (photo 5).

The plunger pumps discharge to the conditioning tank where blended sludge is mixed with polymer and form floc. The conditioning tank feeds the screw press. The press comprises a screw inside a perforated basket. Sludge entering at one end is conveyed toward the discharge chute at the opposite end by the screw. A pneumatic pressure cone provides backpressure at the outlet. A small air compressor near the press supplies compressed air to the cone. The screw pushes the sludge against the cone, squeezing water out of the sludge. The water passes through the perforations in the basket and leaves through the filtrate line. A spray bar cleans the basket while the press is in daily operation. The spray bar encircles the basket and moves across the length of the basket (refer to photo 6).

Dewatered cake discharges from the press into a shaftless screw conveyor. A series of screw conveyors transports the dewatered cake to a roll-off container equipped with a leveling cover. The leveling cover is adjustable. A hand crank raises and lowers the cover to fit either a 20 yd³ (15 m³) or 30 yd³ (23 m³) container. The leveling cover distributes dewatered cake across the bin while containing odors. The container and level loader are connected to an existing biofilter for treatment of odors (photo 7).

To reduce cost and improve the schedule, the major equipment was purchased before hiring a contractor. The sludge feed pumps, grinder, mixers, screw press, and leveling covers were all purchased before the final design was completed. The procurement process began in November 2017 to allow the contractor to install the equipment immediately instead of needing a long procurement phase in the construction schedule. The critical piece of equipment was the screw press, which had a lead time of six months. Construction documents were finalized in April 2018, and the project was bid in May 2018.

Construction started in May 2018 with the goal of producing cake by August; however, equipment delays and field issues caused the schedule to slip. Screw press components produced outside the United States were delayed, causing the press delivery to be delayed. Delivery was further delayed when the truck used for delivery broke down and a backup could not be found. The press is large and heavy, requiring a crane to take it off the truck. When the first truck broke down a crane needed to be rescheduled. Once the press was installed, the support configuration was determined to be outside the tolerance required by the manufacturer and had to be modified. The concrete supports had been poured, and the grout pads had been set, so the change required chipping the grout out and raising the leveling nuts to meet the manufacturer’s specifications.
The facility was producing cake by the first week of October and all manufacturer representatives for the pumps, grinder, polymer system, leveling cover, conveyors, and air compressor arrived first to field check their components. Once each component was commissioned, the completed system was commissioned with the screw press. The screw press manufacturer came to the site for a week of commissioning to optimize the system and train operators. The plant operators then took ownership and have been operating the facility ever since.

Table 4 presents the average influent and effluent copper concentrations prior to, during, and after commissioning the press.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent Copper Concentration (µg/L)</th>
<th>Effluent Copper Concentration (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-commissioning</td>
<td>52.4</td>
<td>9.7</td>
</tr>
<tr>
<td>During Commissioning</td>
<td>66.0</td>
<td>10.2</td>
</tr>
<tr>
<td>Post-commissioning</td>
<td>57.2</td>
<td>10.3</td>
</tr>
</tbody>
</table>

The average cake solids concentration since commissioning is 25 percent. The plant is using 16 to 150 gallons (380 to 570 liters) of polymer per week.

The cost of disposal has also dropped from an average of $46,849 per month prior to commissioning to $24,840 per month after commissioning. Plant staff now have more time to address other projects. They no longer must attend to three to four liquid trucks per day or operate the labor-intensive rotary drum thickener.

LESSONS LEARNED

Lessons learned from this project are as follows:

- Engage plant operators early and throughout design. This should be a common practice for all design projects, but several design changes were implemented on this project that further reinforced this. Plant operators requested a platform outside a new roll-up door for delivery of polymer totes. The platform is the same elevation as the floor inside, so the polymer totes can be set at the platform and can be easily transported inside without navigating a step or a slope. It is a simple request but greatly simplifies a weekly activity that could have become a troublesome chore (photo 8).
- The initial drain location was modified after discussion with plant operators. They requested a longer trench drain that would be the full length of the press (see photo 8).
- The operators requested the previously discussed flexibility in the suction piping. They also wanted it hard-rigged so that a single operator could transfer sludge from one tank to the other or load a truck from the tanks without multiple operators assembling temporary piping and temporary pumps. Having maximum flexibility for a minimally staffed plant was important.
- Engage haulers in discussion with installing and commissioning the screw press. We also thank the haulers for their assistance during design, pilot testing, and operation. We thank the haulers for their assistance during design, pilot testing, and operation. We thank the haulers for their assistance during design, pilot testing, and operation.
- The authors acknowledge Ishigaki USA LTD for its assistance during design, pilot testing, and commissioning of the screw press. We also thank the Westerly WWTP staff and the town of Westerly for helping with the project.

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The authors acknowledge Ishigaki USA LTD for its assistance during design, pilot testing, and commissioning of the screw press. We also thank the Westerly WWTP staff and the town of Westerly for helping with the project.

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- Stephen Clark is a project manager with Jacobs Engineering in the Wethersfield, Connecticut office. He has 12 years of experience in the wastewater process design, residuals management, and construction services.
- Nick De Gemmis is the project manager for Jacobs’ Westerly WWTP. Mr. De Gemmis has 12 years of wastewater treatment experience in Rhode Island, Connecticut, and New Jersey. He has been involved in two facility upgrades/improvements: a $4.6 million design-build operate in Woonsocket, Rhode Island; to transition the treatment facility to meet new, stringent nutrient limitations; and a smaller, biosolids handling upgrade in Westerly to bring state-of-the-art technology to an aging facility.
- Kevin Dahl is a regional manager for the Jacobs operations and maintenance business in the North region. Mr. Dahl, based in Connecticut, is an engineer and a licensed operator with 20 years of experience in the wastewater industry operating, maintaining, and overseeing various plant operations and improvement projects.
Beginning anew—a wastewater treatment system design for Orleans

TESS LAFFER, AE.COM, Chelmsford, Massachusetts
THOMAS PARECE, PE, AE.COM, Chelmsford, Massachusetts

ABSTRACT | Excess nitrogen in the groundwater is impairing the water quality in coastal waters and estuaries in the town of Orleans, Massachusetts. Because of this, the town’s Comprehensive Wastewater Management Plan (CWMP), prepared and approved in 2011, recommended to sewer approximately 60 percent of Orleans over 20 years. However, funding for the recommended plan failed to be appropriated twice at different Town Meetings, leading to the development of a “hybrid” approach that incorporates both traditional and non-traditional technologies to remove the same amount of nitrogen as identified in the CWMP. Implementation of a “hybrid” approach under the Cape Cod 208 Water Quality Plan was approved by both EPA and the Massachusetts Department of Environmental Protection. Various non-traditional technologies were studied and piloted, and permeable reactive barriers (PRBs) were identified as one potentially cost-effective and reliable alternative. Thus, the current design includes a collection system, wastewater treatment facility, effluent disposal site, and demonstration project placements for PRBs.

KEYWORDS | Nitrogen removal, permeable reactive barriers (PRBs), equipment preselection, sequencing batch reactors (SBRs), collection system, wick wells, comprehensive wastewater management plan (CWMP)

Prior Planning Work
The Comprehensive Wastewater Management Plan (CWMP)/Single Environmental Impact Report (SEIR) for the town of Orleans, Massachusetts, included a 20-year phased construction of a wastewater collection system and wastewater treatment facility (WWTF) to reduce nitrogen loadings to coastal embayments. Since the approval of the CWMP in 2011, the town has allocated funds each year through the town meeting process to advance the planning and implementation of the agreed-upon solutions and projects. Subsequent to CWMP approval in 2011, the Cape Cod Commission updated the 1978 water quality management plan for the region in accordance with Section 208 of the Federal Clean Water Act due to the impairment of water quality in coastal waters resulting from excess nitrogen. The Section 208 update identified several recommendations to improve water quality in coastal waters surrounding Cape Cod and potential alternative technologies to achieve improvements, such as aquaculture, floating constructed wetlands, permeable reactive barriers (PRBs), nitrogen reducing barriers (NRBs), and others. The Section 208 update was approved by the Massachusetts Department of Environmental Protection (MassDEP) and EPA in 2015, and included a matrix of potential alternative approaches to reduce nitrogen in coastal waters. The alternative approaches were identified as non-traditional (NT) technologies. In 2014, the Orleans Water Quality Advisory Panel (OWQAP), comprising Orleans selectmen and citizen constituents with liaisons from key town boards and commissions, organizations, neighboring towns, and regional, state, and federal partners convened to build widespread community support for a customized, affordable water quality management plan for the town. Following the Section 208 update, the OWQAP investigated both traditional and NT approaches, and in 2017 developed consensus agreement on a written plan that identified a hybrid approach to nutrient management technologies as an alternative, more cost-effective strategy for managing wastewater and reducing nitrogen in the Rock Harbor, Nauset Marsh, Pleasant Bay, Namasket, and Little Nauset watersheds.

