Fall 2023, Vol. 53, No. 3

New York Water Environment Association, Inc.

ClearWaters

The Research Issue

Also Inside:

KOESTER®

KNOWLEDGEABLE | CARING | LOYAL

CELEBRATING

50 YEARS

Est. 1973

OUR HANDSHAKE IS OUR COMMITMENT TO YOU.

Upstate New York

3101 Seneca Turnpike
Canastota, NY 13032
Phone: (315) 697-3800
Fax: (315) 697-3888

NYC, Long Island, New Jersey

170 Kinnelon Road
Kinnelon, NJ 07405
Phone: (973) 492-0400
Fax: (973) 492-9581

sales@koesterassociates.com
service@koesterassociates.com
parts@koesterassociates.com

CELEBRATING 50 YEARS SUPPLYING EQUIPMENT, SOLUTIONS & SERVICE FOR WATER AND WASTEWATER

www.koesterassociates.com

Fall 2023, Vol. 53, No. 3

Clear Waters

New York Water Environment Association, Inc.

Correction from Summer 2023, Vol. 53, No. 2:
Page 7, Image 7, the fifth person from the left is Mark Grisanti, not Jim Tierney.

Cover: *Brazhyk, Adobe Stock*

Clear Waters (USPS 004-595) (ISSN 01642030) is published quarterly by the New York Water Environment Association, Inc., 525 Plum Street, Suite 102, Syracuse, NY 13204. Subscription is through membership; public subscription is $25.00/year. PERIODICALS postage paid at Syracuse, NY. POSTMASTER: Send address changes to the New York Water Environment Association, Inc., 525 Plum Street, Suite 102, Syracuse, NY 13204. Ph: (315) 422-7811, Fax: (315) 422-3851.

Hello, Friends!

Summer has come and gone, and it is time for crisp air and pumpkin spice. (I do love sweata weatha!) But even during the dog days of summer, between the barbecues and the beach, the NYWEA volunteers were hard at work!

In July, CHAPEX was held in Utica and leadership from all our chapters gathered to share ideas, learn from our successes and strengthen our organization. It was a full day of collaboration that resulted in some fantastic ideas for our future endeavors. We also got to dine on some local favorites. I have to admit, as someone from downstate, I've never had chicken riggies, Utica greens or tomato pie. It was quite the treat! It is always a treat to get together face-to-face to work toward our common goals. As always, a huge thank you to my husband Dale for playing chauffeur. He is my rock, and I couldn't do what I do without him.

In September, we had a few exciting events to attend. The Met Chapter held their annual Cut Pipe Eat Lobster event at the Varuna Boat Club in Brooklyn. It is such a fun night with teams of folks who are not on ops challenge teams coming together to see who can cut pipe the fastest in a relay event. Of course, there is delicious food and wonderful company as well.

The next day, Lisa Melville and her colleagues put together an outstanding program at the Watershed Conference at the Bear Mountain Inn. The sessions focused on watershed issues but were diverse enough that there was something for everyone to enjoy. Lisa's article in this issue details the exciting program. Great job Lisa!

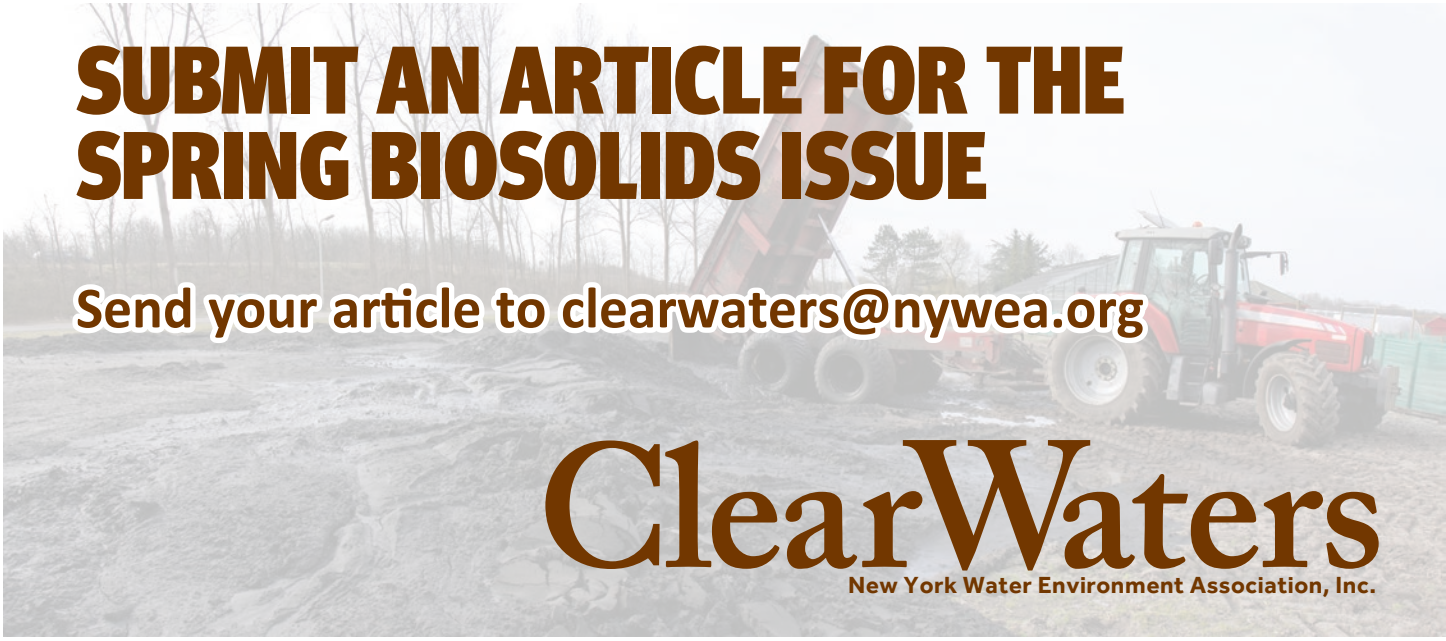
The culmination of the conference was the inaugural Operation SOS fundraising event. I am grateful to all who attended from as far away as Buffalo (you know who you are Dan and Lisa!), and for the many companies and individuals who donated to our cause. As of this writing, we have made over $40,000 toward our $200,000 goal (see page 62), but there is much left to do. I implore you to consider a donation, no matter what the size. Together, we can help to show our commitment to strengthening our workforce and supporting the hard-working, front-line members of our family.

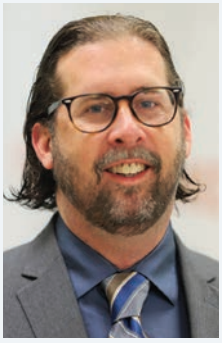
On the heels of the Watershed Conference, we traveled to the Windy City and WEFTEC. In all the years I have been attending, I have never seen so many people on the floor — the energy in the room was electric! NYWEA was well represented this year in the Student Design Competition, WEF Leadership Institute and the Operations Challenge. All the accomplishments are detailed on pages 6 and 7, as well as Sara Igielski's and Stephanie Castro's article about their efforts to institute a student design competition for NYWEA. Congratulations to all the participants!

On a very personal note, I would like to thank all the Operations Challenge teams for voting me as the recipient of the Bobby Williams Competitive Spirit Award. This award is named for Bobby Williams, a husband, father and grandfather who was shot down by a disgruntled co-worker. Bobby died along with 11 others, and several more were gravely injured in the shooting at the Municipal Building in Virginia Beach in May 2019. Bobby worked in clean water for 41 years and was a respected member of the WEF Operations Challenge community. The award was presented by Bobby's wife and Steve Motley, Bobby's teammate who was injured on that fateful day. This was one of the greatest honors of my career.

The horrifying truth is that things like this continue to happen to the innocent members of our society. As I write this, it is less than a week since our friends at Buffalo Sewer Authority lost one of their own and had two others injured. The senseless loss of Keyshawn Gault will forever be felt by those who knew him. The lives of Myron Walker and Lamar Whitfield Jr. will never be the same. We all need to be outraged by this senseless violence and I for one will be holding my loved ones a bit tighter this holiday season. I wish you and your families peace and grace as 2023 comes to an end.

Donna Grudier
NYWEA President





Volunteers Drive NYWEA

NYWEA's volunteers are the engine of this organization! Without the effort and commitment of all our water industry professionals there is a lot of work that would not get done! That said, there is still so much to do to advance our collective goals for the betterment of our members.

- Our PFAS Taskforce and Government Affairs Committee are going gangbusters, but there is so much to track and respond to.
- Public Education, Membership and Member Education committees could provide endless work if we had endless volunteers to go the extra mile.
- The constant churn of students through our student chapters makes the work of the Student/University Committee ever-evolving.
- The continuing connection of these students to NYWEA as they move their way through academia and into the professional realm requires the vigilance of our Young Professionals Committee.

This work isn't solely to benefit NYWEA as an organization; it provides benefits to NYWEA's members. That's why the volunteerism of our members is so important. If you are not active on a committee, take this as a call to consider it. Give me a call or send me an email so we can chat about how best to get you involved in a way that is meaningful to you.

In This Issue

As you flip through this issue of Clear Waters magazine you may notice some changes in formatting, layout and design. That is thanks to our new Communications Manager, Chris Boyle. Of course, Kerry Thurston continues as the Clear Waters editor and the Publications Committee continues to identify the topics and authors to provide the content you'll soon be reading. With gratitude and thanks, we wish a happy retirement to Anne Sabach of Sabach Design, who provided all the layout and design for Clear Waters and NYWEA's other print materials for the past 20 years.

We expect to see Clear Waters evolve moving forward to better highlight the good work of our members, including regular updates from our chapters and committees in addition to the updates you already receive from me, NYWEA's president, Jim Tierney from the NYSDEC and so on. But, for now, take a look at the great things we have in this issue.

Sara Igielski and Stephanie Castro-Sanchez write in their article, "Establishing the Student Design Competition for NYWEA Student Chapters" about the effort that goes into the Student Design Competition and coordinating with NYWEA's many and diverse student chapters. Again, work that wouldn't happen if it weren't for our volunteers.

Richard Loeffler, chair of NYWEA's Wastewater Collection Systems Committee, writes about innovative ways to better manage CSOs by using the collection system as short-term storage in his article, "On Considering the Collection System to be an Extension of Your Treatment Process."

You'll see some photos from our recently held NYC Watershed Conference, held at Bear Mountain Inn in September, in Watershed Committee Chair Lisa Melville's "Compendium of the 2023 NYC Watershed Science and Technical Conference". In this article, you'll get a better idea of the great presentations given there.

Operation SOS

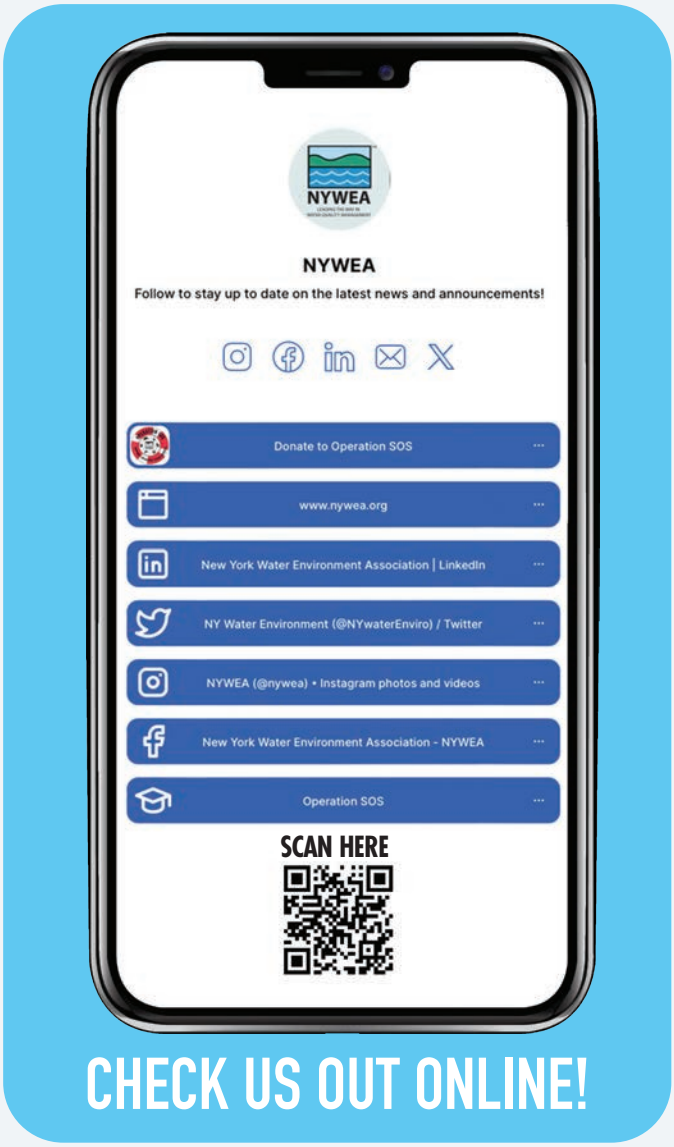
Finally, if you have not yet heard, we are raising money to better support our operator members by re-investing in our operator scholarships, specifically the Lucy Grassano and Brian Romeiser Scholarship funds. Operation SOS: Supporting Operator Scholarships is the brainchild of President Donna Grudier to provide a long-lasting impact from her presidential theme year of celebrating the essential worker. Special thanks to the more than 100 people who have contributed to this scholarship fundraiser so far!

Annual Meeting News

Our 96th Annual Meeting, New York's largest water quality technical conference and exhibition, is scheduled for Feb. 5 through Feb. 7, 2024. The Program Committee is working hard to bring you the best annual meeting yet! We received more than 150 abstracts this year and are expanding the technical program on Monday and Wednesday. Thanks to Kathryn Serra and the great work of the many Program Committee members who reviewed all those abstracts. Hotel reservations for the conference are already being accepted at the Marriott Marquis in New York City. There's still time to secure your exhibit booth or sign on as a conference sponsor (see page 60).

We are looking forward to seeing you all at the meeting!

Khristopher Dodson
Executive Director
khris@nywea.org



NYWEA's reception for WEFTEC 2023 was held at The Hampton Social. The well-attended event was a home-away-from-home for members and offered a time of fun, finger foods and fellowship.

Bobby Williams Competitive Spirit Award

2023 Graduates

WATER LEADERSHIP INSTITUTE

Powered by wef

SARA IGIELSKI
YP BOARD REPRESENTATIVE
METROPOLITAN CHAPTER

LISA DERRIGAN
PRESIDENT-ELECT
WESTERN CHAPTER

STUDENT DESIGN COMPETITION

Photos Page 10

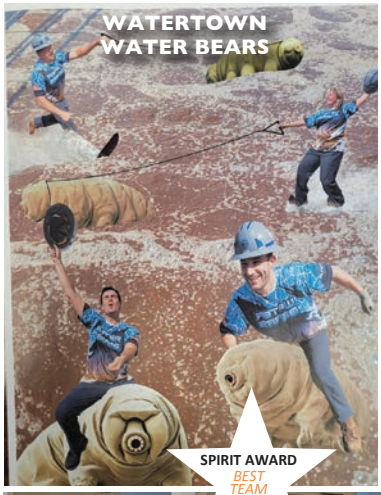
COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY
ESF
STATE UNIVERSITY OF NEW YORK

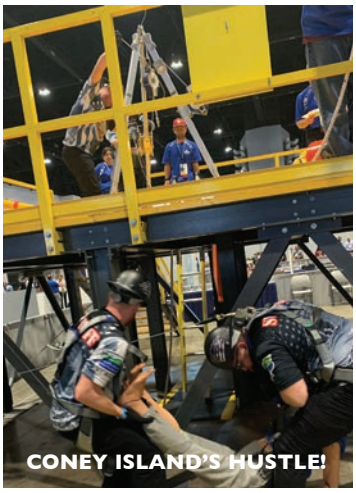
1853
MANHATTAN COLLEGE

Donna Grudier was honored with the Bobby Williams Competitive Spirit Award, which recognizes individuals who exemplify outstanding sportsmanship, philanthropy and professionalism. We congratulate Donna for this well-deserved award!

Lisa Derrigan and **Sara Igielski** graduated from WEF's prestigious Water Leadership Institute! The Institute's Class of 2023 includes 54 water professionals representing 22 states, Canada and Botswana. This 12th class of water leadership graduates joins 451 program alumni. For those interested in water leadership and joining this elite club, the application period for the 2024 Water Leadership Institute began November 1st.

2023 Recap





Epic Operations Challenge

NYWEA had four teams competing in an EPIC record breaking Operations Challenge at WEFTEC 2023. The **Bowery Bay Coyotes, Long Island Brown Tide, Coney Island Sludge Hustlers** and **Watertown Water Bears** were part of the largest operations challenge ever, which included a record 55 challengers, including international teams from Columbia, Finland, Denmark, Germany, the U.K. and Canada.

Kudos to all who participated!

The **Long Island Brown Tide** made a strong showing, taking home a third place victory in the Division I Safety Event. We applaud the Brown Tide team and their dedication to Ops excellence!

With a first place Division 2 Laboratory finish and second place in Process Control, the **Watertown Water Bears** brought their A-game to WEFTEC 2023. They also won a Spirit Award for Best Team Photo. Hats off to the Water Bears for their amazing effort!

WEF members will be able to see full coverage of the event in the December 2023 issue of ***Water Environment & Technology*** Magazine.

Water Research

As a science, ecology and safety agency, DEC relies on inter-disciplinary research to inform decisions. In addition to our research, DEC encourages and supports innovative studies by others to help us better protect and manage New York's water resources. Examples of critical projects happening in New York right now include researching methods to reduce nitrogen pollution from ground and surface waters on Long Island and increasing our understanding of the causes of — and remedies for — harmful algal blooms (HABs).

Long Island has over 400,000 cesspools and septic systems that cause ground and surface waters to be degraded by nitrogen. Drinking water, recreation and aquatic life are often adversely impacted. As part of the Long Island Nitrogen Action Plan, which focuses New York's partnership efforts to address nitrogen pollution, DEC helped establish and fund the Center for Clean Water Technology (CCWT) at SUNY Stony Brook. CCWT is developing cost-effective, non-proprietary, Innovative and Alternative On-site Wastewater Treatment Systems (I/A OWTS) to dramatically reduce the level of nitrogen discharges. Interestingly, these systems show promise in breaking down several common pharmaceutical and personal care products found in septic effluents.

CCWT is also researching methods to reduce nitrogen in marine waters through bioextraction. Bioextraction involves growing and harvesting shellfish and seaweed for the purpose of removing nitrogen and other nutrients from coastal waters — hopefully in a manner that ultimately creates a profitable, self-sustaining business model.