For each NT technology selected, the town has either compiled, is compiling, or is planning to compile three years of nitrogen removal data at several strategically chosen demonstration project sites for MassDEP review and determination of whether the NT technology could be assigned a nitrogen removal credit. In addition, a MassDEP-sponsored modeling program is under development that will help inform these discussions. If a nitrogen removal credit is agreed upon, the town may propose replacing part of the traditionally envisioned sewer area in the CWMP with a combination of NT technologies. However, it is still premature for the town to propose any change to the CWMP’s recommended sewer plan. The 2017 plan included a conceptual and preliminary design to update the CWMP and to reflect the consensus plan. The goal was to minimize the proposed sewer system footprint, while maximizing the use of NT technologies (coastal habitat restoration, aquaculture, floating constructed wetlands, PRBs, and NRBs). The proposed new sewer system could consist of two construction phases that each covers a different area of Orleans: Phase 1 includes the Downtown Area, and Phase 2 includes the Meetinghouse Pond Area. This reduces the CWMP-proposed collection system area from approximately 60 percent of the town and average daily flow (ADF) of 60,000 gpd (241,000 L/d) to about 24 percent and ADF of 35,000 gpd (132,000 L/d). In the reduced consensus plan, the Downtown Area consists of about 330 parcels, and the Meetinghouse Pond Area consists of about 370 parcels.

Reduced Consensus Plan Initial Phase Scope
Phase 1 consists of the following: construction of a combination of gravity sewers and low-pressure sewers to service the Downtown Area; construction of a WWTF; and installation of the effluent disposal system. The WWTF is proposed to be constructed at the former Tri-Town Septage Treatment Facility on Overland Way; this facility has been demolished as of April 2019. Phase 2 is the construction of a combination of gravity sewers and low-pressure sewers to service the Meetinghouse Pond Area. The proposed wastewater system schematic is shown in Figure 1. The Phase 1 project will be bid under two contracts: one for the WWTF and effluent disposal, and a second for the Downtown Area collection system and pumping stations.

Figure 1. Proposed wastewater system schematic

Wastewater Flows
The WWTF is also to be constructed in two phases: a first phase to accommodate the Downtown Area flows including associated inflow/inflow (I/I) and septage receiving; and a second phase to accommodate the capacity requirements for the Meetinghouse Pond Area including associated I/I. The second phase would be scheduled for construction approximately one to five years after the first phase, subject to funding approval for the design and construction of the Meetinghouse Pond Area collection system. Where the construction cost makes sense, the design concept incorporates many features, such as installed equipment capacity, building space, and tank volumes for expansion to accommodate both phases. Since it is assumed that wastewater flows will not be available until 6 to 12 months following substantial completion of the WWTF, equipment manufacturers will be required to provide a mothballing procedure to maintain the operability of the systems during the idle time.

Wastewater flow estimates assumed that 95 percent of water consumed enters the wastewater system. Two years of water records were used for this calculation; under consideration were various Downtown Area development scenarios as well as zoning for the Downtown and Meetinghouse Pond Area. Average daily flow (ADF) estimates, with allowances for I/I, include the Downtown Area estimate of 140,000 gpd (530,000 L/d) and future ADF estimated at 210,000 gpd (781,000 L/d); and the Meetinghouse Pond Area estimated at 62,000 gpd (240,000 L/d) and future ADF estimated at 90,000 gpd (345,000 L/d). Table 1 (next page) presents the WWTF average annual flow for Phase 1 and Phase 2.

Septage Acceptance
The former Tri-Town Septage Treatment Facility treated approximately 8 to 9 MG (30 to 34 ML) of septage per year. The necessary treatment rate is expected to decrease because of a proposed wastewater system that would sewer various areas of the lower Cape, including Orleans, Chatham, and Harwich, and because the local Yarmouth–Dennis

Groundwater Recharge
Meetinghouse Pond Area
Septage Receiving
Overland Way
WWTF
Downtown Area
Residuals Disposal
WWTF

Figure 1. Proposed wastewater system schematic
Table 1. WWTF annual average flow for Phases 1 and 2

<table>
<thead>
<tr>
<th>Description</th>
<th>Future Wastewater Flow (with build-out)</th>
<th>Annual Avg gpd (L/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWTF–Phase 1</td>
<td>245,400 (930,000)</td>
<td></td>
</tr>
<tr>
<td>Downtown Area</td>
<td>212,900 (803,000)</td>
<td>16,800 (62,560)</td>
</tr>
<tr>
<td>Septage</td>
<td>16,500 (62,460)</td>
<td></td>
</tr>
<tr>
<td>WWTF–Phase 2</td>
<td>104,600 (396,000)</td>
<td></td>
</tr>
<tr>
<td>Meetinghouse Pond Area</td>
<td>96,600 (366,000)</td>
<td>8,000 (30,283)</td>
</tr>
<tr>
<td>Septage</td>
<td>350,000 (1,325 ML/d)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Septage receiving and processing flow

The average or high-water-level elevations from groundwater mounding are insignificant and well below surrounding surface levels. While simulations show that increased groundwater levels near Namskaket and Little Namskaket creeks could cause a shift from salt marsh to freshwater plant species (e.g., a potential increase in existing Phragmites), any vegetation shift is difficult to predict. Post-start-up monitoring of the plant species distribution within Namskaket Marsh may be necessary to document any such shifts in plant species.

Over time, these changes may be dwarfed by the impacts of sea level rise. Compared to the minimal likely impact from strong storm surges, as a result of sea level rise groundwater levels on Cape Cod will rise as high as 2.11 ft (64.3 cm), with a more nominal rise of 0.1 ft (3 cm) near inland streams (based on a recent U.S. Geological Survey study).

No portion of the pipeline route from the WWTF to the effluent discharge site at the Lots Hollow Road parcel is in wetlands or buffer zones.

- **Wastewater Nitrate Loads**: The elimination of septic systems will result in long-term improvements in groundwater quality. No significant short-term impacts on surface water quality are expected, though surface water quality should improve as groundwater moves from inland areas to coastal discharge areas, or toward ponds from tributary areas. The emergence of effluent groundwater and its blended concentration to well-mixed off-shore coastal waters would not occur until many years after the initiation of treatment and disposal activities. The preliminary modeling results indicate that the anticipated blended concentration of freshwater flow and nitrate load from the discharged WWTF will eventually reach Cape Cod Bay. Little Namskaket Creek, Namskaket Creek, Town Cove, Rock Harbor, and Boat Meadow River, but the discharge plume will not reach these receiving water bodies for approximately 100 years.

While Cape Cod Bay and Boat Meadow River have not been evaluated by the Massachusetts Estuaries Project (MEP), the MEP modeling analysis of the combined Namskaket Marsh and Little Namskaket Marsh systems indicates that they can still assimilate additional nitrogen without adverse water quality and benthic habitat impacts. The residual nitrogen remaining in treated wastewater discharge at the Lots Hollow sites will increase the nitrogen loading to both Namskaket Marsh and Little Namskaket Marsh, but the loading would still be below the respective MEP nitrogen load target. The MEP analysis indicates that Rock Harbor and Town Cove already receive nitrogen loads exceeding the target watershed loads for a healthy aquatic ecosystem, but the proposed discharge location will reduce nitrogen loading to these sub-watersheds, benefiting the previously impaired receiving waters.

- **Increased Freshwater Flow to Watersheds**: Either the proposed new discharge or the proposed new discharge location would add freshwater flow to receiving estuaries. Most of the relatively low percentage increased flow would likely enter the marshes through the stream channels where the greatest stream flow occurs (tidal flow). Those estuaries with the greatest flow would discharge most of the additional freshwater with each tidal cycle, with minimal effect on the estuaries.

- **Potential Impacts to Coastal Resources**: The groundwater mound and effluent discharge would occur within the inner Cape Cod Bay area, and the effluent would discharge into the Gulf of Maine, with minimal individual impact to local coastal receiving waters. The distance from the discharge point to the source and the volume of wastewater that would impact the receiving waters is expected to be minimal.

- **Potential Impacts to Rare and Endangered Species**: No adverse water quality impacts are anticipated for the discharge move toward the groundwater mound and the discharge plume nor the groundwater mound are not expected to impact any sensitive receptors.

DOWNTOWN AREA COLLECTION SYSTEM

MassDOT Project

Part of the Downtown Area collection system design (Figure 3 next page) overlapped a Massachusetts Department of Transportation (MassDOT) road intersection upgrade project. MassDOT has a moratorium on building new roads in Orleans and Harwich, so five years after it has been rebuilt, so this area of the collection system had to be designed prior to MassDOT’s road repair project to align with the anticipated collection system construction schedule. Thus, a project was created to install this portion of the collection system, including gravity sewers, force mains, and service connections to provide wastewater service to the Downtown Area. This area was completed in the fall of 2018. See photos 1 and 2 and orange gravity lines in detail of Figure 3. This infrastructure is considered the initial for the rest of the Downtown Area collection system.

Remainder of Collection System Design

The Downtown Area collection system consists of approximately 25,850 ft (7,890 m) of gravity sewers, 2,100 ft (640 m) of low-pressure sewers, and 8,500 ft (2,600 m) of force mains. An estimated 1,090 users will be connected into the system with about 57 privately owned and maintained pump stations used to pump to the gravity system. The system has been designed to accommodate future flows from the Meetinghouse Pond area.

The wastewater collection system and associated force mains will be installed by open trench cut and cover methods (within existing roadways), not including the 275 ft (84 m) segment crossng Route 6, which will be installed by jacking. The crossing...
Each station will have submersible pumps with slide rails, one of which will feature a base elbow flushing connection. There will be level controls (transducer and an equipment storage facility (ESF). See Figure 4 for a process flow diagram. The WWTF comprises the following: influent wastewater recycling system, SBR, one thickened sludge storage tank with tank-to-slab pre-equalization tanks with three sequencing batch reactor (SBR) transfer pumps, two SBRs, two effluent disk filters, one post-equalization tank with submersible mixers and three effluent pumps, two ultrafiltration reactors, seven mixing and aeration blowers, two waste sludge storage tanks with two sludge transfer pumps, two rotary drum thickeners, one thickened sludge storage tank with tank-to-sludge transfer pumps, and chemical storage and feed systems.

Because no sewage collection or treatment system exists, no data is available to project sewage pollutant concentrations for mass loadings, so the normal textbook ranges for the key parameters as shown in Table 3 were used. As this will be a new collection system with low I/I, medium-to-high end concentration were assumed and applied to the annual average flow to determine annual average mass loadings. Table 4 (next page) summarizes the WWTF design sewage flow and loads, which were based on New England Interstate Water Pollution Control Commission Guidelines for the Design of Wastewater Treatment Works (TR-16) recommendations. A seasonal peaking factor of 2.6 was used based on TR-16 and other Cape Cod WWTFs.

**Secondary Influent Design Flows and Loads** Table 5 (next page) presents the secondary influent flows/loads for Phase I and for Phase 2 and combined. The secondary influent includes internal recycle flows and loadings from the various processes including effluent filter backwash and sludge processing filtrate.

**Thickened Waste Activated Sludge Design**

Waste activated sludge ( WAS) will be stored with received septage in holding tanks, pumped through rotary drum thickeners and discharged into thickened waste activated sludge ( TWAS) holding tanks. The TWAS/septage will be pumped into a haul truck for offsite processing.

**Architectural Design**

The building lies within the Old King’s Highway (OKH) district, which requires specific architectural features. The design abides by these OKH district requirements and preferences, and the approval process with the OKH District Committee has commenced.

The WWTF is oriented parallel to Overland Way in the same general location as the previous Tri-Town Septage Treatment Facility. The WWTF layout allows for the future expansion (up to double in size) to allow for the proposed flows in the CWMP. The exterior architectural design of the WWTF and the ESF (with its vehicle bays and maintenance facilities) is intended to convey a state-of-the-art treatment facility using attractive, appropriately-colored, and highly durable materials that require minimal maintenance. The overall attention to materials, details, building setbacks, historic requirements, and scale create an architectural solution fitting for the small-scale Cape Cod/OKH residential context of this area. Figure 5 (page 47) depicts the preliminary overview of the WWTF and the ESF at the site.

**Process Equipment Pre-selection**

The town has elected to pre-select sewage receiving equipment, SBRs, effluent disk filters, and rotary drum thickeners in accordance with MGL Ch. 33b Section, 33M. The pre-selection process will include advertising, receiving of manufacturer’s proposal submittals, conducting interviews, and evaluating each piece of equipment based on performance and a life-cycle cost analysis.
Effluent Disposal Site

While the CWMP identified that effluent be discharged at the former TecTown Septage Treatment Facility and location of the proposed WWTF on Overland Way, a nearby less archaeologically sensitive location was proposed and approved at 32 Lots Hollow Road, approximately 4,840 ft (1.48 km) from the WWTF. Nearby reserve or back-up sites are located at 43 Lots Hollow Road, the Route 6 Exit 12 Lobe, or 223 Beach Road.

In addition, a wick discharge is now proposed instead of discharge via open bed infiltration. The number of wicks installed includes redundancy in the WWTF discharge capacity as well as the proper operation and maintenance of the wicks. A pre-cast concrete distribution chamber housing motorized valves and magnetic flow meters is proposed at the site. The operator inputs the order of the operation of the wicks into the SCADA system and the duration of discharge (a number of days) into a single wick. As an alternative, the duration of discharge into a single wick could be changed based on the volume of effluent discharged (e.g., in excess of 500,000 gpd) into the wick.

In addition, if the wicks water level reaches a high-water-level (HWL) SCADA system set point, an alarm will be activated, opening the next wick valve and closing the wick valve with the HWL reading. The operator will remove the wick with the HWL reading from service until the issue is addressed.

The location of the wicks, distribution chamber, roadway, and associated piping allows for the construction of a future water tank on the site.

PROGRAM COSTS, SCHEDULE, AND FUNDING

Cost estimates were developed to perform a life-cycle cost analysis on various collection system types and WWTF processes. This analysis was used to recommend the basis of the design for the Downtown Area sewer collection system, pumping stations, WWTF, and effluent disposal site through the MassDEP Clean Water State Revolving Fund (CWSRF) loan program. The Orleans Downtown Area sewer collection system, pumping stations, WWTF, and effluent disposal site met the minimum scoring criteria and therefore was included on the Final IUP. In addition, the Final 2019 IUP stated that “All projects on the Intended Use Plan are eligible for 2 percent interest rate loans. Certain projects that are primarily for nutrient removal are eligible for zero percent interest rate loans. nutrient removal projects will be evaluated in accordance with 310 CMR 41.04(a) and a determination will be made as to the eligibility for zero percent interest loans before the loan is permanently financed.”

PUBLIC MANAGEMENT SYSTEM DOCUMENTS

In addition to the implementation of the wastewater infrastructure, various public management system documents will be required to be developed to enable practical and effective operation, maintenance, and administration of the new system. These documents include GIS wastewater mapping, sewer use rules and regulations, pretreatment rules and regulations, private property rules and regulations, a septage management plan, and operation and maintenance manuals for the wastewater treatment facility, pumping stations, and collection system.

CONCLUSION

Among the many choices that are presented by the challenge that the town of Orleans faces in complying with its wastewater collection and treatment responsibilities under federal and state statutes, NT technology alternatives may enable a practical plan and design that is far less onerous and more palatable to the citizenry than that proposed in its original CWMP. As further decisions are still to be made (e.g., regarding PRB and NRB technology), beginning anew and composing a hybrid system including the best of both traditional and NT techniques appear to be the most effective and acceptable approach for all concerned.

ACKNOWLEDGMENTS

• Town of Orleans: Board of Selectmen/Town Administrator’s Office, Department of Public Works and Natural Resources, Board of Water and Sewer Commission, Planning Department, Board of Health/Health Department, Finance Committee/Town Accountant, Orleans Water Quality Advisory Panel, Shellfish and Waterways Improvement Advisory Committee, Marine and Fresh Water Quality Committee
• Tighe & Bond

continued on next page
ABOUT THE AUTHORS

• Tess Laffer is a water/wastewater engineer at AECOM in Chelmsford, Massachusetts. Ms. Laffer graduated from Worcester Polytechnic Institute (WPI) with a Bachelor of Science in Environmental Engineering in May 2018. She has been involved with the Orleans project since the beginning of her employment.
• Thomas Parece, P.E., is an associate vice president and senior project manager at AECOM in Chelmsford, Massachusetts, with 38 years of experience. He was the project manager for the development of the 2018 Plan for the Cape Cod Commission and is the project manager for the work associated with the town of Orleans.