DEC has tracked the occurrence of HABs in New York since 2012 and evaluated their frequency, intensity and duration as part of efforts to inform the public of their occurrence and strategies to abate them. Several causes and contributing factors of HABs have been documented, but there are significant unknowns concerning how they interact, what management strategies could reduce occurrences, and which in-waterbody controls might abate HABs.

Working with the Departments of Health (DOH) and Agriculture and Markets, among others, DEC developed the HABs Research Guide. This guide highlights topics to advance the study, management and mitigation of HABs and is intended to facilitate HABs research and coordination. The guide's four research focus areas are: Prevention and Mitigation; Causes of HABs; Monitoring and Modeling; and Engagement. DEC has dedicated over $12 million to support research concerning HABs in recent years.

Several DEC-led HABs research initiatives have been completed or are ongoing. For example, DEC initiated a CyanoHABs Advance Monitoring Pilot, in collaboration with the United States Geological Survey (USGS) New York Water Science Center, to monitor and understand cyanoHABs in the Finger Lakes region. USGS, in cooperation with DEC and DOH, developed and implemented a comprehensive monitoring strategy for Owasco, Seneca and Skaneateles lakes, which were affected by HABs. Descriptions of this pilot and other research published by DEC experts are presented on DEC's HABs webpage.

These examples provide just a sense of the research DEC supports to move us toward understanding and solving today's water quality issues and improving water management.

LINAP: *https://www.dec.ny.gov/lands/103654.html*
CCWT: *https://www.stonybrook.edu/cleanwater/*
DEC HABs Research:
https://www.dec.ny.gov/chemical/77118.html#Research
HABs Research Guide (PDF):
https://www.dec.ny.gov/docs/water_pdf/researchguide.pdf

– James Tierney, Deputy Commissioner for Water Resources
New York State Department of Environmental Conservation

Rescue Harness Trauma

To avoid the would-be rescuer in a confined space becoming a victim, OSHA Standards emphasize out-of-vessel rescue, where entrants wear a chest or body harness attached to retrieval gear. However, it is important that the rescue process includes the ***removal of the rescued person from the harness as quickly as possible upon retrieval to prevent rescue harness trauma, also known as suspension trauma or harness-induced pathology.***

When a person is suspended in the harness, gravity causes the blood to quickly pool in the legs. This is due to lack of muscle movement and/or because the harness straps around the thighs or groin area restrict blood flow. The lower legs have a large storage capacity, which reduces return blood flow to the right chamber of the heart and decreases the heart's output. To compensate, the heart rate first speeds up to maintain the brain's blood supply. If the blood supply to the heart is restricted enough, beating faster is ineffective and the body abruptly slows the heart rate and the person faints. Fainting solves the problem; the person slumps to the ground putting legs, heart and brain on the same level. With blood now returned to the heart, the person typically recovers quickly. ***But, when suspended in a harness, the worker can't fall into a horizontal position and the reduced blood supply to the brain can drop below the critical level.*** The person can lose consciousness and, if not placed in a horizontal position, may die. Even a healthy adult can experience this trauma in as little as five minutes.

Published case histories are of harnesses used for fall protection when working at a height and for sports climbing, as well as laboratory simulations of harness suspension. However, it is controversial as to which harness type — chest, dorsal, seat type, positioning, full-body — is riskier for harness trauma. If possible, use a harness with foot slings that are within easy reach, known as "leg up suspension trauma straps" or "suspension trauma relief straps." An entrant in a harness should never work alone; one reason why the OSHA Confined Space Standards require an attendant. The suspended person needs to move the legs, such as pushing them off the sidewalls of a confined space or elevate the legs to a semi-recumbent position. ***Upon retrieval, remove the rescued person from the harness as quickly as possible and place them in a horizontal position as soon as safely possible.*** If the person has fallen while in the harness, there may be additional crush injuries that can lead to shock, even when the person is released from the harness, so the treatment should follow Advanced Trauma Life Support guidelines. Fall arrest equipment can help reduce or eliminate such additional injuries.

– Nellie J. Brown, MS, CIH, ILR School, Cornell University

Managing Today's Environment for a Better Tomorrow.

Wyandanch Spring Lake at Geiger Park, Deer Park, NY

A proud supporter of NYWEA since 1965

Sustainable, cost-effective engineering and environmental solutions have been D&B's focus since our inception, including the **Carlls River Sewering Project** in Suffolk County, New York.

Wastewater or water supply, environmental remediation, architecture or civil engineering, D&B lives by an unwavering commitment to total customer satisfaction.

D&B Engineers and Architects

516-364-9890 | DB-ENG.COM

Facing Challenges. Providing Solutions.

WOODBURY, NY • WHITE PLAINS, NY • ISLANDIA, NY • EAST SYRACUSE, NY • ALBANY, NY • SOMERSET, NJ • TREVOSE, PA

Establishing the Student Design Competition for NYWEA Student Chapters

By Sara Igielski and Stephanie Castro

The Water Environment Federation (WEF) Student Design Competition (SDC) is intended to promote "real world" design experience for students interested in pursuing an education and/or career in the water and wastewater fields. As explained in the WEF SDC Entry Guidelines:

"This competition tasks individuals or teams of student members within WEF to demonstrate their ability to evaluate alternatives, develop a comprehensive design, and present a solution that meets the requirements of a socially relevant problem statement." (*WEF 2022*)

The competition is held annually on an international stage at WEFTEC and is organized by the WEF SDC Subcommittee of the Students and Young Professionals (SYP) Committee. This year's competition at WEFTEC in Chicago marked the 22nd annual WEF SDC competition.

SUNY ESF represented NYWEA in the Water-Environment category at the 2023 WEF SDC and placed third. Left to right: Annie Roux, Lauren Henkler, Daniel Mack, Thomas Nightengale and Jack Murtagh (SUNY ESF), and Howard Carter (WEF president-elect). *WEF*

The WEF SDC hosts two separate competitions at WEFTEC: a Wastewater Design Competition and a Water Environment Design Competition. The Wastewater Design Competition includes traditional wastewater collection and treatment design projects, whereas the Water Environment Design Competition includes design projects related to stormwater and watershed management, green infrastructure, low-impact development, water reuse, drinking water treatment systems and other related topics.

The Member Associations (MAs) play a critical role in the success of the WEF SDC as all teams must have the support of their MA to participate. In addition, a design competition at the MA level may be warranted to determine the winner of each category competition as only two teams per MA may be invited to compete in the WEF SDC held in-person later that year.

With a rising interest amongst NYWEA's student chapters, the Young Professionals Committee initiated an effort to formalize a NYWEA SDC by:

1. Creating a steering committee comprised of NYWEA young professionals, faculty advisers with demonstrated WEF SDC experience, and the SDC committee chairs from the Florida and New England Water Environment Associations (FWEA and NEWEA, respectively).
2. Identifying goals, challenges and resources of the NYWEA SDC.
3. Developing standard tools for communication and outreach.

Creating the Steering Committee

The NYWEA Young Professionals Committee spearheaded an SDC steering committee in the winter of 2021 — with the support of the WEF SYP Committee — to build connections with the FWEA and NEWEA SDC subcommittees and the NYWEA University Committee. The steering committee, led by Sara Igielski (NYWEA), was comprised of:

- FWEA - David Hernandez and George Dick
- NEWEA - Joanna Sullivan and Nick Tooker
- NYWEA - Doug Daley, Krish Ramalingam, Jeanette Brown and Stephanie Castro

Collectively these individuals volunteered their time and shared their expertise to help build the NYWEA SDC foundations.

Goals

Initial discussions with the steering committee centered upon the benefits of the SDC, and how these benefits could be realized at the MA and/or WEF level. Together the committee agreed that by participating in a competition, students will have the opportunity to:

- network with other students and industry leaders across the water sector
- gain professional experience and exposure
- develop "real-world" skills and enthusiasm for the water environment

Challenges

Further conversations helped the NYWEA Young Professionals Committee understand the challenges associated with hosting an MA-level competition. To begin, the steering committee identified three major barriers to executing the competition – timing, funding and robust participation – and with each barrier, identified key questions.

Timing - When should NYWEA host the MA-level competition? Where should it be hosted?

Funding - What are the expenses for a student chapter team at the MA level and WEFTEC competitions? Who is responsible for funding? How can funding be made available?

Robust Participation - How can we encourage and support new student chapter teams to participate? What tactics can promote consistent participation from teams each year?

These questions both summarized the nature of the challenges and opportunities to overcome each. Many of these challenges are compounding, and oftentimes individual solutions can offer resources to tackle multiple problems.

Opportunities to Overcome

The opportunities to overcome the challenges fall into three actionable categories:

- build upon the success of other MA chapters
- accept that there will be imperfections
- leverage the existing association resources

Build Upon the Success of Others

Conversations with the FWEA and NEWEA SDC subcommittees highlighted the opportunity to build upon the success and incorporate the lessons learned from their chapters. Both subcommittees hosted a website page that included standard guidelines, timelines and other expectations for quick reference by all chapter members. The subcommittees explained the importance of mirroring the WEF SDC when establishing deliverable milestones, expectations and scoring. In this way, the MA-level competition can best prepare the students for the WEF SDC using the WEF SYP Committee's guidelines and rules.

To support robust participation, the NYWEA SDC adopted this approach knowing that the WEF SYP materials only had minor edits year-to-year, so participants could utilize the previous year's guidelines for early planning efforts before the current year's publications were released.

Accept the Imperfections

Each university operates differently, both in terms of their schedule and curriculum. It became evident that there was not an "ideal" time to host the NYWEA SDC.

To participate in the WEF SDC, the team entry forms are due June 1. Therefore, the MA-level competition and selection of team(s) must be completed prior to this date. Most SDC teams are comprised of upper level (i.e., junior and senior year) and graduate students, so balancing the elements of school curriculum, internships and graduation, among other activities, becomes increasingly difficult.

While the FWEA SDC is held at the Florida Water Resources Conference in May, the NYWEA SDC Subcommittee was unable to identify a statewide conference in New York to host the competition. For example, the NYWEA spring Technical Meeting is typically held the first or second week of June, which occurs after WEF's early June entry deadline. Conversely, the NYWEA Annual Meeting, which is held in February, occurs too early in the school semester to pull together a team and prepare for competition. To overcome this timing dilemma, a virtual competition was proposed for the NYWEA SDC.

To support robust participation, it was decided that early and often communication was important so that all prospective SDC participants were well-informed of the timeline associated with the MA-level competition. Any funding allocated to the SDC could be offered to the winning teams and support financing their participation in the WEF SDC.

In addition, the MA-level competitions are not required to provide a single problem statement for all competing teams; both FWEA and NEWEA have left the development of a problem statement up to the individual teams. The faculty members of the steering committee also shared how they have developed problem statements in the past. For example, the State University of New York College of Environmental Science and Forestry (SUNY ESF) facilitates a senior capstone project that also satisfies the SDC problem statement and prompts. Manhattan College has typically partnered with a consultant (who is a college alum) and/or utility to support their endeavors.

While the judges are not comparing "apples-to-apples" during the MA-level competition, the exercise does afford each team the creativity to explore the problem statement of their choosing that is in line with the WEF SDC competition experience.

Leverage Existing Resources

Discussions with the steering committee led to ideas to leverage existing resources within NYWEA to jump-start MA-level competition. For example, it was suggested that the NYWEA University Committee could allocate some budget to partially sponsor teams, and the remaining cost to fund the travel expenses to the WEF SDC is the participating team's responsibility. In addition, information on the NYWEA SDC could be provided on the existing student chapter webpage of the NYWEA site for quick access and reference by prospective teams.

To further improve communication, the NYWEA SDC Subcommittee could utilize NYWEA's existing social media (i.e., LinkedIn, Facebook), the newsletter Currents, and other local chapter distribution email lists to share updates of the competition.

Lastly, to solicit judges' participation, the NYWEA SDC Subcommittee could look to their members who could provide valuable, constructive feedback to the teams based on their experience and expertise in the wastewater and/or water environment field.

Current Status

As of fall 2023, the NYWEA SDC Subcommittee is co-chaired by Sara Igielski and Stephanie Castro, with participating members Noelle Sawicki and Cameron Daley, under the Young Professionals Committee umbrella.

To date, the subcommittee has hosted two competitions, and each competition has had a set of guidelines and a timeline. In consideration

continued on page 12

Participants at the 2023 WEF SDC from Manhattan College (left to right): Gianna Gervino, Sofia Rivera, Christopher Farrington, Antonia Argudo, Patrick Gaudet, Frederico Cipriani and Vincent Carway. *WEF*

continued from page 11

of the WEF SDC timeline, the NYWEA SDC timeline is as follows (with exact dates varying year-to-year):

- team entry form due by the end of March
- project team reports due mid-May
- project team presentations toward the end of May
- announcement of competition winners by end of May

Looking Ahead

With two competition seasons complete, the NYWEA SDC Subcommittee is always looking for new members as well as seeking opportunities to improve and encourage more participating teams for the 2024 SDC Competition. For instance, the subcommittee recognizes the value that consulting firms and utilities can offer participating teams; while the work remains largely with the students, a partnership can offer hands-on experience and introduction to design, construction and operational challenges that can be difficult to learn in a classroom setting. These partnerships may also offer an adviser and/or problem statement to participating teams.

In addition, to help close the funding gap, the subcommittee is interested in exploring additional fundraising opportunities such as:

1. A partnership with vendor(s) to host a raffle at the Annual Meeting.
2. Company sponsorship of the SDC, including subsequent advertisement and recognition in Clear Waters magazine, social media, etc.
3. A resume and networking event at a local, regional or state conference, where the NYWEA SDC Subcommittee can package and distribute student resumes to SDC-sponsoring firms.

In closing, the NYWEA SDC Subcommittee would like to express their gratitude to the NYWEA Executive Office, the NYWEA SDC Steering Committee, and all our SDC participants for making this vision a reality! We are so proud of our competing schools' success to date, and excited for the future of the NYWEA SDC!

Sara Igielski, PE, ENV SP, Assoc. DBIA, is a lead engineer with Carollo Engineers and may be reached at sigielski@carollo.com. Stephanie Castro, PE, is a water resources engineer with Arcadis and may be reached at stephanie.castro@arcadis.com.

References

WEF. 2022. *Student Design Competition Entry Guidelines.* Revised December 2022. (*https://www.wef.org/globalassets/assets-wef/3-membership/member-associations/students-and-young-professionals/2023-sdc-guidelines.pdf*)

STUDENT SPOTLIGHT – NYWEA SCHOLARSHIP RECIPIENT MARY COTTER

Hi NYWEA!

My name is Mary Cotter from Rochester, NY and I am a second-year student at the University of Virginia studying mechanical engineering with an environmental engineering focus. I'm working with civil and environmental engineering professor Leo Liu on applications of geothermal energy to support UVA's goals to be carbon neutral by 2030 and fossil fuel free by 2050. I'm proud to apply everything I'm learning in the classroom and labs to such an important environmental initiative.

I had a great summer working as the IDEA (International District Energy Association) intern and learned a lot about heating and cooling distribution as well as energy generation. I toured a few campus district energy systems, and it's amazing to see the variety of approaches and technologies.

I spent time at Cornell University's Lake Source Cooling Facility, getting an overview of their operations and the facility's unique characteristics. Interestingly, I found a lot of intersections between water and energy, as water is essential to every step of energy generation. Water (or steam) is almost always the substrate that carries heating and cooling to buildings or stores thermal energy. For Cornell, they use the lake as a free storage station, which is such an ingenious way to utilize their unique local resources.

The internship and my experiences this summer further solidified my career plan to become an environmental researcher focused on energy and water.

Thank you for your support!

Mary Cotter
University of Virginia

Wastewater Testing for Public Health Benefit: New York State's Wastewater Surveillance Network

By David A. Larsen

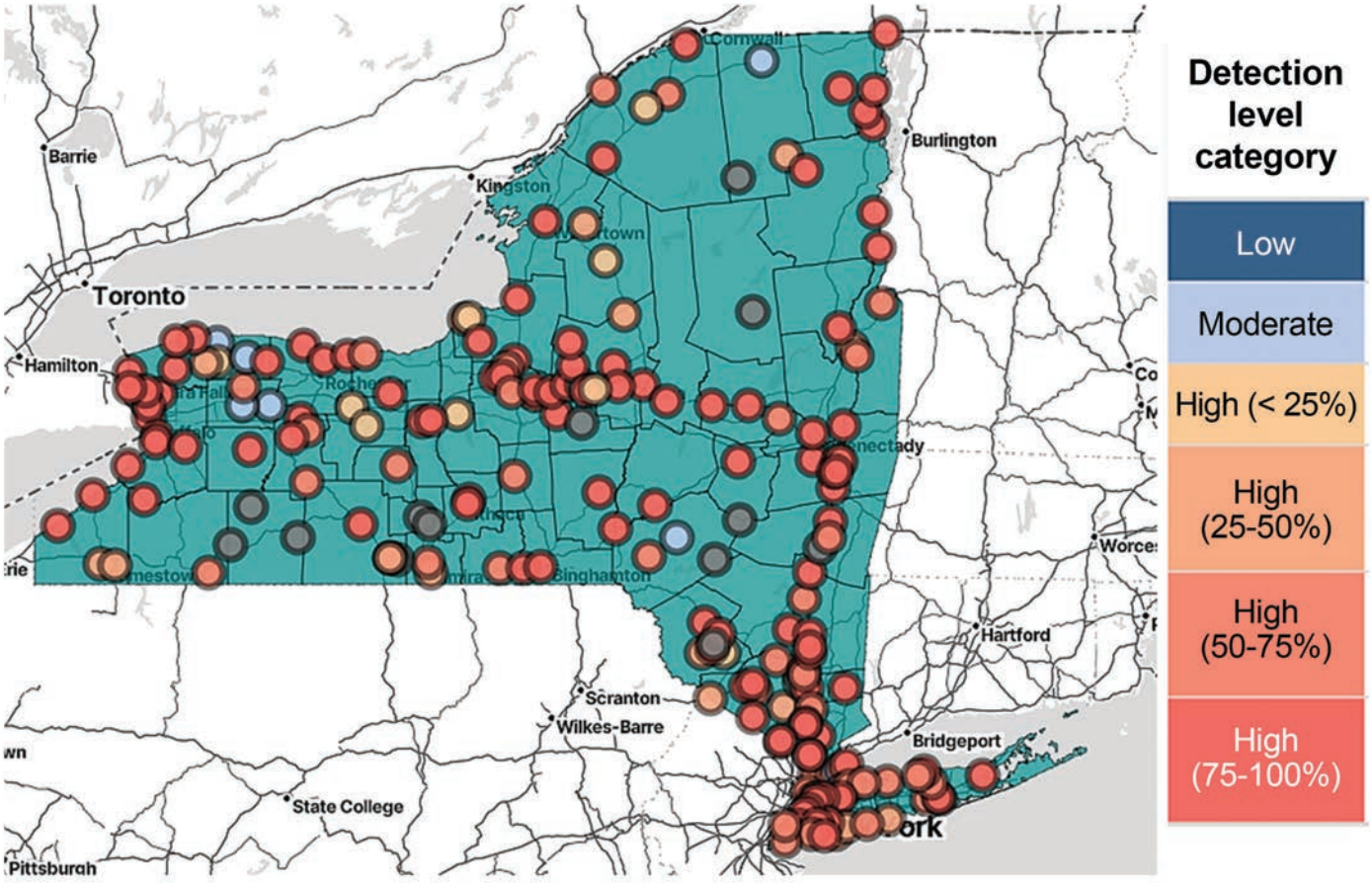
In response to the COVID-19 pandemic, wastewater treatment plants across New York state began sharing samples with laboratories to test for SARS-CoV-2, the virus that causes COVID-19. This type of continuous testing for public health benefit is called wastewater surveillance. Since its inception in May 2020 the state's wastewater surveillance network has reached every single county. Each week, five laboratories across the state analyze influent wastewater from 200 of the largest wastewater treatment plants in the state. The results are shared with the local health departments, participating treatment plants, the state department of health and the public.