REFERENCES

• AACE International – AACE International Recommended Practice No. 18R-97, Cost Estimate Classification System as Applied in Engineering, Procurement and Construction for the Process Industries, 2005
• Biological Wastewater Treatment by Grady, Daigger, & Lim
• Cape Cod Commission – Barnstable County Cost Report, Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod, Revised 2004
• Commonwealth of Massachusetts, Department of Environmental Protection, December 23, 2018, MassDEP issued the Draft 2019 Intended Use Plan (IUP) for the Clean Water State Revolving Fund
• Commonwealth of Massachusetts – 310 CMR 15.000: The State Environmental Code, Title 5: Standard Requirements for the Siting, Construction, Upgrade and Expansion of On-Site Sewage Treatment and Disposal Systems and for the Transport and Disposal of Septage
• Commonwealth of Massachusetts, Department of Labor Standards – Topical Outline of Massachusetts Prevailing Wage Law, March 2012
• Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal by MassDEP
• New England Interstate Water Pollution Control Commission – TIN-9, Guides for the Design of Wastewater Treatment Works, 2011 Edition
• Process Design Manual: Land Treatment of Municipal Wastewater – Supplement on Rapid Infiltration and Overland Flow by United States EPA (EPA 625/R-01-004)
• Process Design Manual: Land Treatment of Municipal Wastewater by United States EPA (EPA 625/R-03-021)
• United States Environmental Protection Agency – Decentralized Systems Technology Fact Sheet: Low Pressure Pipe Systems, September 1999
• Wastewater Engineering: Treatment, Disposal, and Reuse by AECOM (Metcalf & Eddy)
• Wastewater Treatment Plant Design: Manual of Practice (MOP 9) by Water Environment Federation
• Water Environment Research Foundation (2010)
• Water Reuse: Issues, Technologies, and Applications by AECOM (Metcalf & Eddy)
• Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal by MassDEP
• New England Interstate Water Pollution Control Commission – TIN-9, Guides for the Design of Wastewater Treatment Works, 2011 Edition
• Process Design Manual: Land Treatment of Municipal Wastewater – Supplement on Rapid Infiltration and Overland Flow by United States EPA (EPA 625/R-01-004)
• Process Design Manual: Land Treatment of Municipal Wastewater by United States EPA (EPA 625/R-03-021)
• United States Environmental Protection Agency – Decentralized Systems Technology Fact Sheet: Low Pressure Pipe Systems, September 1999
• Wastewater Engineering: Treatment, Disposal, and Reuse by AECOM (Metcalf & Eddy)
• Wastewater Treatment Plant Design: Manual of Practice (MOP 9) by Water Environment Federation
• Water Environment Research Foundation (2010)
• Water Reuse: Issues, Technologies, and Applications by AECOM (Metcalf & Eddy)

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www.adsenv.com/echo
Continuing a more than 20-year tradition, NEWEA members attended the National Water Policy Fly-in, which took place in Washington D.C., April 3–4, during Water Week 2019. For the second year, the Government Affairs Committee collaborated with the New England Water Works Association (NEWWA) to produce joint talking points. By collaborating, we bring the knowledge of 8,000 New England water professionals to the event. We started with an informational lunch for the attendees in the Rayburn Building (where many U.S. House of Representatives offices and committee rooms are located). Instructions and pointers about meeting with the legislators were given out, and Steve Dye from WEF distributed the national “Asks,” which were compiled by a consortium of water groups including WEF, the National Association of Clean Water Agencies (NACWA), and the American Water Works Association (AWWA). Representative Jim McGovern, who has sponsored the NEWEA event for many years, attended the lunch and gave an excellent speech emphasizing that we need to stress to the legislators we meet with that water quality needs to be included in any bipartisan funding package.

As this was the third event I have helped organize as chair of the Government Affairs Committee, and as my term will end in January, I thoroughly thank all the members of the Government Affairs Committee, especially the Fly-in attendees and the two vice-chairs, Scott Firmin and Ray Willis. None of this would be possible without a total “team” effort. I am especially excited that we have partnered with NEWWA these last two years and that the collaboration will continue as we continue to conduct joint meetings.

The NEWEA/NEWWA “Talking Points” emphasized multiple issues, including the following:

1. **Funding**—Our top priority: provide robust federal funding for water quality
   - America’s economic future depends on clean and safe water; yet our water, wastewater, and stormwater systems are old and in critical need of repairs, upgrades, and replacements. The American Society of Civil Engineers gives these systems only a “D” grade. Many utilities are financially challenged, and simply keeping up with standard maintenance and repairs can be an issue even with State Revolving Fund loans and funds available via the Water Infrastructure Finance and Innovation Act – WIFIA. The WIFIA loans must be repaid, while O&M costs continue to rise faster nationwide than the funding for these capital investments. Federal government spending on these systems has continually decreased. Federal water industry funding decreased from $7 billion in 1977 (2014-dollar equivalent), 6 percent of total investment) to $4.4 billion in 2014 (9 percent of total investment), and that trend persists. As a greater share of the cost burden for future investment is shifted down to the local level, affordability becomes increasingly more difficult for low-income and fixed-income customers. This is especially difficult for NEWEA members, as many of the oldest collection and treatment systems are in the Northeast.
   - Federal funding is needed to separate combined sewers with reduction and containment of combined sewer overflows, which are an increasing public/political issue locally. Continued federal support of integrated planning to address these issues will allow for local communities to have a larger voice in prioritizing water quality projects.
   - Federal funding is increasingly needed by utilities to treat the ever-increasing numbers of emerging contaminants, such as perfluoroalkyl and polyfluoroalkyl substances (PFAS). Many emerging contaminants are best managed by eliminating them from the source, an effort in which Congress can play a key role. Treatment in advanced wastewater treatment facilities, where technologies are always improving, may reduce contaminants somewhat but at significantly higher costs. Onsite septic tank systems are not as robust and may be costlier to adapt; besides, many private systems do not function adequately.
   - Additional federal funding would strengthen water and wastewater resiliency (e.g., additional water sources, drought preparedness planning, flooding, cybersecurity).
   - We support continued funding for U.S. Department of Agriculture Rural Development programs, a key resource for small rural systems.
   - Federal funding is increasingly needed by states and local communities for regional interconnection projects, which combat water scarcity, emerging contaminant remediation, or brackish water infiltration.

2. **Regulations**
   - Use sound science and research before imposing additional, overly onerous or impractical requirements on water and wastewater utilities—as exemplified by stringent aluminum standards in National Pollutant Discharge Elimination System (NPDES) permits when natural background levels of aluminum in the Northeast exceed the imposed standards. These requirements strain already limited resources and often divert funding away from infrastructure improvements that would better protect public health. Cost/benefit analyses must be considered for any federal or state regulatory mandate.
   - Carefully monitor bills regarding limiting groundwater extraction or water rights. Although mainly aimed at private entities, by limiting supply to capacity capabilities these bills can negatively affect public water suppliers that are providing full services to consumers.
   - Increase funding for the EPA National Priorities Water Research grant program to $20 million and fully fund the Innovative Water Technologies grant program at $10 million as authorized, for fiscal year 2020.

When we returned from Washington, D.C., we drafted thank-you letters to the region’s legislators with links to the information we had discussed with them. Having attended this event for the last six years, I cannot stress enough what an amazing experience it is and how you all should try to attend next year. Very few Americans ever go to Washington to interact with their legislators. After visiting our capital, I am always left with the feeling that fewer people than we think run this great country of ours. The legislators and their staffs have limited knowledge on water industry topics; they need and appreciate the expert information and insight that we as NEWEA members can offer, and they are impressed by how much impact we have on their constituents. We encourage you to share your expertise with your legislators freely. The D.C. Fly-in is just one way that the Government Affairs Committee helps us to carry our message forward to our governmental leaders. Join us and help us make your voice heard.
Phosphorus Sustainability Challenge
How can your operations use phosphorus more efficiently and release less to water? At its annual forum on April 5 in Washington, D.C., the Phosphorus Sustainability Alliance announced the phosphorus sustainability challenge, a call to action for organizations of any size and type to publicly commit to lowering their phosphorus footprints. Wastewater treatment and biosolids management are opportunities for phosphorus recycling.

For the challenge, efforts should concentrate on several key phosphorus sustainability goals, including using phosphorus more carefully in crop production and animal operations, sustainably recycling phosphorus, reducing food system waste, recovering phosphorus pollution from surface waters, removing phosphorus from human and animal waste streams, and improving the efficiency of phosphorus mining. In wastewater and biosolids management, actions are underway and can be further advanced to reduce phosphorus discharges, recover concentrated phosphorus from wastewater and biosolids, and carefully manage phosphorus applied to land in biosolids and reclaimed water.

We urge all organizations to join the phosphorus sustainability challenge and lead the charge toward improving phosphorus sustainability. Follow the conversation on social media using the hashtag #PhosphorusChallenge.

NEBRA Welcomes New Executive Director
Janine Burke-Wells is the new executive director of NEBRA. The announcement was made at the beginning of May by NEBRA President Tom Schwartz (Woodard & Curran) after a five-month search process and interviews with several outstanding, experienced finalists for the position. Janine Burke-Wells has been executive director of the Warwick Sewer Authority in Rhode Island since early 1998, responsible for daily management of the wastewater system for the second largest city in the state, including a 77 mgd (29 ML/d) treatment facility and associated collection system. She worked for the town of West Warwick as director of administration/assistant superintendent beginning in 1998 and, prior to that, worked for EPA.

The challenge is this: PFAS are the only commonly used chemicals regulated in drinking water in parts per trillion. (A part per trillion is one second in 31,700 years.) Such small traces of PFAS can get into groundwater and drinking water in many ways, including through conveyance in wastewater, biosolids, and residuals, where their inevitable presence is due to PFAS being used in many consumer products and in our daily living environments. If society wants to ensure no waters are impacted at levels above identified screening values—i.e., EPA’s 70 parts per trillion (ppt) for PFPeA + PFHxS (perfluorooctanoic acid and perfluorohexanesulfonic acid) in drinking water—the management of wastewater and residuals may be challenged. If society chooses to regulate PFAS at even lower levels, as several states do (e.g., Vermont’s 20 ppt limit in groundwater for five PFAS combined), current wastewater and biosolids/residuals management practices might not be acceptable. What that means and the solutions are challenging questions from front and center for regulators and policymakers. Either the regulatory trends in these few states are too severe, or wastewater and biosolids management will have to be widely disrupted, at a cost to utilities.