Local health departments use wastewater surveillance data to understand the COVID-19 risk in their communities. By using data from wastewater surveillance, we are able to forecast hospitalizations and track COVID-19 variants of concern such as BA.2.86. Beyond COVID-19, wastewater surveillance has supported the response to mpox and polio outbreaks. We are working to make that small wastewater sample even more powerful in supporting local health departments' responses to influenza, respiratory syncytial virus (RSV) and other infectious diseases.

"I wanted to take this moment to thank all the wastewater treatment plants participating in this effort."

To date we have analyzed more than 10,000 wastewater samples in New York state! It has been my pleasure to lead the epidemiological analysis team, but nothing would be possible without the dedicated work and service from our wastewater treatment plant operators. Thank you for all your efforts, and I look forward to continuing this public health partnership with you. In doing so I hope that together we can ensure a healthier and more secure New York.

David A. Larsen, Ph.D., MPH, is a professor and chair of the Department of Public Health with Syracuse University and may be reached at dalarsen@syr.edu.



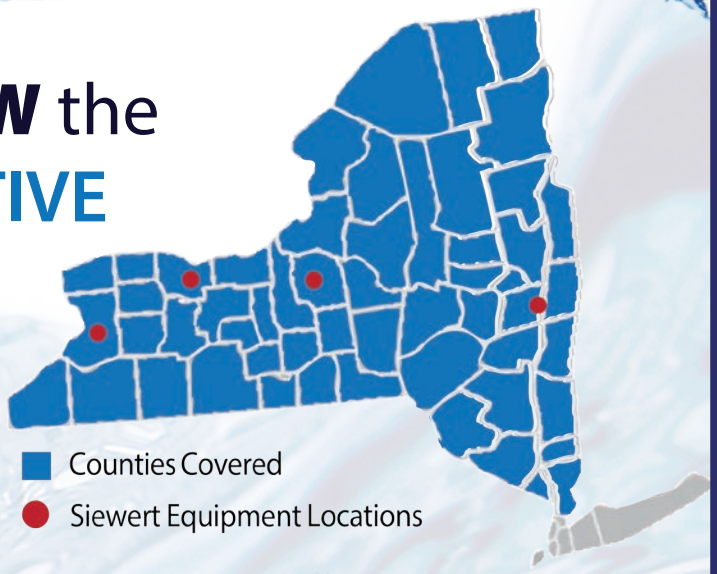
A screenshot of New York state's wastewater surveillance network dashboard from Oct. 3, 2023, showing high levels of COVID-19 transmission across most of the state. More than 200 treatment plants across New York state are regularly participating in testing for COVID-19. Local and state health departments rely on the data for understanding COVID-19 transmission trends and risk to the public.
NYS Wastewater Surveillance Network

SIEWERT EQUIPMENT
A Division Of
CUMMINS-WAGNER
100% Employee Owned

KSB
AUTHORIZED REPRESENTATIVE

Siewert Equipment is **NOW** the EXCLUSIVE REPRESENTATIVE for **KSB** in New York State.

(North of and including Westchester and Rockland Counties)



KSB is a worldwide leader in submersible pumps, with North American Headquarters in Richmond, VA. KSB stocks submersible pumps in Richmond, including multiple impeller styles and horsepowers.

AMAREX ARX

AMAREX KRT

Sales • Parts • Service (24/7) • Specification • Start-Up • Training

Contact Your Local Siewert Equipment Outside Sales Representative To Discuss KSB Solutions.

BUFFALO

ROCHESTER
175 Akron Street
Rochester, NY 14609
Phone: (585) 482-9640

ALBANY
10 Corporate Circle
Albany, NY 12203
Phone: (518) 272-3431

SYRACUSE

Call 800-333-0598 or visit SiewertEquipment.com

Mitigating Combined Sewer Overflows using Green Infrastructure and Simulation-Optimization Methods

By L. Sean Matott, Zhenduo Zhu, Maria N. Torres and Alan J. Rabideau

The challenges of stormwater management have become increasingly difficult for cities across the world. One such challenge is that urbanization increases the proportion of impervious surfaces, causing increased stormwater runoff and pollutant loads. These effects are exacerbated by extreme precipitation events associated with climate change, especially along the U.S. East Coast (*Sanderson et al. 2019*).

One of the greatest concerns related to stormwater management is combined sewer overflow (CSO). About 40 million Americans live in cities that have combined sewer systems — systems that collect rainwater runoff, domestic sewage and industrial wastewater into a single pipe. The combined and untreated sewage will overflow into receiving waters and cause potential environmental and health risks (*Miller et al., 2022*), if it exceeds the capacity of the collection system or treatment plant.

A number of innovative solutions have been proposed or developed to mitigate CSO and secure the safety and quality of urban drinking water and recreational waterways. In this regard, green stormwater infrastructure (hereafter green infrastructure or GI) is a resilient approach that can reduce stormwater runoff and provide other environmental and social benefits. Examples of GI include rain gardens, green roofs and permeable pavement. However, the effectiveness of GI on CSO mitigation is difficult to quantify because GI is often installed far away from any CSO outfall. Furthermore, GI performance tends to be highly localized and sensitive to rainfall patterns (***Figure 1***). These factors make it difficult to assess GI effectiveness at city scales. Consequently, city managers find it difficult to adopt GI as a measurable tool for CSO mitigation. This results in the missed opportunity to maximize GI CSO mitigation capacity.

Numerical hydrologic modeling is the primary tool for evaluating and comparing alternative GI design plans and potential improvements. There is no practical alternative to computational modeling when it comes to visualizing the relationship between time-varying precipitation and coupled hydrological processes like surface and groundwater runoff and flow through complex networks of sewer pipes.

The effects of GI on stormwater runoff reduction and water quality improvement have been widely studied with the help of numerical hydrologic models. One of the most widely used urban hydrologic models, originally developed by the U.S. Environmental Protection Agency (USEPA), is the Storm Water Management Model (SWMM). However, hydrologic models like SWMM are most commonly used to demonstrate compliance with regulatory requirements. Using hydrologic modeling as the basis for proactive planning and cost-benefit analysis is known as "simulation-based design" and continues to be an active area of research.

Applying simulation-based design to city-scale systems is challenging because encoding a design choice (e.g., instituting a downspout disconnect program) into the underlying hydrologic model requires adjustment of many different model inputs. This difficulty can be addressed by employing automated model perturbation techniques such as simulation–optimization (S/O) methods. S/O methods automatically adjust a given hydrologic model to explore alternative GI interventions in search of a configuration that optimally satisfies a given set of user-defined objectives. An example user-defined objective is to identify a design that minimizes the cost of GI while simultaneously satisfying regulatory constraints on CSOs.

This paper introduces a novel S/O tool known as OSTRICH-SWMM, which has been recently developed at the University at Buffalo (UB). The tool has been applied to a hydrological model of the City of Buffalo as an aid in evaluating the potential of two different types of GI interventions — rain barrels and permeable pavement — to reduce CSO occurrences in the city.

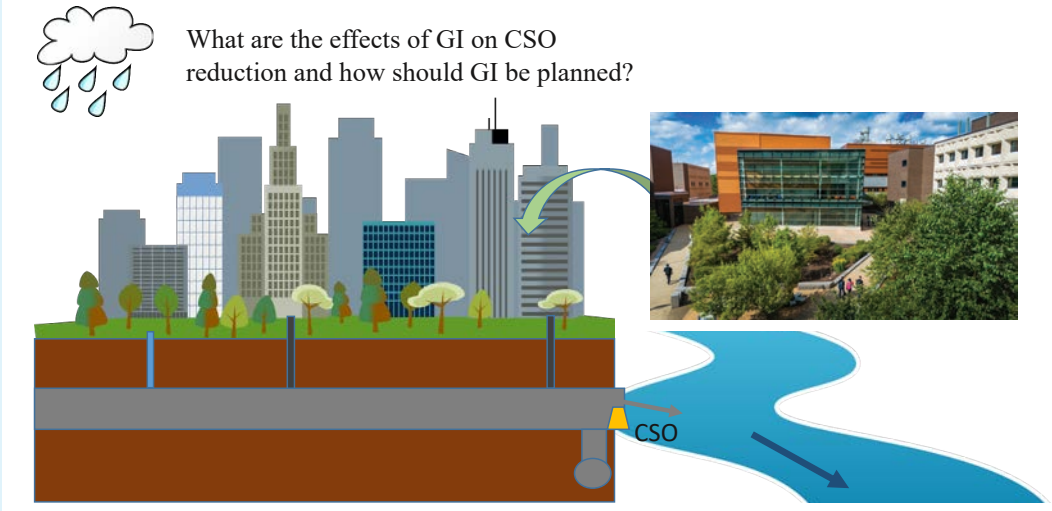


Figure 1. Conceptual diagram of simulation-optimization methods for planning green infrastructure (GI).
University of Buffalo | Douglas Levere

OSTRICH–SWMM

The OSTRICH-SWMM tool is middle-ware that connects the Optimization Software Toolkit for Research Involving Computational Heuristics (OSTRICH) with a hydrological model (SWMM). OSTRICH is open source and has been used for a variety of applications in water resources management and environmental engineering by researchers in academia, the USEPA and Environment Canada. OSTRICH implements diverse algorithms that are suitable for simulation-based optimization including many that have been parallelized and can take advantage of distributed computing resources such as those available at the UB Center for Computational Research.

continued on page 17

continued on page 54

LOOKING FOR A SCREW PUMP UPGRADE?
LAKESIDE REPLACES ALL BRANDS AND TYPES.

Lakeside's screw pumps offer the ideal and cost-effective "drop in" replacements for less reliable designs. Improve pumping performance and reduce maintenance costs with our superior dual upper bearing design and heavy-duty self-aligning lower bearing designs. For decades we've been the go-to source for replacing all screw pump brands. Replacements typically require little or no structural modifications. It's what you expect from Lakeside Equipment—known for nearly a century for efficient and dependable operation in all wastewater, drainage and industrial applications.

LAKESIDE REPRESENTATIVES:

www.gafleet.com

G.A. FLEET
New Constuction
T (914) 835.4000
F (914) 939.4850

FLEET PUMP
Aftermarket
T (914) 835.3801
F (914) 835.2946

Serving the tri-state region

J. ANDREW LANGE, INC.
Water & Wastewater
Treatment Products
& Services
T (315) 437.2300 • **F** (315) 437.5935
info@jalangeinc.com

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

Cleaner Water for a Brighter Future®

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

Screw Pumps
Open Screw Pumps
Enclosed Screw Pumps

continued from page 15

USEPA's SWMM is a semi-distributed hydrologic model that uses sub-catchments and flow routing as basic building blocks for assembling large models. Each sub-catchment is divided into one pervious area, one impervious area with depression storage and one impervious area without depression storage. GI interventions are referred to as Low Impact Development (LID) controls in SWMM and can be added to one or more sub-catchment(s). Adding a new LID control to a sub-catchment requires careful adjustment of the SWMM model to maintain coherent flow routing and a consistent overall surface area.

OSTRICH–SWMM (*Macro et al. 2019*) is a Python module that facilitates the linkage of OSTRICH and SWMM. OSTRICH-SWMM performs a pre-processing step to consume a pair of JavaScript Object Notation (JSON) files and a "clean" version of the SWMM ".inp" file (i.e., a version of the model with no GI interventions). Based on the contents of the JSON files, OSTRICH–SWMM will add GI components to one or more sub-catchments of the "clean" model and create a modified input file that is syntactically correct and maintains total sub-catchment area and flow-routing coherency.

OSTRICH interacts with OSTRICH–SWMM by templating the JSON input file so that GI sub-catchment locations and GI counts can be iteratively adjusted by the OSTRICH optimization routines. After processing a given JSON input file, OSTRICH–SWMM will invoke the SWMM numerical engine and post-process the resulting binary output file. This post-processing is facilitated by PySWMM (*McDonnell et al. 2020*) — a Python module for reading SWMM binary output files. The post-processing step extracts information on predicted flows from the SWMM output and writes to a text-based comma-separated ".csv" file that can be easily parsed by OSTRICH. The overall simulation-optimization sequence for the linked set of applications is as follows:

1. The user configures OSTRICH to select a search algorithm and specify the design parameters and desired cost functions and/or system constraints.
2. The user invokes OSTRICH to launch the desired optimization search procedure.
3. OSTRICH evaluates alternative GI interventions by adjusting the design parameters according to the rules that govern the selected search procedure. OSTRICH invokes OSTRICH-SWMM for each GI intervention to construct a corresponding hydrologic model.
4. OSTRICH-SWMM launches SWMM to evaluate each model and then uses the PySWMM module to process binary outputs into .csv outputs.
5. OSTRICH reads in the processed outputs provided by OSTRICH-SWMM, computes costs and assesses whether the model satisfies the design constraints provided in step 1.
6. OSTRICH updates its search algorithm based on the results of step 5 and then either returns to step 3 or stops searching if stopping criteria have been met. For example, based on the results of step 5, OSTRICH may either update the search algorithm to the "best" design found so far, if appropriate, then return to Step 3, or stop due to convergence on a solution or exhausted computational budget.

Study Area

The City of Buffalo is a city along the coastline of Lake Erie, one of the Laurentian Great Lakes. The Buffalo sewer system services more than 250,000 people and contains more than 790 miles of combined sewers (*Nogle 2019*). There are 52 permitted CSO outfalls discharging to the Buffalo River and other waterways during wet weather events. GI has been proposed by the Buffalo Sewer Authority as part of a comprehensive strategy aimed at reducing the amount of water that enters the sewer system by 1 billion gallons of water per year.

Source-level Modeling Approach

An innovative "source-level modeling" approach was adopted for developing the SWMM model of Buffalo. In this approach, the area associated with each parcel is decomposed into as many as 13 different subareas of land use (e.g., lawns, rooftops, streets, parking lots, etc.). Each land use subarea is then modeled as a separate sub-catchment in the SWMM model. The increased fidelity of the source-level modeling approach is advantageous for analyzing GI interventions at a city scale (*Ghodsi et al. 2021, Roseboro et al., 2022*).

GI Optimization

The source-modeling approach employed for the Buffalo SWMM model has made it an attractive choice for demonstrating the simulation-optimization capabilities of OSTRICH–SWMM. For example, *Macro et al. (2019)* used a 4,075-acre portion of the Buffalo SWMM model to demonstrate that OSTRICH-SWMM could be used for optimizing rain barrel placement and downspout disconnection.

The study considered several alternative single- and multi-objective optimization algorithms and found significant variation in search algorithm performance. *Shahed Behrouz et al. (2020)* applied OSTRICH-SWMM to perform both single- and multi-objective automatic calibration of the Buffalo SWMM model using a long-term (six-month) time series of precipitation data. Automatic calibration is a type of simulation-optimization exercise in which the goal is to minimize the difference between measured data and equivalent simulated output. *Torres et al. (2022)* used the Buffalo SWMM model to demonstrate that OSTRICH-SWMM could aid in optimizing the size and placement of porous pavement to mitigate CSOs. *Ghodsi et al. (2023)* further extended the application of OSTRICH-SWMM to optimize the siting of rainwater harvesting cisterns throughout the entire Buffalo SWMM model.

Overall, these studies have demonstrated that OSTRICH-SWMM is a promising tool for evaluating and optimizing a variety of GI interventions. The tool is open-source and hosted on GitHub (https://github.com/lsmatott/ostrich-swmm) and is the focus of ongoing development. A release that supports additional types of GI (i.e., green roofs, vegetative swales, rain gardens, planters and infiltration trenches) is currently undergoing pre-release testing and validation. Additional enhancements are planned for OSTRICH-SWMM, including improved support for optimal GI placement and robust analysis of search algorithm performance using high performance computing infrastructure.

L. Shawn Matott is a senior research assistant with the Department of Civil, Structural and Environmental Engineering at the University at Buffalo and may be reached at lsmatott@buffalo.edu. Zhenduo Zhu is an associate professor in the Department of Hydraulic Engineering at Tsinghua University and may be reached at zhenduozhu@tsinghua.edu.cn. Maria N. Torres is a senior hydroinformatics engineer at Xylem Inc. and may be reached at Maria.Narine@xylem.com. Alan J. Rabideau is professor and chair of the Department of Civil, Structural and Environmental Engineering at the University at Buffalo and may be reached at rabideau@buffalo.edu.

References

Ghodsi, S.H., Z. Zhu, H. Gheith, A.J. Rabideau, M.N. Torres and K. Meindl. 2021. "Modeling the Effectiveness of Rain Barrels, Cisterns and Downspout Disconnections for Reducing Combined Sewer Overflows in a City-Scale Watershed." Water Resour Manage 35: 2895–2908. (*doi 10.1007/s11269-021-02875-7*).

continued on page 18

continued from page 17

Ghodsi, S.H., Z. Zhu, L.S. Matott, A.J. Rabideau and M.N. Torres. 2023. "Optimal Siting of Rainwater Harvesting Systems for Reducing Combined Sewer Overflows at City Scale." Water Res, 230: 119533. (*doi 10.1016/j.watres.2022.119533).*

Macro, K., L.S. Matott, A. Rabideau, S.H. Ghodsi and Z. Zhu. 2019. "OSTRICH-SWMM: A New Multi-Objective Optimization Tool for Green Infrastructure Planning with SWMM." Environmental Modelling and Software 113: 42–47. (*https://www.sciencedirect.com/science/article/pii/S1364815218307515*).

McDonnell, B., K. Ratliff, M. Tryby, J. Wu and A. Mullapudi. 2020. "PySWMM: The Python Interface to Stormwater Management Model (SWMM)." J Open-Source Softw 5(52) 1-3. (*doi 10.21105/joss.02292*).

Miller, A.G., S. Ebelt and K. Levy. 2022. "Combined Sewer Overflows and Gastrointestinal Illness in Atlanta, 2002–2013: Evaluating the Impact of Infrastructure Improvements." Environmental Health Perspectives 130(5): 057009. (*doi 10.1289/EHP10399*).

Nogle, R.B. 2019. "Buffalo's Sewers: The History of the Queen City from Below." Clear Waters 49(3): 37–41. (*https://www.nywea.org/Clearwater%20Article%20Documents/BuffaloSewersF19.pdf*).

Roseboro, A., M.N. Torres, Z. Zhu and A.J. Rabideau. 2022. "The Impacts of Climate Change and Porous Pavements on Combined Sewer Overflows: A Case Study of the City of Buffalo, New York, USA." Frontiers in Water 3. (*doi 10.3389/frwa.2021.725174*).

Sanderson, B.M., C. Wobus, D. Mills, C. Zarakas, A. Crimmins, M.C. Sarofim and C. Weaver. 2019. "Informing Future Risks of Record-Level Rainfall in the United States." Geophysical Research Letters 46: 3963–3972. (*doi 10.1029/2019GL082362*).

Shahed Behrouz, M., Z. Zhu, L.S. Matott and A.J. Rabideau. 2020. "A New Tool for Automatic Calibration of the Storm Water Management Model (SWMM)." Journal of Hydrology 581: 124436. (*https://www.sciencedirect.com/science/article/abs/pii/S0022169419311710*).

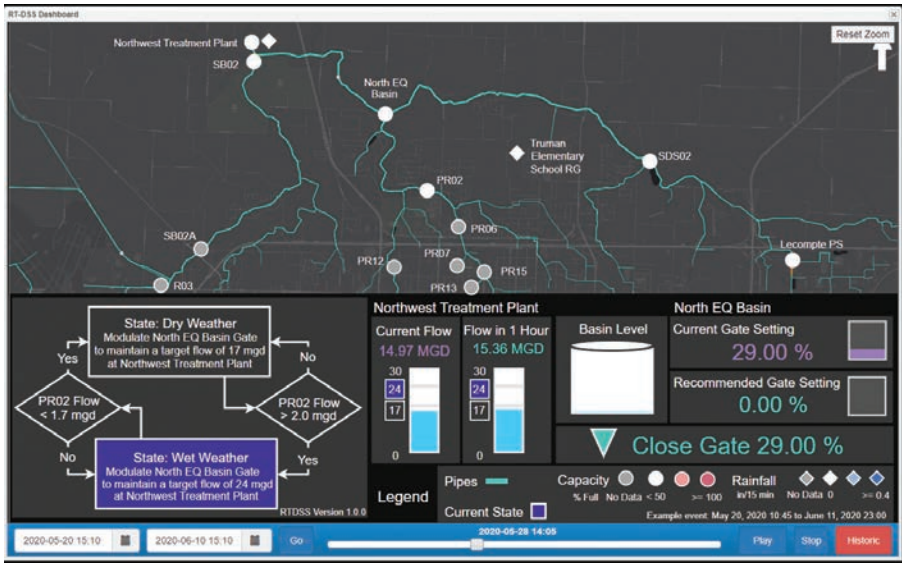
Torres, M.N., A.J. Rabideau, S.H. Ghodsi, Z. Zhu and L.S. Matott. 2022. "Spatial Design Strategies and Performance of Porous Pavements for Reducing Combined Sewer Overflows." Journal of Hydrology 607: 127465. (*https://www.sciencedirect.com/science/article/pii/S0022169422000403*).

On Considering the Collection System to be an Extension of Your Treatment Process

By Richard Loeffler

For many large wastewater utilities, the collection system and treatment plant operate as separate entities. On the surface, they have very different priorities. What does an operator trying to avoid a combined sewer overflow (CSO) need to know about activated sludge? Why would a treatment plant operator want to know about lift station status?

The answer to both questions is, surprisingly, quite a lot! The reality is that the entire wastewater network is a single, unified system and what happens in collections can affect operator goals in treatment and vice versa. Wastewater utilities that want to take their operations to the next level need to connect their collection system and treatment processes.



A real time decision support system interface, showing operational status and recommendations across the collection and treatment system. *Xylem*

Connecting collections and treatment means operators from both groups are looking at and engaged with the same sets of data. This enables clear communication between all departments, as all operators will be able to pull up the same readings and compare activity in compatible terms.

While this may seem like a lofty goal, it is easier than it might seem.

Benefits of Holistic Operation

When collections and treatment are run like a single, holistic operation, it offers the following benefits to the utility as a whole:

- lower energy consumption
- better treatment outcomes
- improved maintenance
- fewer capital expenditures (CAPEX)
- reduced environmental impact

Lower Energy Consumption

Being able to communicate with collections may allow the treatment plant to receive more consistent flow rates. Depending on the network of controllable assets in the collection system, flows can be modulated to reduce diurnal swings. This can reduce stress on the plant and perhaps reduce the need to run blowers or other energy-intensive processes, which in turn can significantly cut energy usage while simplifying water quality compliance.

Better Treatment Outcomes

In addition to more consistent flows, the treatment plant will have more insight on incoming organic loadings and flows. Typically, operators do not know organic loadings to their secondary treatment process for hours or even days, as they typically must wait for lab results. Normally it takes hours for secondary treatment to prepare for large changes in flow. But if the incoming flow rate can be observed while in the collection system (or even predicted via analytics), it gives the plant time to prepare or adjust the flow rate as needed. This reduces chemical consumption and ensures consistent treatment results.

Improved Maintenance

Having a single, holistic view of the entire system allows operators to make adjustments so maintenance on infrastructure or pump stations can be performed with minimal impact on the rest of the system. For example, if a lift station has to go offline for maintenance, operators can make adjustments to all the pump stations, as well as inline and offline storage that are in its sphere of influence. This builds flexibility in the system and reduces or avoids adverse conditions elsewhere.

Fewer Capital Expenditures (CAPEX)

Improved visibility allows operators to maximize usage of existing assets in lieu of upsizing facilities or constructing new ones. This allows the utility to spend capital dollars on other projects, or ones with a higher degree of environmental benefit.

Reduced Environmental Impact

Much of the above can cut the overall carbon footprint of an operation via less energy consumption, lower chemical usage, fewer construction projects, and provide more consistent effluent quality.

How To Connect Collections and Treatment

One of the most important things to do to connect collections and treatment is unifying data silos as much as possible. At many sites, operators need to switch between two or three software programs or other interfaces to execute a function or get a picture of what is happening. On top of that, collections and treatment are likely pulling only the data that is immediately relevant to their specific roles. For that reason, true connectivity requires both groups to be utilizing the same system to incorporate, compare, and analyze data from sources throughout the entire wastewater network.

With the advancement of technology, managers have the opportunity to provide operators with new tools to evaluate the collection system and treatment process in a holistic manner. Connected data across the entire system can empower teams with holistic digital insights so they can better see how every control decision upstream of the plant has an impact on hydraulics and process "inside the fence," not the least of which is final effluent water quality.

By working together from the beginning and finding a solution both groups can agree on, they will have a better understanding of how the solution is designed to help them as well as how they can use it to help each other.

Richard Loeffler is a senior practice solutions architect with Xylem and may be reached at richard.loeffler@xylem.com.

Creating vibrant and resilient communities in New York.

Jacobs has been providing sustainable, cost-effective infrastructure solutions to the state of New York for decades. We're proud to support the communities where we live, work and play. From program and construction management, to transportation, flood protection and critical infrastructure, our team is pushing the boundaries of what's possible, with an eye on a resilient future.

We're pushing the limits of what's possible.

Follow us @JacobsConnects | jacobs.com

Jacobs

Challenging today.
Reinventing tomorrow.

Project Profile: Global Wastewater Project of the Year, Victor Valley Wastewater Reclamation Authority

By Melissa Bailey

VVWRA establishes a landmark reference for biomethane production at any such wastewater resource recovery facility in the U.S. *Anaergia*

How did a 12 million-gallon-per-day (MGD) facility beat out huge treatment plants around the world for Project of the Year? By digesting food waste diverted from landfills and creating a carbon-negative operation.

It takes something pretty amazing to impress the water industry experts who nominate and vote in the Global Water Awards. This year's wastewater project of the year nominees included huge facilities in China and Saudi Arabia. But a project by Victor Valley Wastewater Reclamation Authority (VVWRA) — a 12 MGD facility serving a few hundred thousand people in the high desert of California — won out over the big players this year, earning admiration for "demonstrating how technically advanced retrofits of old digesters can make the utility a net energy exporter at the same time as reducing its carbon footprint."

In fact, VVWRA reduced its carbon footprint to less than nothing. It now prevents more greenhouse gas emissions than its operations create. It does this by co-digesting food waste that has been diverted from landfills, eliminating the methane emissions that this waste would have caused in the dump. The facility converts 235,000 tons per year of organic waste — in the form of food slurry and biosolids — into 320,000 million British thermal units (MMBtu) per year of carbon-negative biomethane, reducing greenhouse gas emissions by more than 72,000 tons per year.

And, while it's doing good for the planet, VVWRA is also doing good for its ratepayers, by creating new income streams that help to stabilize rates and fund new capital improvement projects without impacting service costs. The revenue comes from tipping fees for accepting organic waste and a share of the sales of the renewable natural gas (RNG) it puts on the grid. What's more, VVWRA completed the project via a public-private partnership (P3), eliminating upfront investment and risk to ratepayers.

Putting Food Waste to Work

In 2016 California passed a mandate (SB1383) to divert food waste from landfills, and VVWRA saw an opportunity. At that time, the agency had three 0.75-million-gallon digesters that were retired and not in use. VVWRA was also fortunate to have a high-pressure Southwest Gas Corporation transmission line running inside its property. These positive attributes, combined with an existing partnership with Anaergia, ignited discussions about working together on a public-private partnership to develop co-digestion of municipal wastewater and food waste — and whether or not the additional biogas should be upgraded to RNG for pipeline injection.

"Timing for the project was ideal. VVWRA had an existing partnership with Anaergia for the operation of on-site combined heat and power (CHP) units, and with the passing of SB1383 we were excited to see if there was opportunity to take in food waste," says VVWRA's General Manager Darron Poulsen.

VVWRA received strong interest from waste haulers seeking competitive tipping fees, local food waste slurry disposal options, and the regulatory compliance offered by VVWRA. In fact, available feedstock exceeded the receiving capacity of VVWRA.

As VVWRA looked to increase organics processing capacity, Anaergia worked with the agency to conduct a cost-benefit analysis to find out which use of the added biogas would be the most economically favorable.

"We needed to find out which would make more economic sense," says Anaergia's Project Manager Margaret Laub. "Should they use the expanded biogas production to increase power generation? Or would the analysis favor upgrading the added biogas to renewable natural gas?"

The assessment indicated that the value of RNG sales — driven by renewable energy credits that monetize the fuel's low carbon-intensity and potential to offset fossil fuel use — far exceeded the value generated from using biogas for CHP. Further, the potential RNG value would more than offset the cost of natural gas purchases to continue operating VVWRA's CHPs for resilient on-site energy production.

"Upgrading 100% of the biogas from the plant's digesters to pipeline-quality RNG is so favorable economically that the P3 entity could actually cover the cost of the fossil natural gas to run the CHP," says Laub. "So VVWRA benefits from continued energy independence and resilience and avoids stranding its CHP asset, without having to pay for the fuel."

The P3 project moved ahead, leveraging the use of VVWRA's existing digesters and Anaergia's experience with food waste to deliver a state-of-the-art project providing alternative organics disposal capacity to meet California's growing need to digest food waste scraps, while allowing VVWRA to upgrade its public infrastructure and develop a secondary revenue source.

The findings at VVWRA are generally consistent with the analysis of similar wastewater biogas projects throughout California and North America. When sufficient biogas production scale is achieved, then

continued on page 24

continued from page 22

upgrading and conditioning this biogas to pipeline-quality RNG will create the greatest value, even where CHP systems are already in place. And this approach creates additional meaningful benefits by generating carbon-negative RNG, a cost-effective tool in achieving carbon-neutrality goals and mitigating climate change.

Upgrades and New Technologies

Based on the results of the analysis, VVWRA partnered with Anaergia, which formed a special purpose vehicle (SPV) called SoCal Biomethane LLC, to develop, design, build, finance and operate a state-of-the-art co-digestion and biogas upgrading facility. The project included facility upgrades to expand co-digestion including:

- a new receiving station for food slurry
- food waste buffer storage
- Omnivore high-solids digestion technology, including SST and OmniMix mixers
- biogas conditioning
- RNG membrane upgrading
- natural gas utility interconnection

Three mothballed digesters were brought back online, increasing active digestion capacity by 50%. The facility now uses 990,000 gallons of previously unused digester capacity and has the ability to receive 100,000 gallons of high-strength waste per day in the form of food scraps. Anaergia also provided ancillary upgrades such as dedicated digester feed lines to support overall operations for the plant and address capital improvement needs of the VVWRA.

Using a P3 to complete the infrastructure upgrades offered another benefit: rapid completion. The Anaergia subsidiary began construction of the RNG infrastructure in 2020 and completed it in just 15 months. The project was officially commissioned and began injecting RNG to the Southwest Gas pipeline in early 2022.

How the Public-Private Partnership Works

A P3 structure solves two problems for small and mid-sized utilities like VVWRA. First, it provides the capital, avoiding up-front ratepayer investment as well as long-term RNG value risk. Second, small and mid-sized public facilities with limited staff can tap into the "knowledge capital" provided by experts at private companies.

The P3 structure for the VVWRA project works like this: Anaergia's SoCal Biomethane subsidiary owns and operates the biogas utilization facility, located on a small parcel it leases from VVWRA. The Anaergia facility then receives all biogas produced at VVWRA and conditions it to remove contaminants such as hydrogen sulfide, volatile organic compounds (VOCs), and siloxanes. The conditioned biogas is upgraded via Anaergia's Biogas Upgrader System (BUG) to produce pipeline-quality RNG. The carbon-negative RNG is 99% methane and delivered to the Southwest Gas utility's point of receipt for pipeline injection and sale, offsetting the use of fossil fuels.

Anaergia's subsidiary also manages interconnection and offtake agreements for the sale of the RNG, as well as registration with renewable fuel standard programs to maximize renewable energy credits and RNG value. Anaergia recently announced that the RNG produced by the facility will be used to produce carbon-negative hydrogen and electricity for Toyota Motor North America's logistics operation at the Port of Long Beach in California, which handles import and exports for North America and processes about 200,000 vehicles per year.

VVWRA continues to own and operate all of the co-digestion equipment and ancillary upgrades. The utility also maintains responsibility for coordinating organic feedstock and receives hauler tipping fees (approximately $13.20 per cubic meter, or $0.05 per gallon). These high-strength waste tipping fees add up to $4,000 per day (nearly $1.25 million per year).

In addition, VVWRA continues to benefit from energy resilience and electric grid independence via natural gas-fueled CHP.

Maximizing the Value of Waste

This innovative project demonstrates that advanced high-solids anaerobic digestion—a technology platform originally created for the European agricultural sector—can be adopted by the wastewater sector to maximize the use of existing digester infrastructure, allowing co-digestion of food waste with biosolids to create RNG and reduce methane emissions that occur when food waste is landfilled.

Industry experts have noted that the VVWRA model can be easily replicated in thousands of wastewater treatment plants across the country and would have significant environmental benefits. While using anaerobic digestion to convert wastewater biosolids into pipeline-quality RNG is not new in the U.S., before VVWRA it had been practiced only at large wastewater treatment plants. Because 95% of treatment plants in the U.S. are sized at less than 15 MGD, a large segment of the sector is currently missing out on the energy savings, greenhouse gas reduction, cost reductions, and new revenue stream potential that co-digestion offers.

Emulating a resource recovery project such as VVWRA's throughout the U.S. water sector would improve wastewater infrastructure, provide clean energy, and improve air quality while reducing greenhouse gas emissions and addressing climate change. VVWRA's innovative approach demonstrates that co-digestion upgrades at any size treatment facility can generate revenue, provide redundant capacity, and enhance a utility's energy independence, all while eliminating the operation's carbon footprint.

"This project is really a cutting-edge example of how to effectively manage waste as a valuable resource, with the added benefit of doing good for the environment," says Darron Poulsen, VVWRA's general manager. "It not only gives us energy resilience, independence from the power grid, and increased capacity to serve our community, it also gives us a source of revenue."

Melissa Bailey is the former director of Marketing & Corporate Communications with Anaergia in Carlsbad, California.

The Problem of Landfill Methane Emissions

When food waste and wastewater biosolids are landfilled, they contribute significantly to methane emissions. And landfills represent a much larger portion of methane emissions than is typically understood. If all of the methane from organic wastes were eliminated by diverting that waste from landfills, it would have the effect of eliminating more than 695 million tons of carbon dioxide-equivalents (CO2e) per year (based on a 20-year time horizon), which is more than 13% of total annual U.S. greenhouse gas emissions.

Rather than contribute to this issue through the generation of biosolids, wastewater treatment plants can be part of the solution by leveraging existing digestion infrastructure. The VVWRA project demonstrates the critical role wastewater treatment plants of all sizes can play to combat climate change by preventing greenhouse gas emissions from organic waste and fossil fuel consumption, while improving infrastructure, increasing resilience and creating alternative revenue streams.

Exploring the Recovery Potential of Volatile Fatty Acids in Anaerobic Digestion

By Aykut Sayin, Krish Ramalingam and John Fillos

Anaerobic Digestion Process Overview

Municipal wastewater treatment typically involves a series of physical and biochemical processes resulting in a treated effluent that complies with discharge permit limits set by the United States Environmental Protection Agency (USEPA) and local state agencies. A consequence of these processes is the removal of wastewater settleable solids in dedicated settling tanks, referred to as primary sludge (PS), and an excess growth of biomass from the biological processes, known as waste-activated sludge (WAS). PS and WAS represent a rich source of organic matter as well as nutrients, primarily nitrogen and phosphorus. Conventionally, these two sludges are mixed and directed into gravity thickeners to produce the gravity thickened underflow sludge (GTUS), which is then pumped into anaerobic digesters for solids reduction, stabilization and reduction of pathogens.