Getting traces of PFAS out of drinking water is possible with moderately priced, scalable activated carbon systems. But keeping them out of wastewater, or removing them from wastewater and biosolids, is not economically feasible—nor will it be for the foreseeable future. The only solution to the challenge of PFAS is a change of focus of concern from PFAS in commerce. That has worked dramatically for PFOA and PFOS, which have been reduced through voluntary phase-outs. But, because they are persistent and do not degrade in the environment, their continued presence will confound efforts to address them.

With the limitations on data and understanding of fate and transport in soils related to PFAS, state regulators—especially those focused on groundwater protection—have begun to target biosolids and septage. Two
regulatory actions this spring have shown how biosolids and residuals recycling can be disrupted. In Maine, on March 22, Jerry Reid, new commissioner of the Department of Environmental Protection (MEDEP), imposed a moratorium on biosolids distribution and use, pending testing of all biosolids for PFAS. Wastewater utilities and companies managing biosolids scrambled to complete required sampling plans and tests. These Maine tests are finding PFAs scrambled in typical low levels, similar to other data in the literature and other state investigations. But MEDEP is applying very low screening levels, which NEBRA has argued are scientifically indefensible for use related to biosolids, and all but one Maine biosolids product exceeds the screening levels (some tests are still pending).

Exceeding the screening values does not preclude possible use of biosolids. MEDEP regulations allow for demonstration, through loading rate calculations, that biosolids applied to soil for several decades will not raise soil levels above the screening values. Those calculations have now been applied to several Class A products, such as the compost from the Casella Organics’ Hawk Ridge compost facility in Unity, New England’s largest compost facility. Maine DEP has determined that compost is safe for use and permitted sales and distribution in mid-April, lessening the impacts of the moratorium. But programs that land-apply Class B biosolids are still unable to proceed during planting season begins. The Lewiston Auburn Water Pollution Control Authority, a leader in progressive biosolids recycling, has had two-thirds of its permitted land-application fields shut down. And farmers are nervous, meaning that the market perception of biosolids has been affected.

Municipalities have met with the commissioner, and there is discussion of collaborating on advancing the science through robust modeling of fate and transport of PFAS applied to soils in biosolids. NEBRA has been pointing to field data that indicate that PFAS in soils at even much higher levels than MEDEP’s screening values do not affect groundwater at levels approaching the state’s 70 ppt groundwater screening value.

Meanwhile, in New Hampshire, a facility that has been managing septage for 30 years has been shut down by the New Hampshire Department of Environmental Services (NHDES) because of PFAS found in neighbors’ wells. The PFAS is thought to have migrated from the septage lagoon and wetlands treatment system. The highest level of PFAS measured in well water was somewhat more than twice the state’s groundwater standard of 70 ppt. Within a week of action, on May 2, NHDES and the local town selectmen held a public informational meeting attended by more than 100 residents. The septage facility owner is cooperating with NHDES on providing bottled water to neighbors and further investigating. But the business, which has been permitted by NHDES for decades and has not had any enforcement action before this, is shut down, ordered to stop receiving and processing any septage. Unanticipated costs are mounting.

“These situations are warnings to the wastewater and biosolids/residuals management profession,” said Mr. Beecher. “While the sites targeted by regulators in Maine and New Hampshire have seen much more biosolids and residuals activity than average, there are likely similar sites in every state. The questions is whether or not the very strict regulatory standards—anything being proposed that is less than EPA’s health advisory of 70 ppt—are necessary to protect public health. Regulators need to carefully assess the costs and benefits of setting drinking water and groundwater standards, recognizing the potential impacts on important, beneficial environmental programs like wastewater treatment and biosolids recycling.”

How are Biosolids and Manures Regulated?

Coming soon: biosolids and manure regulations database

States and provinces across the United States and Canada regulate biosolids and manures differently and in various ways. No two jurisdictions are the same. The complexity and diversity of regulations make managing biosolids and manures more challenging. According to the Sustainable Phosphorus Alliance, this results in barriers to efficient, protective, sustainable recycling of phosphorus and other nutrients and organic matter in these materials.

The alliance has created an online database of state and provincial manure and biosolids regulations, including summaries of each jurisdiction’s regulations and links to key documents. The information is under final review by state regulators. According to Rebecca Muenich, who provided an overview of the project at the alliance’s annual forum on March 5 in Washington, D.C., “the project is useful for understanding the regulatory landscape and the impacts on how manure and biosolids are managed, which influences phosphorus losses. We hope this will help move toward more consistent regulations.” The alliance expects to make the database available online later this year.

Join NEWEA for a Teacher Training (K-12) at the Narragansett Bay Commission, Providence, Rhode Island this summer.

Participate in a treatment plant tour; join in on a laboratory demonstration with microscopes; learn about NEWEA’s educational resources available for use in the classroom; and engage in a variety of hands-on workshops that you can repeat with your students. Continental breakfast, lunch and certificates of attendance will be provided.
Who is WEF? WEF is a not-for-profit technical and educational organization of 35,000 members from 114 affiliated member associations (MAs) representing water quality professionals around the world. Since 1962, WEF has promoted its vision of a community of empowered professionals creating a healthy global water environment, a global water leader WEF’s mission is to connect water professionals, enrich the expertise of water professionals, increase the awareness of the impact and value of water, and provide a platform for water sector innovation. A board of governors governs WEF and holds legal authority and fiduciary responsibilities on behalf of the federation and its membership. WEF employs a staff of nearly 100, headquartered in Alexandria, Virginia, just outside Washington, D.C.

How is NEWEA associated with WEF? NEWEA is one of WEF’s 76 MAs. Forty-one MAs are in the United States, five are in Canada, and 30 others are around the world from South Africa to Singapore. NEWEA has been an MA of WEF since 1979 (when the New England Sewage Works Association—later NEWEA—was formed as an affiliate of the infant National Federation of Sewage Works Associations, which later became WEF). In today’s WEF, based on the size of our MA, NEWEA is assigned a delegation of three persons to represent NEWEA, one of the largest delegations in the country, and one of the most highly respected. This is a testament to NEWEA’s long-term contributions to WEF and our shared success.

What Does WEF do for NEWEA? WEF offers NEWEA similar benefits to those which WEF provides for each New England state. WEF connects water professionals nationally and internationally and enriches the expertise of water professionals through WEFTEC (the annual international technical conference), numerous specialty conferences, and technical publications. WEF also increases awareness of the impact and value of water nationally. Finally, WEF provides a platform for sector innovation—all common goals promoted by NEWEA—but WEF does so nationally with an international audience.

WEF designates a liaison for WEF. NEWEA is fortunate to have Kelsey Hurst working with us. Ms. Hurst is a second-generation water professional from Pennsylvania and fits right in with the NEWEA delegation. She has proved a valuable member of the NEWEA team nationally.

What does a NEWEA WEF delegate do? Acting on behalf of NEWEA, delegates are a primary conduit of information exchange with WEF. Delegates also advise the board of trustees on strategic direction and public policy development.

NEWEA delegates are members of WEF’s House of Delegates (HOD), the organization’s deliberative and representative body. The HOD advises WEF on strategic direction and public policy development. The HOD consists of its delegates representing MAs and is at-large positions, from various broad interest groups. NEWEA’s three-person delegation is currently joined by one at-large delegate from NEWEA. Delegates must attend their MA’s annual conferences, WEFTEC, and at least one WEF MA meeting (WEFMAX) annually. They must also participate in one or more HOD workgroups and/or committees. The workgroups are each given a WEFTEC, a task for the coming year, and they typically report their progress at the next year’s WEFTEC.

Monthly conference calls and individual/small group deliverables are the norm for these workgroups.

UPDATES FROM OUR DELEGATES
Fred McNeil, City of Manchester, New Hampshire—Senior Delegate (term ended September 2019) I am energized by participating as a WEF delegate for NEWEA. Interacting and exchanging ideas with like-minded water professionals from around the world is both professionally and personally fulfilling. It makes me proud of our industry and the contributions we make to the world’s health and well-being.

In March, I participated in a WEFMAX in Scottsdale, Arizona, where more than 50 water professionals from around the country exchanged ideas, practices, and lessons learned. Industry-critical subjects such as membership engagement, diversity, and public communications were discussed. On behalf of NEWEA, I presented on our efforts at membership retention and growth. I was proud to share with this national audience that NEWEA membership is at an all-time high.

I am in my third year as a WEF delegate. NEWEA is fortunate to have Kelsey Hurst working with us. Ms. Hurst is a second-generation water professional from Pennsylvania and fits right in with the NEWEA delegation. She has proved a valuable member of the NEWEA team nationally.

Matt Formica, AECOM—Junior Delegate. After holding several leadership positions with NEWEA, I am pleased to serve as a delegate to share NEWEA’s highly respected programs and forward-thinking initiatives with the other MAs and with the WEF leadership. In May, I attended a WEFMAX in Gulf Shores, Alabama, with leaders from other MAs and WEF. These leaders from across the country all truly see NEWEA as a leader and that we have an obligation as a leader to share our successes. As part of a federation of professionals, we are committed to improving the integration of the MAs and WEF on public awareness, government affairs, and the advancement of education and innovation in our industry. NEWEA also benefits from this relationship by sharing ideas on ways to modify and improve our programs and initiatives and by learning from the successes and challenges that other MAs and WEF face.

I am fortunate this year to be involved in positions that give NEWEA a voice in the selection of future leaders for WEF. I am serving for the second year on the WEF Sub-Nomination Committee with the WEF president and past president, one trustee, and one other delegate. This five-person committee’s charge is to review the applications for two annual positions on the WEF board of trustees and for the next WEF vice president. Ultimately, we will provide a recommended slate of officers to the board of trustees for these positions of significant importance. I also serve as the Nominating Committee chairman for the HOD. This group reviews applications and recommends committee assignments for six HOD committees, the delegate-at-large positions, and the HOD speaker-elect. Helping to create the table for input into the selection of these positions allows us to make sure NEWEA’s initiatives and position in WEF will be secured and maintained.

Susan Guswa, Woodard & Curran—First-year Delegate. I am enjoying my first year as WEF delegate for NEWEA. I participated in my first HOD meeting at WEFTEC in September 2018 and quickly realized how respected NEWEA is, a testament to our organization’s contributions to the water quality profession and the professionalism and vision provided by our current and past NEWEA leaders. This year, I am participating on the Nominating Committee Diversity and Inclusion workgroup and am a member of the WEFMAX Committee.

The Membership workgroup focuses on increasing the diversity of the WEF membership to support our workforce of the future. Our current WEF president, Tom Kunetz, is passionate about this topic and spoke about this as one of this year’s priorities on the October 8, 2018 Words on Water podcast titled #58: “How to Increase the Diversity of the WEF Membership.”

The workgroup is surveying MAs for best practices and facilitating conversations at this year’s WEFMAX meetings on diversity and inclusion.

Participation on the WEFMAX Committee allows me to bring my experience from chairing NEWEA Program Committee to WEF. I was tasked with moderating a session at my first WEFMAX in Orange Beach, Alabama, in May. It was informative and rewarding to engage with leaders from WEF and other MAs on topics such as operator outreach, engagement, and workforce development. NEWEA will be hosting a WEFMAX in 2022, and this will be an excellent opportunity to draw from as we begin planning for that event.

James Barsanti, City of Framingham, Massachusetts—Incoming Delegate (term begins at WEFTEC in September 2019) I am looking forward to participating in our WEF endeavors with my fellow delegates. Since finishing my role as NEWEA past president, I have been working with WEF’s Collections Systems Committee (CSC) and Public Communications and Outreach Committee (PCOC). Beginning in October, I will be the CSC’s project manager for the Operation and Maintenance Technical Practice Workgroup. My activities with the PCOC include reviewing nominations for this year’s WEF Public Communication and Outreach awards.

Susanne Sullivan, New England Interstate Water Pollution Control Commission—Delegate-at-large. After completing my three-year NEWEA delegate role, I was selected by WEF to continue in a delegate-at-large role for a three-year term, during which I will represent the state and interstate member constituencies to WEF. In this role, I joined the WEF Budget Committee, which reviews the budget development process with the WEF Finance Committee and the board of trustees to achieve consistency of the annual budget with WEF’s Strategic Plan and other initiatives. The committee also advises on the budget development process with the WEF Finance Committee and the board of trustees to achieve consistency of the annual budget with WEF’s Strategic Plan and other initiatives.

For more information regarding WEF and NEWEA interactions, see the communication link between the WEF committee, councils, CoPs, HOD, and the board. As the CoP director, I work with WEF’s Awards, Manufacturers and Representatives (MARs), Program, and Students and Young Professionals committees. This is a rewarding opportunity that I have enjoyed since October 2018 when I started my term.

For more information regarding WEF and NEWEA interactions, programs, and involvement opportunities, please ask any current or past WEF delegate or contact the NEWEA office.
We are excited to showcase two talented Young Professionals (YPs) who do not take the business of clean water "for granite." You guessed it, in this issue the Journal spoke with New Hampshire-based YPs to offer their perspectives on the water environment profession and share their reflections on their career development. Kate Biedron is a project manager and environmental engineer with CDM Smith in Manchester and serves as NEWEA’s meeting management council director. Mike Curry is a lead project engineer with Wright-Pierce in Portsmouth.

Kate: How did you come to enter the clean water profession?
Kate: It was not until I got my internship in college that I realized there was this whole underground profession? I started at CDM Smith right out of college, so I have been with CDM Smith for the past five years and have not turned back since. I officially caught the "clean water" bug and I have been infected ever since.

Mike: How tight of a community the industry has and that there would always be need for water and wastewater. I love helping people, and I knew this was going to be a rewarding career. I then decided I was all in and it was time to get my master’s degree.

Kate: The Zakim and Chesapeake Bay bridges always interested me. As my college career progressed, a few memorable and persistent professors led me to the dark side—water. A couple of treatment plant tours later, I officially caught the "clean water" bug and I have not turned back since.

Mike: More or less by accident. The first half of my college career I wanted to focus on structural engineering. The Zakim and Chesapeake Bay bridges always interested me. As my college career progressed, a few memorable and persistent professors led me to the dark side—water. A couple of treatment plant tours later, I officially caught the "clean water" bug and I have not turned back since.

I should also mention that I learned I am terrible at matrix structural analysis. But who isn’t?

Kate: What is a fun fact about you that your professional network may be surprised to learn about you?
Mike: I can juggle torches (yes, when they are on fire). Kate: I am very lucky to have many mentors in my life, and I must say that many of them are from NEWEA.

Mike: I was fortunate enough to study under Dr. Nancy Kinser during my time at the University of New Hampshire. I still use her weekly adage, "There’s no free lunch!" From time to time. Her unwavering passion for this industry helped encourage me to be a part of it.

Mike: What is your rewarding experience with the NEWEA YPs Committee?
Kate: I had a blast moderating the VP summit at the 2019 NEWEA Annual Conference. The panel was so fun, and the room had great energy. I left feeling that we are in good hands with the next generation of folks that participated.

Mike: Poo and Brew Events! Any day at a wastewater treatment plant is a good day. Add a beverage to it, and it is even better.

Kate: I do have any suggestions concerning what steps NEWEA and the state associations could take to attract and maintain young professionals to this line of work?
Mike: I think that NEWEA offers something for everyone. There are great technical committees and so much more to keep this volunteer organization going. Meeting management, which involves event planning, to government affairs, which involves staying up with the latest legislation and regulations, and if you are good with numbers like my CPA friends mentioned above, you could be treasurer or get involved in the Finance Committee. There really is something for everyone. I would recommend getting involved and taking on the leadership positions. You learn so much, and there are so many folks willing to help you. I know what you are thinking, and no, you are not too young. We take all ages. Trust me. They took me!

Mike: Start young. The longer YPs wait, the less likely it is that they will be part of NEWEA and the corresponding state association. Get active!

Kate: What is a fun fact about you that your professional network may be surprised to learn about you?
Kate: I eat way too much sushi.
Mike: I can juggle torches (yes, when they are on fire).
Student Design Competition
by Nick Tooker, PE, Student Activity Committee chair

The NEWEA Student Design Competition (SDC), organized by the Student Activity Committee, was recently completed. This competition promotes “real world” design experience for students interested in pursuing an education and/or career in water engineering and sciences. The competition tasked teams of student members within NEWEA to design a project that they have worked on together as a team. Student teams submitted written reports and presented their findings in front of judges during the SDC reception and presentation, held on April 25 at Northeastern University (NU). A team from NU presented “Town of Amherst Water Reuse Initiative and Wastewater Treatment Plant Retrofit.”

Judges evaluated the technical aspects, the appearance, and structure of the written submittal, and the content organization and effectiveness of the presentation.

The NU project included the design of an upgrade for nutrient removal and increased water reuse capacity at the Amherst Water Resource Recovery Facility in Amherst, Massachusetts. The preliminary design satisfies a potential total nitrogen regulation for secondary treatment and addresses various sustainability goals, including water reuse for the University of Massachusetts (UMass) Amherst. Nitrogen removal is accomplished through the design of a moving bed biofilm reactor (MBBR), and water reuse is accomplished through membrane ultrafiltration followed by reverse osmosis. The reverse osmotic system is used for utility use at the central utility plant, for irrigation of recreation fields, and for toilet flushing on the UMass Amherst campus.

The winning team will receive a travel allowance to WEFTEC 2019 in Chicago, where it will present its project at the WEF SDC.