Anaerobic digestion of sludge typically operates within a mesophilic temperature range of 35°C to 37°C and a solids retention time (SRT) of 15 days to achieve Class B biosolids. Anaerobic digestion consists of four sequential biochemical reactions referred to as hydrolysis, acidogenesis, acetogenesis and methanogenesis. In conventional single-stage mesophilic digesters, all four reactions take place simultaneously. Hydrolysis involves the solubilization of complex organic solids by extracellular enzymes to simpler molecules, monomers. The hydrolyzed organic matter becomes the substrate for the acidogens that yields a specific group of readily biodegradable organic acids referred to as volatile fatty acids (VFAs). The VFAs are stepwise converted to acetate through acetogenesis and ultimately the methanogens reduce the acetate to methane and carbon dioxide that causes reduction of solids.

> ***Volatile Fatty Acids:*** *A readily biodegradable carbon source produced during anaerobic digestion, which can be remarketed as a precursor of bioproducts or repurposed as an external carbon source during biological nitrogen removal.*

In summary, anaerobic digestion of sludge produces by-products of value that include biosolids for potential land application, harvesting of nutrients such as phosphorus and nitrogen, and biogas (a fuel that can be used internally for heating the digesters and/or marketing after purification). However, in many situations because of the lack of market demand and low profitability ($0.10 per cubic meter of biogas; *Winquist et al. 2019*) biogas is wasted by flaring. It is warranted to consider alternate operating options that will valorize potential anaerobic digestion by-products.

Research Objective

The objective of this research is to valorize the anaerobic digestion process by expanding beyond methane and exploring the recovery potential of VFAs, which are precursors of different bio-products in the market such as biodiesel and bioplastics (*Patel et al. 2021*). Additionally, because VFAs are readily biodegradable organics, they can be repurposed as external carbon source for the biological nitrogen removal process in water resource recovery facilities (WRRFs), which would bring additional cost savings by reducing the amount of commercial carbon source consumption (*Zhang et al. 2016*).

Given that the VFAs production potential is financially feasible to recover and repurpose for the aforementioned methods, the process can be achieved in a two-phase anaerobic digestion configuration depicted in ***Figure 1***, where there are two digesters connected in series. The first digester, referred to as the Acid Digester, is where predominant VFAs production takes place through hydrolysis and fermentation. Subsequently, the Acid Digester effluent is introduced into a second digester, the Gas Digester, where the conversion of VFAs to methane and carbon dioxide takes place. Valorization would be achieved by maximizing the production of VFAs in the Acid Digester and instituting a VFAs recovery approach, a product that would be of greater value than methane.

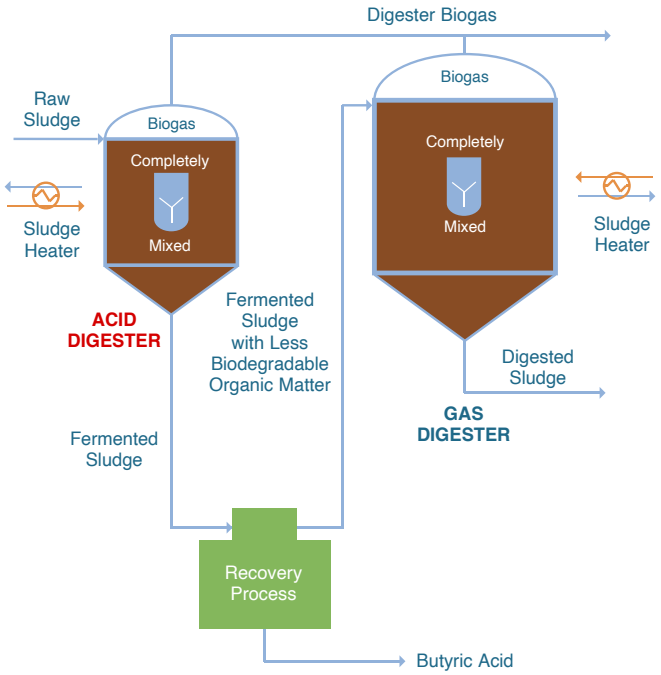


Figure 1. Proposed VFAs recovery setup in two-phase digestion. *Aykut Sayin*

Research Approach

As a first step, a series of batch experiments were undertaken to identify operating conditions that would maximize production of VFAs using gravity thickened sludge from the Wards Island WRRF. The sludge samples were brought to City College of New York, where both batch and semi-continuous flow fermentation experiments were conducted in the Environmental Engineering Laboratory. The operating conditions of the batch Acid Digesters included mesophilic and thermophilic temperatures to assess the performance of both hydrolysis and fermentation in terms of soluble chemical oxygen demand (COD) and VFAs production. An additional benefit of considering a thermophilic Acid Digester upstream of a mesophilic Gas Digester is that the biosolids produced would comply with Class A, a significant improvement from Class B when both digesters operate in the mesophilic range (*USEPA 2006*).

As already stated, the initial evaluation of Acid Digestion would be based on a series of batch experiments that would assess the impact of pertinent operating parameters on VFAs production. The question raised was whether an inoculum was necessary, especially when the batch experiments would be conducted under thermophilic conditions. Since

continued on page 28

continued from page 26

digesters in New York City operate in the mesophilic range and thus may not be an appropriate source of inoculum, it was decided to use a bench scale semi-continuous flow thermophilic Acid Digester as the source of the inoculum. A basic criterion of operation was to control the SRT at 2.5 days to prevent the growth of methanogens and thus avoid their enrichment in the batch reactors. At the same time, the semi-continuous flow thermophilic Acid Digester would provide preliminary guidance for the second phase of the study.

Semi-continuous Flow Thermophilic Acid Digester

The bench-scale Acid Digester was built and operated for approximately three months in the City College of New York Environmental Engineering Laboratory (***Figure 2***). Gravity-thickened sludge of approximately 3% solids from the Wards Island WRRF, which was used as the digester feed, was refrigerated to minimize biochemical activity. The sludge was pumped intermittently into the digester once every hour at a rate of 125 milliliters per hour. Thus, an SRT of 2.5 days was maintained, which falls within the SRT range of Acid Digestion of zero to five days

Figure 2. Semi-continuous flow thermophilic acid digester. *Aykut Sayin*

(*USEPA 2006, Ucisik et al. 2008, Gioannis et al. 2017*). The temperature in the reactor was set at 50°C, within the range of thermophilic fermentation. Pertinent parameters monitored included COD, total solids (TS), volatile solids (VS) and VFAs. While assessing the fermentation performance of the semi-continuous flow Acid Digester, its fermented sludge was used as the inoculum (seed) in thermophilic batch experiments.

Batch Experiments

Batch experiments were performed with the following objectives and operating conditions:

1) Relate hydrolysis and VFAs production to incubation time. Determine future operating periods for batch studies based on achieving 80% of the ultimate VFAs production.
   a. Contact Time: zero to six days
   b. Seed-to-Feed Ratio (SFR): 0.25 (milligrams VS/milligrams VS)
   c. Temperature: 50°C
2) Determine whether a thermophilic seed is necessary to conduct future batch studies.
   a. Contact Time: five days
   b. SFR: 0 (no inoculum), 0.25 and 0.5
   c. Temperature: 50°C
3) Determine the optimum thermophilic Acid Digestion temperature to maximize VFAs production.
   a. Contact Time: zero to 10 days
   b. SFR: 0 (no inoculum)
   c. Temperature: 50°C, 60°C and 70°C

All batch experiments were carried out using the aforementioned gravity-thickened sludge of approximately 3% solids from the Wards Island WRRF. The temperatures of the batch reactors were controlled using an air incubator. Any off-gas generated in the reactors was continuously measured with a respirometer. Pertinent parameters monitored included pH, total COD, soluble COD, VFAs, TS, VS, total ammonia nitrogen, total alkalinity and orthophosphate.

Findings

Semi-continuous Flow Thermophilic Acid Digester

During the three-monthslong operation of the semi-continuous flow Acid Digester (***Figure 3***), it became evident that biological activity passed through the following three distinct sequential stages:

Stage 1: Quasi Steady-state Performance 1 (SS-1). In the absence of a seed, the thickened sludge began fermenting quickly, producing significant VFAs with minor amount of biogas for the next 30 days of operation. However, after 30 days, performance began to change with reduction of total COD, suggesting methanogenic activity was becoming significant.

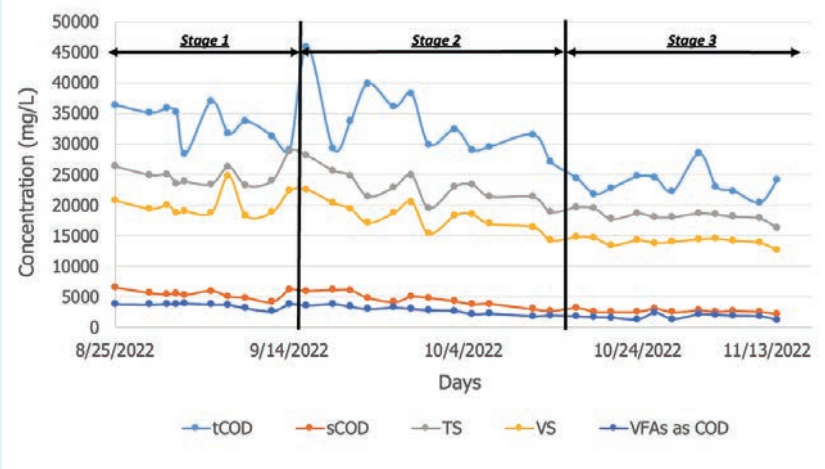


Figure 3. Fermented sludge characteristics throughout the three-months long semicontinuous flow thermophilic acid digester opertion. *Aykut Sayin*

Stage 2: Intervening Stage (IS). The reduction of total COD continued to decrease linearly and simultaneously all other parameters showed similar effect. However, all parameters began to stabilize to a new equilibrium after approximately 30 days.

Stage 3: Quasi Steady-state Performance 2 (SS-2). In the new equilibrium, total COD concentra- stabilized at a lower concentration than during SS-1, suggesting a new dynamic equilibrium between the fermenters and the methanogens.

continued on page 30

MOTT MACDONALD

From New York Harbor to Niagara Falls

Clients of Mott MacDonald are strengthening water and wastewater infrastructure, meeting increased demand, protecting waterways, cutting energy use, reducing carbon emissions, and achieving cost-effective solutions.

Find out how you can join them.

New York City
1400 Broadway
New York, NY 10018
212.532.4111

Buffalo
438 Main Street, Suite 300
Buffalo, NY 14202
716.854.1181

Tarrytown
120 White Plains Road, Suite 140
Tarrytown, NY 10591
914.292.1810

mottmac.com

continued from page 28

Supporting evidence includes lower concentrations of VFAs and soluble COD compared to those during SS-1, and lower concentration of total COD indicates higher production of methane.

The implication of the biological changes occurring in the semi-continuous flow reactor is that the seed collected for the batch reactors is not consistent, but subject to change when taken. This made interpretation of data from the batch reactors more challenging. For example, seed collected from Stage 3 contained more methanogens that made the batch reactor prone to methane production.

The Effect of Contact Time on VFAs Production

Batch experiments were performed using seed from the semi-continuous flow Acid Digester during Stage 1, where methanogenic activity in the reactor was significantly restricted by the short SRT and as further indicated by the relatively small amount of total COD produced. The batch reactors were incubated at 50°C for a six-day duration.

Total VFAs concentrations in the batch reactors plateaued at 6,500 milligrams per liter (mg/L) as shown in ***Figure 4***. The rate of production was steep initially, achieving approximately 80% of the ultimate value by the end of Day Two, an indication that performance comparison among samples need not wait for longer incubation times. The concentration of total COD reduced slightly after Day Four as shown in ***Figure 5***, suggesting the onset of methanogenic activity and methane production, though actual methane production was below the detection limit of the respirometer. Approximately 25% of total COD, corresponding to an amount of 10,000 mg/L, hydrolyzed to soluble COD after Day Three of contact time. The soluble COD produced within Day One of incubation equaled 80% of this ultimate soluble COD concentration. However, only approximately 65% of the solubilized COD was converted to VFAs by the end of the experiments, indicating the probability of an inhibitory feedback caused in part by the VFAs produced.

Fermentation of the protein fraction of sludge VS released ammonia that reacted with dissolved carbon dioxide to produce ammonium bicarbonate, the main path for producing bicarbonate alkalinity. ***Figure 6*** shows the release of the total ammonia nitrogen and consequently the total alkalinity produced, again showing that approximately 80% of their ultimate concentration was formed within an incubation time of two days. The data also shows orthophosphate solubilization of approximately 90% of the plateau value was reached much faster, within the first day of incubation. Orthophosphate is predominantly the product of the hydrolysis of cellular (biomass) debris as phosphorus represents 2% of the biomass composition (*Metcalf & Eddy 2014*).

Influence of Initial Seeding on Thermophilic Acid Digestion Performance

Batch experiments were performed with and without seed, the seed being collected from the semi-continuous flow Acid Digester during Stage 3, when significant methanogenic activity was present in the reactor as confirmed by the significant reduction of total COD and VS of approximately 30% and 35%, respectively.

Greater methane production in the batch reactors was measured by the respirometer, which increased with higher seed-to-feed ratio. The increased ratio introduced more methanogens in the batch reactor, leading to a higher rate of methane production. Hence, by the end of the five-day incubation period, the concentration of the VFAs was reduced (with increasing seed-to-feed ratio) compared to the control because of methanogenic activity producing methane. A mass balance conducted among the batch reactors (by adding credit for the methane produced) appeared to show that the ultimate VFAs concentrations in both seeded and control reactors were similar as shown in ***Figure 7***. This indicated that the additional effort to produce a thermophilic inoculum or seed for the batch reactors was not warranted because fermentation of sludge appears to be rapid and also adapts to mesophilic and thermophilic conditions quickly.

Optimum Thermophilic Acid Digestion Temperature to Maximize VFAs Production

Batch experiments were carried out without using any seed, since seed-

Figures 4, 5 & 6.

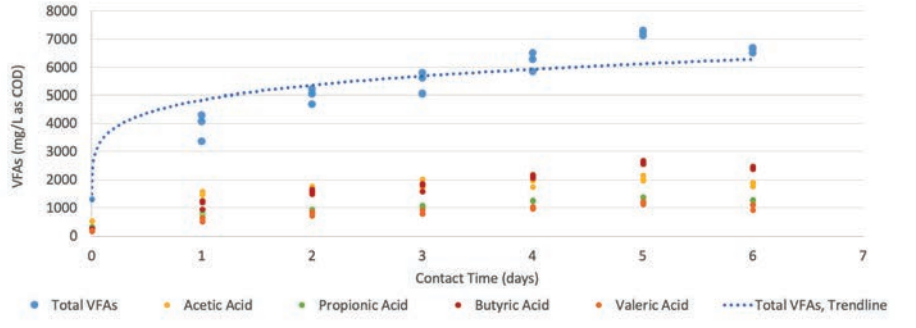


Figure 4. VFAs concentrations over contact time during acid digestion at 50°C. *Aykut Sayin*

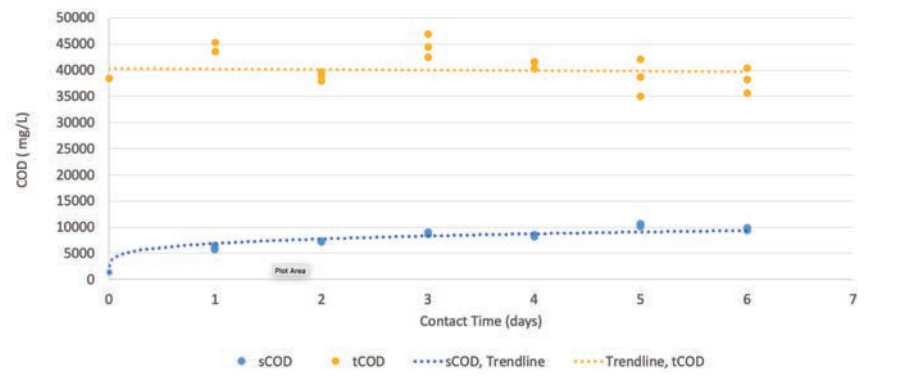


Figure 5. Total and soluble COD concentrations over contact time during acid digestion at 50°C. *Aykut Sayin*

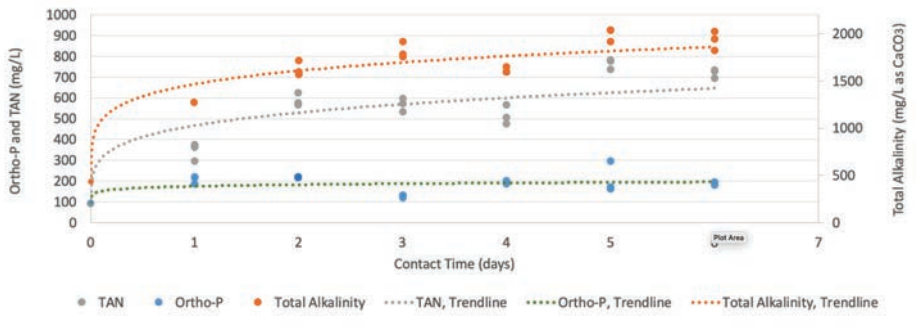


Figure 6. Orthophosphate (Ortho-P), total ammonia nitrogen (TAN), and total alkalinity change over contact time during acid digestion at 50°C. *Aykut Sayin*

ing did not show any improvement in VFAs production in the previous sets of Acid Digestion experiments. VFAs production at 50°C, 60°C and 70°C reached similar ultimate concentrations at 6,500 to 7,000 mg/L as COD (***Figure 8***). Approximately 25% to 30% of total COD was solubilized by the end of the third day of fermentation for all temperatures. By the end of 10 days of fermentation contact time, 35% to 40% of soluble COD was still not fermented to VFAs, which confirmed the previous observation that accumulated concentration of the VFAs are probably inhibiting further conversion.

Figures 7 & 8.