Meet the winning team: Margaret Keefe (left in photo) managed the project and was available in all aspects for support whether it be design research or client communication. Ms. Keefe was extensively involved in the design for the ultrafiltration and reverse osmosis components of the tertiary treatment upgrade. She also helped to construct a preliminary BioWin model and assembled the project poster.

Brendan Curran (not in photo) provided additional support through preliminary research and vendor communication for the ultrafiltration and reverse osmosis system. He also compiled specifications for the system and the chemical cost breakdown. Kestral Johnston (middle in photo) served as the wastewater engineer for the project. Ms. Johnston was the design lead for the MBBR and all other aspects of the secondary treatment retrofit. She also helped to construct a preliminary BioWin model and assembled the project poster.

Winners of the NEWEA Student Design Competition: (l to r) Margaret Keefe, Kestral Johnston, and Marcus Brunelle of Northeastern University presented their team project “Town of Amherst Water Reuse Initiative and Wastewater Treatment Plant Retrofit.”

Kestral Johnston (middle in photo) served as the wastewater engineer for the project. Ms. Johnston was the design lead for the MBBR and all other aspects of the secondary treatment retrofit. She also helped to construct a preliminary BioWin model and assembled the project poster.

Brendan Curran (not in photo) provided additional support through preliminary research and vendor communication for the ultrafiltration and reverse osmosis system. He also compiled specifications for the system and the chemical cost breakdown. Kestral Johnston (middle in photo) served as the wastewater engineer for the project. Ms. Johnston was the design lead for the MBBR and all other aspects of the secondary treatment retrofit. She also helped to construct a preliminary BioWin model and assembled the project poster.

The winning team’s project was presented at the WEFTEC 2019 conference in Chicago, where it will present its project at the WEF SDC.

Specialty Conference, Training, & Networking Proceedings

Participants gather at the Operations Challenge Facility Tour and Training Day at the West Warwick, Rhode Island Wastewater Treatment Facility.

YOUNG PROFESSIONALS NETWORKING EVENTS

NEWEA’s Young Professionals Committee hosts a popular multi-discipline networking event aptly named Poe & Brew. This event features a tour of a local wastewater treatment facility followed by networking at a brewery. These events are open to organization members and non-members who are professionals in the early stages of their water industry careers.

Sponsored by AECOM, Aquatic Solutions; Arcadis; Brown and Caldwell; Carlson Systems; CDm Smith; David F. Sullivan & Associates; Dewberry; Environmental Partners Group; EST Associates; Flow Assessment Services; Font & O’Neill; Green Mountain Pipeline Services; Hazen and Sawyer; Hoyle, Tanner & Associates; Jacobs; The MAHER Corporation; Mott MacDonald; NASSCO; Stantec; SUEZ; Tata & Howard; Tighe & Bond; Weston & Sampson; Woodard & Curran; Wright-Pierce

POO & BREW #19

This event featured a tour of the Amherst, Massachusetts Water Resource Recovery Facility, followed by a networking reception at Abandoned Building Brewery. Sixty students and professionals attended this event, held on April 24, 2019. The Massachusetts Water Pollution Control Association (MWPCA) co-hosted, and CDm Smith and ACV Enviro sponsored as Event Supporters.
New England Water Environment Association, Inc.

Statement of activities
For the years ended September 30, 2018 and 2017

<table>
<thead>
<tr>
<th>Changes in unrestricted net assets:</th>
<th>2018</th>
<th>2017</th>
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<tbody>
<tr>
<td>Revenues and gains:</td>
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<tr>
<td>Registration Fees</td>
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<td>Exhibitor Fees</td>
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<td>Certification Fees</td>
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<td>Investment Income</td>
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<td>Other Income</td>
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<td>Total unrestricted revenues and gains</td>
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<td>1,133,752</td>
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<tr>
<td>Total unrestricted revenues, gains and other support</td>
<td>1,181,968</td>
<td>1,133,752</td>
</tr>
</tbody>
</table>

Expenses:

| Program services                  | 844,935  | 739,129  |
| Management and general            | 256,934  | 252,997  |
| Pass Through Dues                 | 44,751   | 35,343   |
| Total expenses                    | 1,146,620| 1,027,469|

(Decrease) Increase in unrestricted net assets | 35,348 | 106,283 |

Net assets, beginning of year | $ 735,175 | 628,892 |

Net assets, end of year | $ 770,523 | $ 735,175 |

New Members
February – March 2019

Robert Backman
Weyland, MA (PRO)

Brian Bernard
North Hampton, NH (PRO)

Ben Chadwick
Smith & Wilkinson
Saco, ME (PRO)

Taylor Cheverier
Town of Northborough
Northborough, MA (PWO)

Emily Church
Tighe & Bond
Worcester, MA (YP)

Tricia Fabrizio
Narragansett Bay Commission
Providence, RI (PWO)

Ryan Flynn
Worcester, MA (YP)

Jody Frymire
Gornam, ME (STU)

Todd Gaignat
Loudon, NH (PWO)

Ryan Weeks
City of Somersworth
Somersworth, NH (PWO)

Frank Bottone
Westport, CT (PWO)

Jason Carelli
Lebanon WWTP
West Lebanon, NH (PWO)

Brenda Callahan
Stantec
Philadelphia, PA (PRO)

Umaag Chauhan
Boston, MA (STU)

Isaas Colombari
Westfield, MA (STU)

Chelsea Conlon
JK Muri LLC
Rocky Hill, CT (YP)

Crystal Cooper
Windham, ME (PRO)

Adrianna Copeland
Baton Rouge, LA (STU)

James Costa
City of New Bedford
New Bedford, MA (PWO)

Christopher Coyle
CDM Smith
Hartford, CT (PWO)

Jami Fitz
Lynn Water & Sewer Commission
Windham, ME (PRO)

Peter Fitzgerald
Lunenburg, MA (STU)

Doug Flanagan
Rock Hill, SC (PRO)

Stephen Frederick
Springfield Water & Sewer Commission
Springfield, MA (PRO)

Elizabeth Fulton
Cranford, NJ (STU)

Susan Geilmuyden
Dewberry
Boston, MA (PRO)

Alan Gunnison
Beta Group, Inc.
Lincoln, RI (PRO)

Insley Haciski
Onset Computer
Boune, MA (PWO)

Tyler Hebert
Baton Rouge, LA (STU)

Caitlin Hunt
Massachusetts Water Resources Authority
Winthrop, MA (PRO)

Matthew Hutchins
Vestavia Hills, AL (STU)

Charles Johnson
Nantucket Sewer Department
Nantucket, MA (PWO)

Ronald Kelton
City of Portland
Portland
Thank you TO ALL OUR 2019 ANNUAL SPONSOR PROGRAM PARTICIPANTS:

Platinum
ARCADIS

Gold
Flow Assessment Services, LLC

Bronze

Join NEWEA’s 2020 Annual Sponsor Program

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

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

Sponsorship Benefits:

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

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

Committee Member Appreciation Event & Watershed Homebrewing Competition
July 18, 2019
Kentfield Farms, Westford, MA

TEACHER TRAINING WORKSHOP
August 20, 2019
NBC, Providence, RI

WEFTEC TECHNICAL EXHIBITION AND CONFERENCE
September 21 – 25, 2019
McCormick Place, Chicago, IL

NORtheast Residuals & Biosolids CONFERENCE, EXHIBIT AND TOUR
October 16 – 18, 2019
Shelton Springfield Monarch Place, Springfield, MA

NEWEA ANNUAL CONFERENCE & EXHIBIT
January 26 – 29, 2020
Boston Marriott Copley Place Hotel, Boston, MA

This is a partial list. Please visit the state association web sites and NEWEA.org for complete and current listings.

Measurement unit conversions and abbreviations used in the Journal

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<thead>
<tr>
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<td>Head</td>
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Amendment to NEWEA’s 2020 Annual Sponsor Program

A web presence on NEWEA.org’s sponsorships program page

The option to customize sponsorship levels by selecting to participate in up to eight additional unique NEWEA events plus additional activities

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<td></td>
<td>square miles (mi²)</td>
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<tr>
<td>Flow</td>
<td>million gallons per day (mgd)</td>
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<td></td>
<td>million cubic feet per day (mcfd)</td>
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<td></td>
<td>gpm</td>
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<td></td>
<td>horsepower (hp)</td>
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<tr>
<td>Velocity</td>
<td>feet per second (fps)</td>
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<td>miles per hour (mph)</td>
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<tr>
<td>Pressure</td>
<td>pounds/square inch (psi)</td>
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<tr>
<td></td>
<td>inches water column (in. wc)</td>
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<tr>
<td>Head</td>
<td>feet of head (ft of head)</td>
</tr>
</tbody>
</table>

Join NEWEA’s 2020 Annual Sponsor Program

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

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

Sponsorship Benefits:

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

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

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Phone: 781-939-0908

Measurement unit conversions and abbreviations used in the Journal

<table>
<thead>
<tr>
<th>U.S. Unit</th>
<th>International System of Units (SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
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<td></td>
<td>feet (ft)</td>
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<td></td>
<td>miles (mi)</td>
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<td>Area</td>
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<tr>
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</tbody>
</table>
The Assabet River Consortium

November 1 through March 31. This paper provides a brief history of the Assabet River Consortium, which was the state’s first regionally-based water quality management program. It was established in 1986 to address and study regional wastewater treatment issues that affect each community.