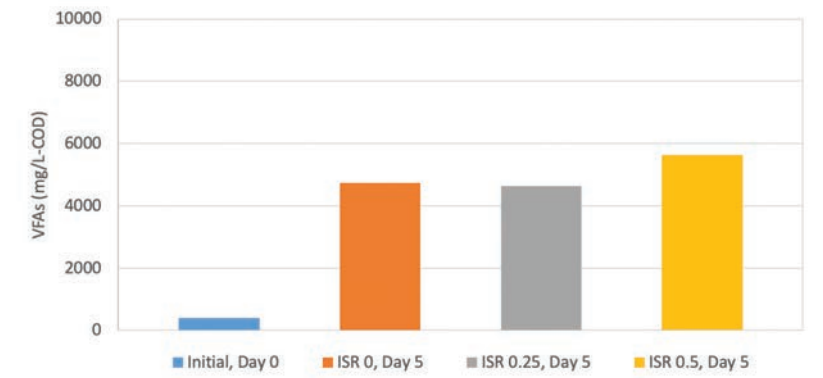


Figure 7. Influence of inoculum on VFAS concentrations during acid digestion at 50°C. *Aykut Sayin*

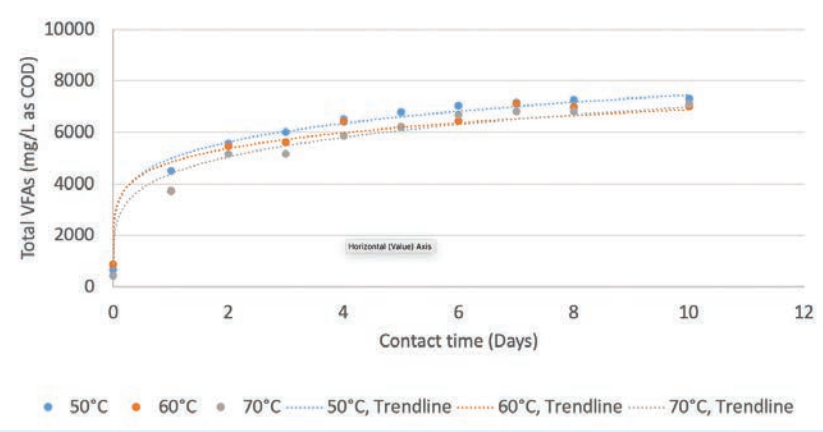


Figure 8. VFAs concentrations over contact time during acid digestion at different thermophilic temperatures. *Aykut Sayin*

Conclusion and Future Work

Semi-continuous Flow Thermophilic Acid Digester

The three-monthslong semi-continuous flow Acid Digester study revealed that an SRT of less than 2.5 days is needed to prevent or limit the growth of methanogens. Therefore, the next stage of semi-continuous flow thermophilic Acid Digester experiments will be operated at shorter SRTs of 1.5 and two days to assess fermentation performance in the absence of methanogenic activity.

The Effect of Contact Time on VFAs Production

Comparison of batch fermentation performances could be facilitated using a contact time of two days, since both hydrolysis and fermentation achieved 80% of their ultimate value. Only 65% of the soluble COD produced by biological hydrolysis was fermented to VFAs. Apparent inhibition of fermentation would be addressed in future batch and semi-continuous experiments.

Influence of Initial Seeding on Thermophilic Acid Digestion Performance

Batch thermophilic experiments showed similar performance with and without the need of an acclimated seed (an inoculum). This is due to the rapid acclimation of fermenters in municipal wastewater sludge to hydrolysis and VFAs production.

Optimum Thermophilic Acid Digestion Temperature to Maximize VFAs Production

Fermentation within the thermophilic range of 50°C to 70°C yielded similar performance with respect to solubilization and VFAs production. Hence, 50°C is recommended as the optimum temperature for future thermophilic Acid Digestion studies, since raising the temperature further would not bring any additional benefits in terms of solubilization and VFAs production.

Aykut Sayin, E.I.T., is a Ph.D. candidate and research associate at the City College of New York, Department of Civil Engineering and can be contacted at asayin@ccny.cuny.edu. Krish Ramalingam, P.E., is the director of the City College of New York and New York City Department of Environmental Protection's Applied Research Program and can be contacted at kramalingam@ccny.cuny.edu. John Fillos, Ph.D., P.E., is a professor at the City College of New York, Department of Civil Engineering and can be contacted at jfillos@ccny.cuny.edu.

References

Gioannis, G.D., A. Muntoni, A. Polettini, R. Pomi and D. Spiga. 2017. "**Energy Recovery from One- and Two-Stage Anaerobic Digestion of Food Waste.**" Waste Management 68: 595–602. *(https://doi.org/10.1016/j.wasman.2017.06.013).*

Metcalf & Eddy. 2014. *Wastewater Engineering: Treatment and Resource Recovery.* Fifth ed. McGraw Hill.

Patel, A., A. Mahboubi, I. Sárvári Horváth, M.J. Taherzadeh, U. Rova, P. Christakopoulos and L. Matsakas. 2021. "Volatile Fatty Acids (VFAs) Generated by Anaerobic Digestion Serve as Feedstock for Freshwater and Marine Oleaginous Microorganisms to Produce Biodiesel and Added Value Compounds." Frontiers in Microbiology 12. *(https://doi. org/10.3389/fmicb.2021.614612).*

Ucisik, A.S. and M. Henze. 2008. "Biological Hydrolysis and Acidification of Sludge under Anaerobic Conditions: The Effect of Sludge Type and Origin on the Production and Composition of Volatile Fatty Acids." Water Research 42 (14): 3729–38. *(https://doi.org/10.1016/j.watres.2008.06.010).*

USEPA. 1994. *A Plain English Guide to the EPA Part 503 Biosolids Rule.* Office of Wastewater Management *(https://www.epa.gov/sites/default/files/2018-12/documents/plain-english-guide-part503-biosolids-rule.pdf).*

USEPA. 2006. *Biosolids Technology Fact Sheet, Multi-Stage Anaerobic Digestion*. Office of Water *(https://www.epa.gov/sites/default/files/2018-11/documents/multistage-anaerobic-digestion-factsheet.pdf).*

Winquist, E., P. Rikkonen, J. Pyysiäinen and V. Varho. 2019. "Is Biogas an Energy or a Sustainability Product?" *Business Opportunities in the Finnish Biogas Branch*. Journal of Cleaner Production 233: 1344–54. *(https://doi.org/10.1016/j.jclepro.2019.06.181).*

Zhang, H., J. Jiang, M. Li, F. Yan, C. Gong and Q. Wang. 2016. "Biological Nitrate Removal Using a Food Waste-Derived Carbon Source in Synthetic Wastewater and Real Sewage." Journal of Environmental Management 166: 407–13. *(https://doi.org/10.1016/j.jenvman.2015.10.037).*

GP Jager Inc.

Your #1 Stop for all Water and Wastewater Aftermarket Parts!

AFTERMARKET BRANDS LIST

CHECK OUT OUR PRODUCT OFFERING AND EXCITING NEW ADDITIONS.

Aeration Industries
Aerisa
Aerzen
ANUA Environmental Products U.S.
Anue Water Technologies
Aqua Aerobic Systems®
Aqua Equip Technologies LLC
Aquarius Technologies
Aquionics
Atara
Boerger LLC
C.E. Shepherd Company, Inc.
CHP Clean Energy, LLC
CNP
Centrisys Centrifuge Systems
Charter Machine Company
Cleanwater1
Continental Blower
De Nora Capital Controls, ClorTec & Tetra
DERAGGER, Inc.
Desalitech
Duall Div. of MetPro
DuraMax
EnviroMix
Environetics Inc
FKC Co,. Ltd.
Fairfield Service Co. of Indiana LLC
Fiberglass Fabricators, Inc
Fluid Dynamics Inc
Force Flow Technologies
Ford Hall "Weir-Wolf"
Grundfos
H2O Controls
Haarslev Industries
Hallsten Corp
Hidrogeron
Integrity Municipal Systems
Ishigaki USA
JCS Industries
JWC Environmental
KECO Pump
Koch Membrane Systems
Komline Sanderson
Kusters Water
L&J Technologies/Shand & Jurs
Liberty Tank & Vessel
Marley/SPX
MarMac Water
Netzsch Pumps North America
Nexom
Noreva GmbH
OneWater Group
OTI Olympus Technologies, Inc.
Park Process
Parkson Corporation
Parkson Schreiber
Premier Tech Aqua
Prime Solutions
ProMinent Fluid Controls, Inc.
PureAir Filtration
RM Fiberglass
SAVECO (Formerly Enviro-Care)
S.P. Kinney Engineers, Inc.
SAF-T-FLO Chemical Injection
Serpentix Conveyor Corp.
Sigura Water - Solenis Constant Chlor Plus
Spaans Babcock
SPIRAC
STT Enviro Corp
Tank Connection
Tonka Water, a U.S. Water Brand
UGSI Chemical Feed, Inc. (PolyBlend®, Encore®, Varea-Meter®)
UltraTech Systems Inc
Vaughan® Chopper Pumps and Rotamix® System
Veolia, Suez, Infilco Degremont Inc.
WACO Products
Wallace & Tiernan / Evoqua
Wastewater Technologies, LLC
Watson-Marlow Fluid Technology Group
WSG & Solutions (FMC®, Link-Belt®, Rex®)
Xylem Wedeco UV & Ozone
Zenon Membranes/SUEZ
Evoqua Water Tech (formerly Siemens/ USFilter)

SCAN ME

GP JAGER, INC. AFTERMARKET CONTACT

METRO + UPSTATE | Janelle Sanz | jsanz@jagerinc.com

(973) 750-1180 | Fax (973) 750-1181 | info@jagerinc.com | www.jagerinc.com | P.O. Box 50, Boonton, NJ 07005

GP Jager Inc.

Your #1 Stop for all Water and Wastewater Aftermarket Parts!

AFTERMARKET BRANDS LIST

CHECK OUT OUR PRODUCT OFFERING AND EXCITING NEW ADDITIONS.

With the consolidation of a manufacturer it may be difficult to locate parts for your existing equipment. For your convenience we have listed all the "Legacy" names that are now part of the manufacturers we represent.

cleanwater1

Formerly UGSI - Verea-Meter® Encore® 700 Stranco PolyBlend®
Chemical Feed Systems Liquid V Notch Vol. Feeders-Lime Slakers

WSG & SOLUTIONS
Link-Belt®, Rex® and CSO Products

Link Belt Rex

Parkson

Schreiber Hycor

VEOLIA

Formerly Suez, IDI & Infilco
Degremont

GRUNDFOS

Chicago Clow Morris
Sewer Chewer Shone Ejector Yeomans

Your #1 Source for Wallace and Tiernan Parts

evoqua WATER TECHNOLOGIES

Evoqua has joined Xylem, creating the world's most advanced platform of capabilities to address mission-critical water challenges.

Formerly SIEMENS / US Filter

Aerators Inc.
AquaMedia
Arrowhead Industrial Water
Autocon
Chlorco and Chlor-Serv
Consolidated Electric
CPC
Davco Products
Davis Process
Dewatering Systems
DK Environmental, Inc.
Edwards & Jones
Electrocatalytic
Envirex
Enviroscan
Envirotrol, Inc.
Headworks and Preliminary Treatment
Himsley International
Hydrocarbon Services
Illinois Water Treatment (WT)
Integra Environmental, Inc.
Interlake Water Systems
Ionpure
Industrial Process Machinery (IPM)
JetTech
JWI
Kisco
L*A water
Lyco
Mitco
Monosep
Pacific Flush Tank (PFT)
Passavant
Penfield
Permutit
Perrin
Polymetrics
Portacel
RJ Environmental
Sernagiotto
Sernatech
SG Water
Stranco
Ultrapure Solutions
USFilter Recovery Services
Wallace & Tiernan
Water Services of America
Westates Carbon
Zimpro

SCAN ME

GP JAGER, INC. AFTERMARKET CONTACT

METRO + UPSTATE | Janelle Sanz | jsanz@jagerinc.com

(973) 750-1180 | Fax (973) 750-1181 | info@jagerinc.com | www.jagerinc.com | P.O. Box 50, Boonton, NJ 07005

Pilot Study: Treating Centrate from the Solids Handling Facility

By Jeff Schultz, Jake Hunt and Wayne LaVair

The Frank E. Van Lare Water Resource Recovery Facility (FEV) has been treating residential and industrial wastewater from communities within Monroe County for over 100 years. Over time, many capital improvements projects to upgrade the facility have replaced aging infrastructure and increased treatment capacity.

The recycled effluent wastewater (REWW) contains a significant loading of highly biodegradable soluble chemical oxygen demand (COD) that is recycled back to the head of the plant and ultimately to the activated sludge system when dewatering operations begin Monday mornings. While raw sludge is not typically high in soluble biological oxygen demand (BOD) and COD, particulate BOD and COD loadings can be broken down and hydrolyzed under anaerobic conditions. These conditions are present in the solids holding tanks (SHTs) over the weekends and the sludge blankets in the gravity thickeners (GTs).

Soluble COD is not captured by the dewatering centrifuges and ends up passing through to the centrate stream. These internal recycle loads place additional loadings on the activated sludge process that can lead to the growth of poorer-settling microorganisms, resulting in poorer solids capture in the secondary clarifiers, which at times have resulted in permit exceedances for effluent total suspended solids (TSS), BOD5 and total phosphorus.

This article presents the results of a pilot study to identify improvements for providing increased treatment of the internal REWW streams. The goal of this work is to reduce potential permit exceedances, improve secondary system operations and increase reliability. The information in this article was condensed from the report *FEV WRRF Recycle Improvements Evaluation Engineering Planning Grant Report (Arcadis 2023)* prepared for the Monroe County Department of Environmental Services (MCDES).

Existing Solids Handling Facilities

FEV currently employs GTs to co-thicken the primary sludge that settles in the primary clarifiers and waste-activated sludge (WAS) that is produced in the secondary system. The co-thickened sludge is dewatered using centrifuges and the dewatered cake is loaded into trailers or hoppers and hauled to a landfill during the weekdays (Monday afternoon through Friday afternoon). Since dewatering is only conducted during weekdays, the sludge produced over the weekends (Friday afternoon through Monday morning) is stored in one of two unmixed SHTs until Monday. Sludge is typically stored in the North SHT over the weekends and commercial outside waste (septage) is collected and stored in the South SHT. Additional thickened sludge is stored in the South SHT when necessary.

When dewatering operations begin again Monday morning, the anaerobic sludge stored in the SHTs and the thickened sludge from the GTs are mixed in the day tanks and fed to the centrifuge for dewatering. The contents of the SHTs begin to be drawn down between Monday and Wednesday, based on solids inventory in the GTs. The SHTs are typically emptied between Wednesday and Friday. This process makes for wide disparity in sludge percent solids and the degree of anaerobic rheology that is being fed to the centrifuges. This variability impacts the quality of the centrate, the cake solids, polymer use, and the odor of the sludge and need for odor control chemicals. A high-level process schematic for the sludge handling process is shown in ***Figure 1***, while an overall site plan of the solids handling facilities at FEV is presented as ***Figure 2***.

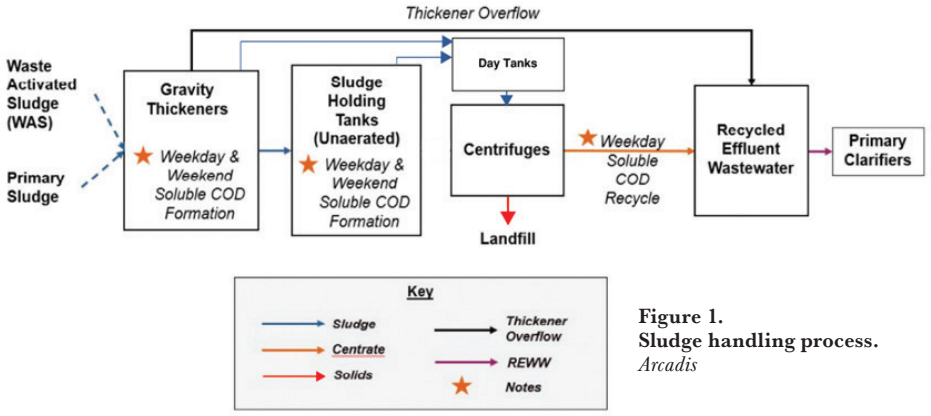


Figure 1.
Sludge handling process.
Arcadis

Sludge can be pumped from the eight GTs to either one or both SHTs. The South SHT has a capacity of approximately 1.0 million gallons and is approximately 80 feet in diameter. The North SHT has a capacity of approximately 1.3 million gallons and is approximately 80 feet in diameter, with a 34-foot-deep sidewall. Each SHT has a conical bottom and a fixed fiberglass cover. These tanks were originally utilized as anaerobic digesters.

Based on data from July 2016 to June 2018, the average daily flow of thickened sludge conveyed from the GTs to the SHTs is 421,422 gallons per day (gpd). During the time frame evaluated, this ranged from a high of 23.5 million gallons pumped during the month of August 2017 (or roughly 760,000 gpd as a maximum monthly flow) to a low of 9.6 million gallons pumped in April 2017 (for a minimum monthly flow of approximately 321,700 gpd).

The centrifuges dewater sludge five days per week (Monday through Friday). The sludge is stored in the SHTs over the weekends and holidays, or when the dewatering equipment is undergoing maintenance. Based on the average daily flow, each SHT has approximately three days of sludge storage capacity, or six days when utilizing both tanks.

Sludge is pumped from the SHTs to the day tanks prior to dewatering.

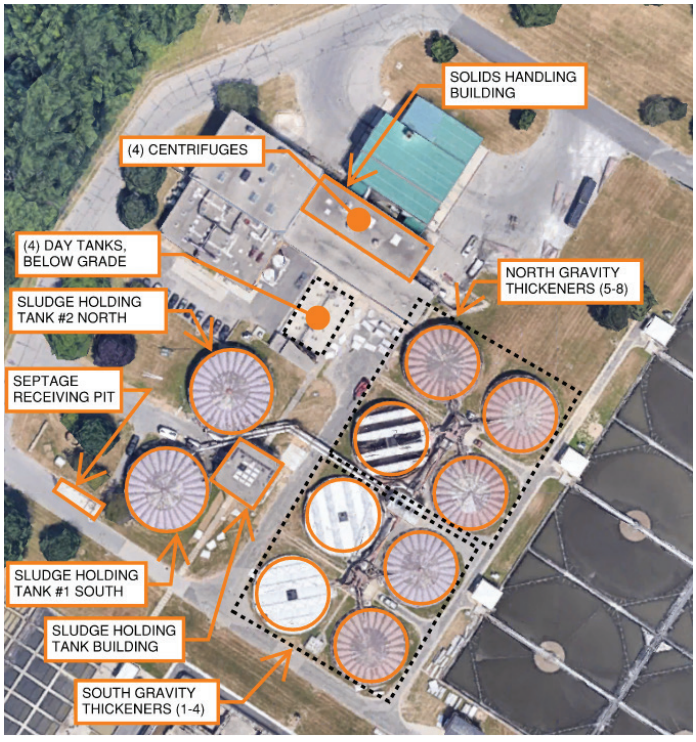


Figure 2. Solids handling process site plan. *Arcadis*

Liquid chlorine is added to the day tanks to reduce sludge odors prior to dewatering. Four day tanks (northwest, southwest, northeast and southeast) are located south of the Solids Handling Building. These tanks were initially used as elutriation tanks in the 1950s and were converted in the 1970s to use as day tanks. The tanks are constructed below grade and have a capacity of approximately 40,000 gallons each.