Four treatment facilities within a 15-mile radius have implemented four different phosphorus removal technologies—Westerly WWTP, Hudson WWTP, Maynard WWTP, and Marlborough WWTP. In 1989, the Town of Hopkinton also upgraded its wastewater treatment plant. In 1999, the Massachusetts Department of Environmental Protection (MassDEP) released a comprehensive wastewater management plan (CWMP), which stimulus to develop regional plans and to achieve seasonal phosphorus limits for the Assabet River.

We surveyed the six communities for the year 2012, five years after implementation of the CWMP, to evaluate:

- Infiltration/Inflow removal and water conservation measures
- Effluent nutrient reduction requirements and increased energy efficiency (refer to Photo 2)
- Water environment regulation and operations forum

For rates and opportunities to advertise with NEWEA, contact Jordan Gosselin. Call: 781-939-0908.

Advertise with NEWEA

Reach more than 2,100 New England water industry professionals each quarter in the NEWEA JOURNAL. The Fall issue advertising deadline is August 1, 2019.

Upcoming Journal Themes

Fall 2019—Collection Systems
Winter 2019—Safety

NEWEA/WEF* Membership Application 2019

Personal Information (please print clearly)

Last Name                                                              Middle Initials First Name (jnr. sr. etc)
Business Name if applicable:                                                                                                                                              (j 11-20)
Street or P.O. Box: _______________                                                                                                  Other (please specify)                                          Date
City, State, Zip:                                                                                          Other (please specify)                                          Date
Home Phone Number: ____________________________________________  Mobile Phone Number: ___________________________  Business Phone number: ________________
Email Address: ____________________________________________

☐ Check here if renewing, please provide current member ID.

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)

Sponsorship Information

Sponsorship Information

Package

MEMBERSHIP CATEGORIES (SELECT ONE)

☐ Professional Package

Individually involved in or interested in water quality

☐ Professional Package

New member or previously member with 5 or less years of experience in the industry and not more than 35 years of age. This package is available for 3 years. Date of birth (mm/yyyy)

☐ Professional Package

Individually in the day-to-day operation of wastewater collection, treatment of laboratory facilities, or facilities with a daily flow of <1 mgd or 4OLs. License #

☐ Professional Package

Instructors/Professors interested in subjects related to water quality

☐ Professional Package

Instructors/Professors interested in subjects related to water quality

☐ Professional Package

Instructors/Professors interested in subjects related to water quality

☐ Professional 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

☐ Executive Package

Upper level managers interested in an expanded suite of WEF products/services

☐ Dual

If you are already a member of WEF and wish to join NEWEA

☐ Corporate Membership


☐ New England Regulatory Membership

This membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including USEPA Region 1, CT DEP, AGS of Energy and Environmental Protection, ME Department of Environmental Protection, MA Department of Environmental Protection, MD Department of Environmental Services, Park and Recreation, MD Department of Environmental Conservation, and SI Department of Environmental Management

WEF Utility Partnership Program (UPPP): NEWEA participates in the WEF Utility Partnership Program (UPPP) and supports utilities to join WEF and NEWEA while creating a comprehensive membership package for designated employers. As a UPPP member, members within their organization can access all content and receive flexibility to tailor the appropriate value packages based on the designated employer’s needs. Contact WEF for questions & enrollment (703-684-2400 x7750).

Payment

☐ Check or money order enclosed

Made payable to NEWEA

10 Tower Office Park, Suite 601

Woburn, MA 01801

For more information: 781-939-0908

Fax: 781-939-0307 NEWEA.org

Charge

American Express

Discover

Credit Card #

Signature

Exp. Date

Name on Card (please print)

Billing Address

Street/P.O. Box

City, State, Zip

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**NEWEA/WEF** Membership Application 2019

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)

<p>| | |</p>
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<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>Public/Private Wastewater Plants and/or Drinking Water and/or Stormwater</td>
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<td>2</td>
<td>Public/Private Wastewater Only</td>
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<tr>
<td>3</td>
<td>Public/Private Drinking Water Only (e.g. municipality, utility, authority)</td>
</tr>
<tr>
<td>4</td>
<td>Industrial Systems/Plants</td>
</tr>
<tr>
<td>5</td>
<td>Consulting or Contracting Firm</td>
</tr>
<tr>
<td>6</td>
<td>State, Federal, Regional Government Agency</td>
</tr>
<tr>
<td>7</td>
<td>Research or Analytical Laboratories</td>
</tr>
<tr>
<td>8</td>
<td>Educational Institution</td>
</tr>
<tr>
<td>9</td>
<td>Manufacturer of Water/Wastewater/Stormwater Equipment or Products</td>
</tr>
<tr>
<td>10</td>
<td>Water/Wastewater/Stormwater Product Distributor or Manufacturer’s Rep.</td>
</tr>
<tr>
<td>11</td>
<td>Public/Private Stormwater (MS4) Program Only</td>
</tr>
<tr>
<td>12</td>
<td>Public Financing, Investment and Banking</td>
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<tr>
<td>13</td>
<td>Non-profits</td>
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<tr>
<td>99</td>
<td>Other ____________ (please specify)</td>
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</table>

### What is your Primary JOB FUNCTION?
(circle one only) (JOB)

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<thead>
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<tbody>
<tr>
<td>1</td>
<td>Management: Upper or Senior</td>
</tr>
<tr>
<td>2</td>
<td>Management: Engineering, Laboratory, Operations, inspection, Maintenance</td>
</tr>
<tr>
<td>3</td>
<td>Engineering and Design Staff</td>
</tr>
<tr>
<td>4</td>
<td>Scientific and Research Staff</td>
</tr>
<tr>
<td>5</td>
<td>Operations/Inspection Maintenance</td>
</tr>
<tr>
<td>6</td>
<td>Purchasing/Marketing/Sales</td>
</tr>
<tr>
<td>7</td>
<td>Educator</td>
</tr>
<tr>
<td>8</td>
<td>Student</td>
</tr>
<tr>
<td>9</td>
<td>Elected or Appointed Public Official</td>
</tr>
<tr>
<td>10</td>
<td>Other ____________ (please specify)</td>
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### What are your KEY FOCUS AREAS?
(circle all that apply) (FOC)

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<table>
<thead>
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<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>Drinking Water</td>
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<tr>
<td>3</td>
<td>Industrial Water/Wastewater/Process Water</td>
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<td>4</td>
<td>Groundwater</td>
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<td>5</td>
<td>Odor/Air Emissions</td>
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<tr>
<td>6</td>
<td>Land and Soil Systems</td>
</tr>
<tr>
<td>7</td>
<td>Legislation (Policy, Legislation, Regulation)</td>
</tr>
<tr>
<td>8</td>
<td>Public Education/Information</td>
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<td>9</td>
<td>Residuals/Sludge/Biosolids/Solid Waste</td>
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<tr>
<td>10</td>
<td>Stormwater Management/Floodplain Management/Wet Weather</td>
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<td>11</td>
<td>Toxic and Hazardous Material</td>
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<td>Utility Management and Environmental</td>
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<td>Wastewater</td>
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<td>14</td>
<td>Water Reuse and/or Recycle</td>
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<td>15</td>
<td>Watershed/Surface Water Systems</td>
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<td>16</td>
<td>Water/Wastewater Analysis and Health/Safety Water Systems</td>
</tr>
<tr>
<td>17</td>
<td>Other ____________ (please specify)</td>
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</table>

### Optional Items (OPT)

**Years of industry employment?**

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<td>2</td>
<td>2 (6 to 10)</td>
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<td>3</td>
<td>3 (11 to 20)</td>
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<tr>
<td>4</td>
<td>4 (21 to 30)</td>
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<td>5</td>
<td>5 (&gt;30 years)</td>
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**Gender?**

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<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>Male</td>
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</table>

**Education level? (ED)**

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<tr>
<td>2</td>
<td>Technical School</td>
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<td>3</td>
<td>Some College</td>
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<tr>
<td>4</td>
<td>Associates Degree</td>
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<tr>
<td>5</td>
<td>Bachelors Degree</td>
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<td>6</td>
<td>Masters Degree</td>
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<td>7</td>
<td>JD</td>
</tr>
<tr>
<td>8</td>
<td>PhD</td>
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**Education/Concentration Area(s) (CON)**

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<td>2</td>
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<tr>
<td>3</td>
<td>Engineering Sciences</td>
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<td>4</td>
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<td>5</td>
<td>Law</td>
</tr>
<tr>
<td>6</td>
<td>Business</td>
</tr>
</tbody>
</table>

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.*
Executing advanced wastewater treatment processes for our communities and industry

Design with community in mind
stantec.com/water

Village of Waterbury, VT
Wastewater Treatment Plant