The day tanks require constant feed from the GT and SHT to keep pace with the centrifuges. Each centrifuge operates up to 300 gallons per minute (gpm) based on the time of year and percent solids. Based on the day tank size of 40,000 gallons, one day tank can be completely drained by one centrifuge in under three hours.

MCDES currently receives an average of 80,000 gpd of commercial outside waste (septage) in the South SHT. Received waste, which is predominantly sludge and grease from commercial haulers, currently flows by gravity from the receiving pit to the South SHT. Residential septage is not discharged to the South SHT. The sludge handling process system parameters have been summarized in ***Table 1.***

Table 1. Current sludge handling process system parameters.

Parameters	Current Conditions
Sludge Holding Tanks (SHT)	
South SHT Capacity	1.0 million gallons
North SHT Capacity	1.3 million gallons
SHT Diameter	80 feet
SHT Sidewall Depth	34 feet
Flow to SHT	
Maximum Month	760,000 gpd
Average Day	421,400 gpd
Minimum Month	321,700 gpd
Centrifuge Dewatering of Sludge	Five days per week (Mon. – Fri.)
SHT Storage Capacity	
South SHT	2.4 days at average flow
North SHT	3.1 days at average flow
Day Tanks	
Day Tank Quantity	Four
Day Tank Capacity (each)	40,000 gallons
Centrifuge	
Centrifuge Quantity	Four (three duty + one spare)
Centrifuge Operation (each)	Up to 300 gpm

Identification of the Problem

The REWW contains a significant loading of highly biodegradable soluble COD that is recycled back to the head of the plant and the activated sludge system when dewatering operations begin Monday mornings. These internal recycle loads place additional loadings on the activated sludge process, which can lead to the growth of poorer-settling microorganisms. This results in poorer solids capture in the secondary clarifiers, which at times have caused permit exceedances for effluent TSS, BOD5 and total phosphorus.

The soluble COD in the REWW is readily degradable and is a food source for fast-growing and poor-settling "young sludge." These poor-settling and fast-growing "young" bacteria become part of the overall microorganism population and are not readily flocculated with the remaining microorganisms. The "young" bacteria contribute to colloidal solids and turbidity in the plant's discharge. As a result, the TSS and COD concentrations in the primary effluent are similar to concentrations in the raw wastewater influent. The REWW contains colloidal solids that have previously resisted removal in the dewatering centrifuges (the centrate). These colloidal solids are difficult to settle in the primary clarifiers and are subject to pass through to the secondary system. The centrifuges do a poor job at removing these solids, so they return to the head of the plant in the REWW along with the soluble COD and start the cycle of events again.

FEV's REWW, which contains centrate from the centrifuges and overflow from the GTs, accounts for approximately 33% of the primary influent TSS. TSS consist of two fractions: settleable solids and non-settleable solids. Non-settleable solids are typically made up of very fine colloidal solids particles whose low density and/or particle charge prevents settling. A portion of TSS loading in the REWW is of the non-settleable fraction. While testing did not examine this portion of non-settleable solids within the TSS loading in the REWW, it did show that 40% to 50% of the TSS and soluble COD loading to the secondary system comes from the REWW.

When thickened sludge is conveyed from the GTs to the SHTs during the weekends when the dewatering process has stopped, the sludge becomes anaerobic and striates due to a lack of mixing. This striation of sludge within the SHTs creates variability in the centrifuge feed. As a result, operators must continuously adjust the sludge feed to the centrifuges to create a more uniform feed to the dewatering process.

Additionally, the anaerobic conditions in the GTs and SHTs lead to excessive use of odor-control chemicals for building and sludge odors (calcium nitrate and chlorine). Chlorine is the first odor-control chemical added to the "septic" sludge in the day tanks to control the tanks' odor emissions. Following dewatering, calcium nitrate is added to the dewatered sludge at the sludge cake pump hopper prior to the sludge cake being pumped to the loading hoppers to prevent the formation of hydrogen sulfide and odorous emissions. Chlorine is also used to control sludge odors within the Solids Handling Building using a building air scrubber.

In addition to the particulate COD being recycled, measurements of the soluble COD generated in the GT sludge blankets and SHTs indicate that between 20,000 and 40,000 pounds per day of soluble COD is also being recycled. Particulate COD, comprised of larger molecules that are not dissolved within the waste stream, can be further degraded. While the majority of particulate COD is typically removed via primary clarification, particulate COD can be degraded and solubilized into soluble COD. This degradation occurs over the weekend in the SHTs. This recycled soluble COD passes through the primary settling tank and represents 20% to 30% of the soluble COD loading to the activated sludge when sludge dewatering is being operated on weekdays. This high soluble fraction of readily biodegradable soluble COD and particulate COD in the recycle can contribute to the proliferation of filaments. The filaments cause challenges with activated sludge settling and can cause permit exceedances.

Lab Bench Scale Testing

Lab bench scale testing for volatile fatty acid (VFA) source determination was conducted by MCDES in May and August 2019. This work was done to trace the soluble COD and VFA formation in the plant during a typical week of operation. VFAs are one component of COD that are formed under the anaerobic conditions within the SHTs and GT sludge blanket via acidogenesis, or acid fermentation. This work measured the VFA and soluble COD from a daily grab sample from the sludge grinder between the SHTs and the day tanks. Composite samples were collected over 24 hours from each centrifuge in use. Lastly, the data from the SCADA system on sludge flows and blanket and liquid levels were recorded in the GTs.

continued on page 37

Emmons Metro LLC

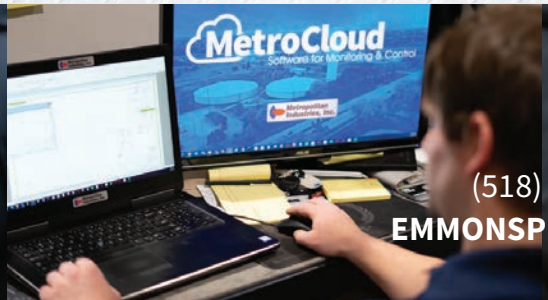
YOUR FULL SERVICE MANUFACTURER & DISTRIBUTOR

IN THE GREATER NEW YORK AREA

OVER 15 MILLION DOLLARS OF INVENTORY IN OUR FOUR FACILITIES TO SERVE YOU

YOUR RETROFIT SPECIALISTS

CUSTOM FITTING FABRICATION FOR FAST PUMP REPLACEMENT



(518) 694-0404
EMMONSPUMP.COM

Emmons Metro LLC

continued from page 35

The conclusions from the lab bench scale testing were as follows:

1. *The centrate accounts for the majority of the soluble COD loading in the REWW.* There were no detectable VFAs in the REWW on days when the dewatering centrifuges were not operating and the soluble COD was below 100 milligrams per liter (mg/L), indicating that any VFAs generated within the GTs remain in the sludge blanket and do not propagate into the GT overflow stream and into the REWW.
2. *VFAs are produced in the anaerobic conditions found in the GT sludge blankets and SHTs.* There is sufficient generation of VFAs in the GT sludge blankets such that a significant amount of VFAs would remain in the centrate, even without the operation of the SHTs. Since it is not just the SHTs that are generating VFAs, separating the primary and WAS flows into separate thickeners can reduce the amount of VFAs formed in the thickeners.
3. *Some VFAs and COD "follow" the dewatered sludge.* During the testing, the concentration of soluble COD and VFA in the centrate was approximately 75% of the grinder pump (SHTs discharge) soluble COD and VFA samples. This indicates that approximately 25% of the VFAs formed in the GTs and the SHTs remain in the sludge that is transported to the landfill. The remaining 75% ends up in the centrate.
4. *Centrate flow (approximately 0.5 to 1 million gallons per day) contributes a significant percentage of the soluble COD and TSS to the primary influent.*
5. *Primary effluent total BOD5 is highly influenced by centrate.* The amount of primary effluent total BOD that is associated with the VFA in the centrate was documented as:
    a. Approximately 13% in August 2019
    b. Approximately 24% in May 2019

Pilot Plant Design and Results

MCDES designed and constructed their own pilot plant as shown in ***Figure 3;*** the pilot construction, testing and data compilation were conducted by Jeff Schultz. The four phases of the pilot plant testing were as follows:

Phase 1—Compared COD and VFA removal efficiencies in a sequencing batch reactor (SBR) and continuously stirred tank reactor (CSTR).

Phase 2—Investigated COD and VFA removal efficiencies at higher MLSS concentrations.

Phase 3—Investigated removal efficiencies of COD and VFAs at various centrate feed rates to the CSTR.

Phase 4—Investigated removal efficiencies of COD and VFAs at various hydraulic residence times (HRTs) and feed rate ratios of WAS to centrate to the CSTR

Pilot Testing Phases 1 and 2

In 2021, Arcadis prepared a protocol for MCDES staff to perform pilot-scale testing to determine the most effective means of capturing the soluble COD in the REWW with either a SBR or a CSTR. The original scope of work of the pilot-scale testing was to compare the SBR and the CSTR removal efficiency rates for soluble COD and VFA at varied mixed liquor and suspended solids target concentrations. VFAs are one component of, and were measured in, the COD test. While VFAs are highly biodegradable and of themselves are not an issue, they are an indicator of anoxic conditions in the solids handling process and were chosen as an easy to test and track indicator parameter.

After about a month of testing, the data showed similar COD and VFA removal efficiencies of 75% and 90%, respectively; this portion of the pilot-scale testing was denoted as Phase 1 and is shown in ***Figure 4.***

MCDES expressed further interest in the pilot-scale study and decided to test the SBR pilot at higher MLSS concentrations. The performance of the CSTR and SBR for this second phase (***Figure 5***) were similar to the results in Phase 1.

Phases 1 and 2 concluded that there were similar performances between the SBR and CSTR pilot-scale configurations at different MLSS concentrations. However, significant foaming and inconsistent MLSS concentrations throughout phases 1 and 2 made FEV operators hesitant.

Pilot Testing Phase 3

Phase 3 further explored the configuration of the easier to operate CSTR pilot set up. The purpose of this set up was to test the CSTR at four different centrate feed rates:

- 55 milliliters per minute (ml/min)
- 80 ml/min
- 100 ml/min
- 150 ml/min

During Phase 3 the removal efficiencies for COD and VFA were approximately 80% and 90%, respectively. The pilot system proved to have similar performance at different feed rates that would represent the necessary feed rates to a full-scale CSTR at FEV. The results of pilot testing Phase 3 are shown in ***Figure 6.***

continued on page 38

Figure 3. Pilot-Scale testing configuration. *Jeff Schultz*

continued from page 37

Figures 4, 5, 6 & 7.

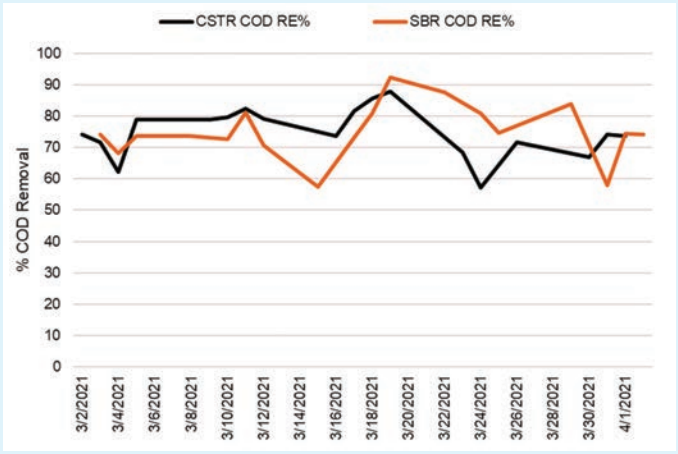


Figure 4. Phase 1 CSTR COD removal efficiency. *Arcadis*

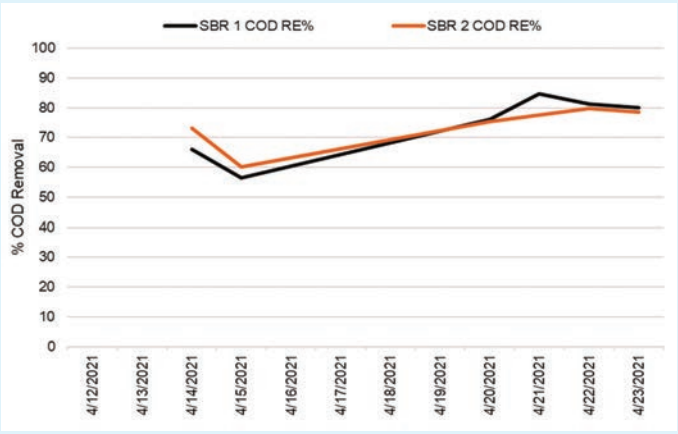


Figure 5. Phase 2 SBR COD removal efficiency. *Arcadis*

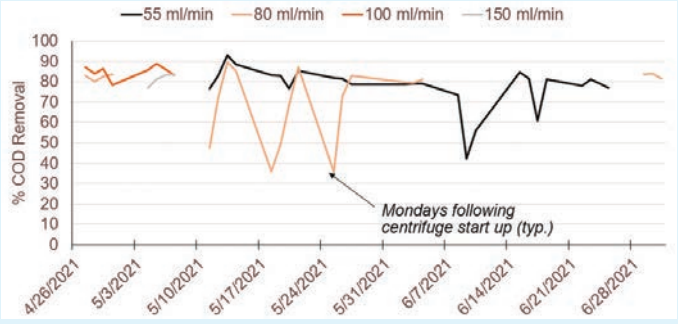


Figure 6. Phase 3 CSTR COD removal efficiency. *Arcadis*

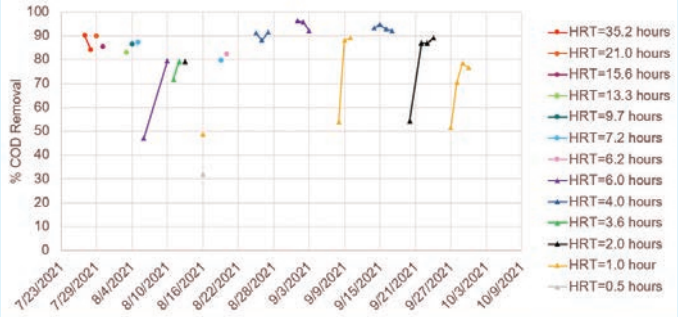


Figure 7. Phase 4 COD removal efficiency. *Arcadis*

Pilot Testing Phase 4

Phase 4 of the pilot test investigated the varying HRTs and feed rate ratios of WAS-to-centrate to the pilot-scale system. Varying flow rates and different proportions of WAS-to-centrate were used. Ratios of WAS-to-centrate ranged from two-to-one to one-to-two, and were tested at different total flowrates of the two streams. HRTs ranged from 0.5 hours to 35.2 hours.

The results found removal efficiencies for COD and VFA were more consistent than the previous phases and averaged 82% and 91%, respectively. Additionally, less foaming was observed within the CSTR throughout Phase 4 compared to the previous phases. The results of the pilot testing Phase 4 are shown in ***Figure 7*** for the various HRTs and WAS-to-centrate ratios.

Pilot Testing Summary

Following the completion of the pilot testing, Arcadis and MCDES held a review meeting to discuss the results, the challenges of the pilot-scale operations, and the high-level outcomes of the pilot testing.

Key high-level outcomes included:

1. SBR and CSTR pilot tests had similar soluble COD removal efficiencies.
2. CSTR and SBR produced similar effluent soluble COD. However, the operation of a CSTR is significantly simpler.
3. Similar performance was observed (with respect to overall COD percent removal) at different CSTR feed rates.
4. Similar performance was observed (with respect to overall COD percent removal) at different WAS-to-centrate ratios.
5. More consistent, continuous WAS addition yielded a higher overall COD percent removal.
6. Higher, more consistent total COD percent removal was observed at HRTs greater than 6.2 hours.
7. An average oxygen uptake rate of 45 milligrams dissolved oxygen per liter per hour was observed in the CSTR.

The similar performance of each configuration in each phase of the pilot-scale testing illustrates the system's resilience to change and variability in the testing.

The biology within the secondary treatment process is currently susceptible to rapid swings in loadings of soluble COD from the REWW at the start of each week resulting from the solids handling process. The results of the pilot study, presented in this article, will help MCDES to chart the path forward to provide increased treatment of the internal REWW streams and address the soluble COD issue. Additionally, pilot-scale testing has provided MCDES with the ability to plan for, develop and optimize the cost-effectiveness of full-scale improvements at FEV.

Jeff Schultz is a former senior water resource recovery operator with MCDES and may be reached at jschultz@recycled-energy.com. Jake Hunt, EIT, is a staff water designer with Arcadis and may be reached at jacob.hunt@arcadis.com. Wayne LaVair is the assistant chief water resource recovery operator with the MCDES and may be reached at wlavair@monroecounty.gov. ***Arcadis provided permission to use the information condensed from their 2023 report in this article. MCDES recognizes Arcadis for their work and appreciates their contribution toward this article.***

References

Arcadis. 2023. *FEV WRRF Recycle Improvements Evaluation Engineering Planning Grant Report.* Prepared by Arcadis of New York, Inc. for the Monroe County Department of Environmental Services. Feb. 17, 2023.

Unraveling the Differences between Densified and Flocculant-Activated Sludge Properties

By Haley Noteboom, Wendell Khunjar, Gaya Ram Mohan, Ron Latimer, Paul Pitt and Alonso Griborio

With increasing nutrient loads and more stringent effluent nutrient limits being applied to water resource recovery facilities (WRRFs), intensification technologies are shifting from advantageous to essential. Densified activated sludge (DAS) is becoming increasingly utilized as a process-intensification technology. The primary focus of this study was characterizing the intrinsic and extrinsic differences between DAS and conventional activated sludge (CAS) and correlating those properties with settleability parameters.

Activated sludge can be densified through a combination of metabolic, kinetic and/or physical selection. Activated sludge can be classified as CAS (also known as flocculant-activated sludge), DAS or aerobic granular sludge (AGS). Sludge volume index (SVI) is the quotient of the settled sludge volume to the mixed liquor suspended solids (MLSS) concentration and is commonly used to measure sludge settleability and quickly categorize forms of activated sludge. CAS can be categorized as small and compact, dispersed non-bulking and bulking.

The DAS Study

Over the past decade, Hazen and Sawyer has worked diligently to advance densification of activated sludge. As DAS implementation and design has become more common, it is important to determine the properties of DAS since they can impact performance and influence infrastructure design. A database of practical benchmarks can also be used to define the degree of densification achieved in different systems.

In 2022, Hazen and Sawyer commissioned a study to compare the properties of DAS to CAS in samples from WRRFs across the United States. The campaign has involved 15 plants with different process configurations, each sampled one to four times to benchmark properties at different settling performances. The sludge was received at the Hazen Research Lab at Manhattan College and analyzed for a range of properties and parameters including:

- settleability
- sludge compaction
- particle size distribution
- extracellular polymeric substances (EPS)
- rheology
- particle strength

Settleability and Sludge Compaction

A stirro-settleometer was used to measure settleability parameters, which included 30-minute stirred sludge volume index (SSVI30), zone settling velocity (ZSV), and the Vesilind settling parameters Vo (maximum settling velocity) and k (sludge compaction coefficient). The SSVI30 results were also correlated with plant-reported SVI measurements to verify that SSVI30 was a valid, independent way to compare settleability across different plants.

Results showed that DAS had a consistently higher Vo and lower k, indicating both faster settling and enhanced compaction in comparison to CAS (***Table 1***). These DAS properties improve a plant's capability to manage solids inventory and increase secondary treatment capacity. The capacity increase has been evidenced by a greater surface overflow rate (SOR) for DAS than CAS when modeled with State Point Analysis and Computational Fluid Dynamics Modeling.

Table 1. Average settleability parameters in DAS and CAS.

	Avg. SSVI30	Avg. Vo	Avg. k
DAS	70 ± 7	50.1 ± 6	0.55 ± 0.04
CAS	108 ± 16	29.8 ± 10	0.71 ± 0.12

Particle Size Distribution

A wet sieve method was used to determine the particle size distribution of the sample. The particle size classifications were:

- greater than 212 micrometers (µm)
- between 106 µm and 212 µm
- less than106 µm

The results indicate that the DAS samples had an average 31% of particles greater than 212 µm, while CAS consistently had less than 10% of particles greater than 212 µm. CAS samples also had a larger distribution of fine particles (less than 106 µm) than DAS (***Table 2***).

Table 2. Average Particle Size Distribution in DAS and CAS.

	Avg. Fraction of Particles Greater Than 212 µm	Avg. Fraction of Particles Less Than 106 µm
DAS	31%	36%
CAS	9%	55%

Extracellular Polymeric Substances

EPS extractions were completed using a modified heat method and analyzed for protein and carbohydrate content in the very loosely bound (VLB), loosely bound (LB), and tightly bound (TB) EPS fractions using colorimetric microplate assays. TB EPS closely surrounds the cells, LB EPS represents the second layer of EPS diffused from the TB EPS, and VLB is the soluble EPS in the bulk solution. The protein content of the extracted EPS components was determined using a BCA Protein Assay using colorimetric quantification of total protein at 562 nanometers (nm) (BSA Standard). Carbohydrate content was determined with the Phenol-Sulfuric Acid Method using colorimetric quantification of total carbohydrate at 490 nm (Glucose Standard).

Samples with SSVI30 less than 80 milliliters per gram (ml/g) were found to produce less EPS, while increases in EPS, particularly in LB fractions, correlated with an increase in SSVI30. The samples with the greatest fraction of particles less than 106 µm had large amounts of carbohydrate EPS. The proteinaceous to carbohydrate ratio (P:C Ratio) of the EPS content was found to correlate positively with Vo, meaning a greater amount of protein than carbohydrates in existing EPS increases settleability. Excess EPS, particularly LB carbohydrate EPS, had a strong negative correlation with Vo.

Literature indicates excess EPS can be caused by food-to-microorganism ratios that are either too high or too low, high substrate uptake rate in a low dissolved oxygen environment, unbalanced microorganism growth caused by high rapidly biodegradable chemical oxygen demand (rbCOD) and low nutrients, or high MLSS and intense aeration.

Rheology

Rheological properties of mixed liquor and return activated sludge

(RAS) were observed using a Brookfield DVT2 viscometer. Viscosity and shear rate were measured by the viscometer and used to calculate the shear stress. In activated sludge, sludge viscosity has an impact on pumping, hydrodynamics, mass transfer rates and sludge-water separation.

Results indicate there is a negligible difference in viscosity between DAS and CAS at typical MLSS concentrations, but at concentrations above 6,000 milligrams per liter (mg/L) DAS had a slightly lower viscosity

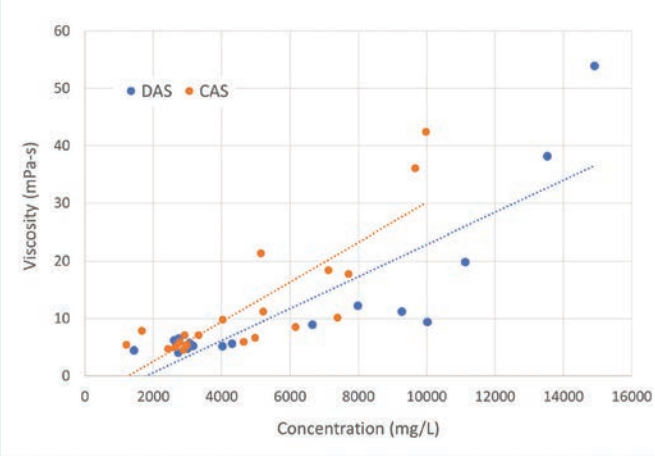


Figure 1. Viscosity in DAS and CAS samples at different solids concentrations. Viscosity units are in millipascal seconds (mPa-s). *Hazen and Sawyer*

(***Figure 1***). Therefore, DAS flow is not likely to be fundamentally different from CAS flow at typical MLSS concentrations.

Particle Strength

Particle stability also influences pumping and mixing design. Particle strength was determined by exposing the large particles (greater than 212 µm) to varying amounts of shear stress, and the "abrasion rate" was determined based on what portion of the large particles abraded into fines (less than 106 µm) when exposed to shear. The particles of the DAS samples were more resistant to abrasion, having a greater particle strength. These results can inform technology selection (e.g., mixing, pumping) and allow for understanding of how shear, due to pumping and mixing, might impact floc/granule composition.

DAS Study Findings

At this point in the study, findings indicate that DAS has consistently distinct characteristics compared to CAS across facilities nationwide. While DAS and CAS both behave rheologically as non-Newtonian fluids with pseudoplastic properties, DAS contained a greater proportion of large particles with less EPS content per mass of volatile solids. The larger DAS particles were also more resistant to abrasion compared to CAS particles. The team also looked for a simple and reliable way of obtaining secondary clarification modeling parameters. Settling behavior was characterized by measuring Vo and k using lab-scale columns and field settling columns.

Planning for the Future

As more samples are being characterized at the lab, a database of activated sludge properties for the participating plants is being built. Each sample received provides a snapshot of sludge properties at a certain point in time.

"Measuring activated sludge properties over time while plant performance and conditions change allows us to better understand what is happening in the secondary system. Collecting samples when the plant is performing well lets us work backward to see how properties change in the event of a performance upset," said Haley Noteboom, Hazen's lead researcher.

As the project moves forward, Hazen researchers will continue analyzing samples and expanding the database of DAS and CAS characteristics. The database will contribute significantly to the understanding and optimization of DAS and CAS processes in water resource recovery facilities. Regularly updated findings will provide practical guidance for plant operators, inform design choices, and pave the way for more advancements in DAS characterization and treatment.

Corresponding author Haley Noteboom is an assistant engineer with Hazen and Sawyer and may be reached at hnoteboom@hazenandsawyer.com. Co-authors are also with Hazen and Sawyer. Wendell Khunjar, Ph.D., PE, is an associate vice president and director of wastewater innovation. Gayathri Ram Mohan, Ph.D., PE, is an associate and regional director of water resource recovery innovation. Ronald Latimer, PE, is a vice president. Paul Pitt, Ph.D., PE, BCEE, is a vice president and wastewater process design director. Alonso Griborio, Ph.D., PE, is an associate vice president.

What Do Lava and Sewer Sludge Have in Common?

By Mary Durlak

Researchers pour lava from a furnace at UB's Geohazards Field Station. *Douglas Levere*

Originally published Aug. 14, 2023, in UBNow. Reprinted with permission from University Communications at the University at Buffalo.

The Buffalo Sewer Authority (BSA), established in 1935, cleans the wastewater produced by more than 500,000 people in Buffalo and several other municipalities. It operates the second largest wastewater treatment facility in New York state, located on Unity Island between the Niagara River and the Black Rock Canal.

Paul Harris, who earned his bachelor's degree in mechanical engineering at UB, is the superintendent of mechanical maintenance, working to improve the reliability and efficiency of every piece of equipment used to clean the wastewater. The process begins with a series of filtering screens and grit removal equipment, followed by four large tanks, called primary clarifiers, where solid waste, or sludge, settles to the bottom.

The clarifier effluent goes through a treatment process that includes both aerobic and anaerobic bacteria and a series of additional settling tanks to remove residual solids. Finally, it is treated with hypochlorite to kill any remaining bacteria before being discharged into the Niagara River.

The sludge that settles in the primary clarifiers presents different challenges. A series of pumps move the sludge through a process designed to treat and concentrate it, reducing the amount of sludge that must be burned at the facility's incinerators. Those incinerators are primarily powered by methane captured from a step in the treatment process in which bacteria "digest" some of the material, emitting methane in the process.

Large molecules called polymers are added to the sludge to thicken it, further reducing the water content. The thickened sludge passes through pumps that require extensive maintenance because some solid materials like sand and grit remain in the sludge, wearing out the pump's components prematurely. Harris began to look for pumps that could move the sludge more efficiently while requiring less maintenance.

As the search progressed, Harris brought it to the attention of Christopher Lowry, associate professor in the Department of Geology in the College of Arts and Sciences. Lowry had collaborated with Harris in ongoing BSA efforts to reduce stormwater runoff to the treatment plant. Lowry suggested that Stephan Kolzenburg, assistant professor of geology and an expert in volcanic flows, might be able to help identify some of the specifications for the pumps.

Different Fluids, Similar Properties

The molten rock that lies beneath the Earth's surface is called magma. When a volcano brings it to Earth's surface, it is called lava. Kolzenburg's work takes him and his students to volcanic eruptions around the world — most recently, sites in the Democratic Republic of the Congo and Iceland.

"What sludge and lava have in common is that they are both a three-phase mixture of gas, liquid and solids," says Kolzenburg. "Lava contains gases such as carbon dioxide and water-steam bubbles, liquid molten rock and solids in the form of crystals. Sludge also has gas, liquid and solids, but the materials that make up these phases are different."

Both sludge and lava have a property called viscosity — a measure of how hard it is for a fluid to flow. Centipoise is commonly used as the unit to measure viscosity.

The BSA initially considered a type of centrifugal pump that could handle sludge with viscosity as high as 3,000 centipoise. (For reference, maple syrup ranges between 150 to 200 centipoise.) But the pump still required excessive maintenance.

After Lowry introduced Kolzenburg and Harris, they decided to use a viscometer in Kolzenburg's lab. It had been custom-built to measure the flow properties of molten rocks, and Kolzenburg adapted it for measurements to obtain more detail about the sludge's viscous properties.

Because viscosity is a complex property, depending not just on the material itself but also variables including flow speed and temperature, the viscometer — able to characterize flow properties while varying these parameters — revealed valuable information for the pump selection process.

First, the viscometer revealed that the sludge's viscosity may reach up to 16,000 centipoise at low flow speeds — too thick for the pump under consideration to handle efficiently. Further, the data suggested to Kolzenburg that the sludge was behaving like a suspension that contains a polymer.

"That made sense," Harris said, "because we use polymers in this phase of the treatment process."

As a result, Harris and his industrial pump vendor began to search for another kind of pump. They found a possible solution with an enhanced centrifugal pump design that can move fluids that have a higher viscosity. Sean Morrison, one of the shift superintendents, worked with Harris during the initial pump trial that helped to identify appropriate process and equipment modifications.

Results to date have been promising. The initial test showed that this type of pump, with appropriate modifications, works more efficiently and requires less maintenance. The next step is to further tweak the proposed pump and run a pilot test.

"We're very hopeful that we're moving toward a solution," said Harris. "Collaborating with UB researchers has been extremely helpful."

Mary Durlak is a writer for UBNow, the daily faculty and staff online newspaper serving the University at Buffalo. Questions about this article may be directed to UBNow at ubnow@buffalo.edu.

Recognizing Value in an Open-Architecture Digital Water System for Research Projects: Managing Time Series and Big Data

By Shawn Dent and Pierre Mishra

Like much of the water and wastewater industry, research projects are experiencing a digital transformation. The management and visualization of "Big Data," specifically extensive amounts of time series data, can be a significant challenge. To meet this challenge, Carollo has developed an open-architecture, cloud-based solution to help researchers better collect, manage, analyze, visualize and integrate raw data to make data driven inquiries and decisions.

A Digital Water System (DWS) is a combination of software, database, web applications, and data pipelines forming an integrated system for organizing, processing and visualizing data. A DWS may manage many different types of data across an organization, however, this paper will focus on the management of the extensive amount of time series data that can be generated by any water/wastewater treatment research project.

Introduction

Many water and wastewater treatment research projects require the collection of significant amounts of data. In many cases, a Supervisory Control and Data Acquisition (SCADA) system is used to collect streaming data such as flows, concentrations, temperature, pH, etc. that are measured with meters and sensors. Researchers use databases to manage these continuous data. Data for other parameters that cannot be measured continuously are collected through grab samples, which are then processed in a laboratory and the measurements are returned to the researcher on a consistent basis. If the grab sampling data can also be integrated into the database with the SCADA data, a full picture of the monitored facilities can come into focus.

The volume of data can grow significantly as a research project progresses. Although spreadsheets have historically been used to manage datasets, they are limited in both functionality and data size. The use of spreadsheets for collection, management, analysis and visualization adds a significant amount of time to any researcher's budget and can distract from the ultimate purpose of the research project.

To overcome these limitations, a DWS can be developed and deployed to efficiently extract, transform and load (ETL) data into a cloud database, which can then be connected to industry standard dashboards. This approach not only facilitates data management, but also allows researchers to analyze and visualize the data across any time interval (e.g., minute, hours, days) and time period (e.g., June through September).

Approach to DWS Development

A DWS is generally defined as a combination of software, database and web applications to form an integrated system for organizing, processing and visualizing planning, operational and management of water-related data to help make data-driven decisions. Many research projects, such as development and testing of new treatment processes at a pilot level, may only be operated for a limited time period (e.g., months). With limited research budgets, these projects may not allow comprehensive data management software to be purchased and used, thus spreadsheets become the only answer to manage time series data. However, once the project is started, it can become apparent that a scalable system is needed to efficiently and effectively turn the raw data into information.

Existing Solutions

Desktop and cloud-based solutions do exist as commercial-off-the-shelf (COTS) software solutions specifically purpose-built for time series data and have been available for many years. However, these software packages can be expensive and beyond the budget of many research projects. These products have historically been desktop solutions that are charged per seat, but many vendors are now changing to the software-as-a-service (SaaS), or subscription, model.

The SaaS model does provide many advantages to a desktop solution. They are easier to maintain and update, they are potentially less costly if a monthly subscription can be used that ends after a year, and they usually provide 24/7 technical support. However, any COTS will have the limitation of analyses that are built into the software. If the software cannot readily be customized and configured (for example, directly using Python code), the researcher may then have to export certain data to be analyzed in a spreadsheet or an on-premises database such as one of the many versions of SQL database such as Microsoft SQL Server, PostgreSQL, MySQL and SQLite.

Selected Solution

To overcome many of the disadvantages of spreadsheets and COTS software, Carollo has developed an open-architecture structure using standard Microsoft cloud resources that can provide researchers (or entire utilities for that matter) a system to manage extensive amounts of data using a cloud database/tool, a dashboard and low-code programming. By not relying on a COTS solution, the researcher can store, manage, scale and share their raw data, QA/QC data, and analyzed time series data with a dashboard(s) through a web browser. Similar architecture can also be developed on other leading cloud providers such as Amazon Web Services (AWS) and Google Cloud Platform (GCP).

The cloud database (e.g., Azure SQL) acts as a central location (data warehouse) to compile select data from each individual on-premises database. This can be accomplished in many ways, but the use of Azure SQL and other Azure tools (e.g., Azure Blob Storage, Azure Databricks, Azure Data Factory) in the cloud now provides a very efficient way to create a data processing pipeline to:

- ingest select data from multiple on-premises systems and other data sources
- transform and blend that data together
- analyze the data
- create star-schema data models to visualize through dynamic dashboards
- help develop new insights

Using Azure cloud data tools coupled with Power BI Pro is an extremely efficient, inexpensive and flexible way to process and share data. With the simple use of a web browser to access these cloud dashboards, researchers have the data and information in one location so they can blend, analyze and extract data to make it easier to develop informed results.

To define the key issues that need to be incorporated into the planning, design and construction of a DWS, design and performance criteria were developed (***Table 1***). The goal is to develop a DWS that adheres to as many of these requirements as possible.

The DWS can be described using an organized interconnected system of six elements that are common to any DWS. These elements include collection, management, analytics, visualization, integration and security. Whether a project is small or large, straightforward or complex, these

continued on page 44

continued from page 43

Table 1. General DWS Requirements.

Requirement	Description of System Requirements
Maximize use of Non Proprietary Applications	Limit custom programmed apps. Thoroughly document any programmed apps (e.g., custom APIs).
Maximize No Code/Low Code	Use COTS software as much as possible (e.g., drag and drop features of Power BI).
Use Standard Technology	As much as possible, use technology that is "standard" within the industry (e.g., Microsoft Azure, PowerBI).
Provide Transferability	DWS should be easily transferable from developers' cloud to client's cloud at the end of project.
Maximize Accessibility	Dashboards, editing applications, online GIS, etc. should be easily accessible to the client and project teams using a standard web browser (e.g., use of a landing page and URLs to access dashboards).
Provide Scalability	Database used for DWS should be easily scalable to accommodate future data types, quantities and qualities.
Maximize Efficiency	System must work quickly and serve data to multiple users (with little lag) no matter the size of the database.
Provide Flexibility/ Interoperability	System can easily be connected to outside software systems through I/O exchange (such as COTS or custom programmed apps).
Provide Mobile Options	Dashboards and apps work on desktop computers as well as mobile devices with minimal reworking.
Maximize Security	Minimize threats in the system that could potentially cause data breaches, especially when data is exchanged with outside applications.
Start with Low-Cost Solutions	Start with inexpensive solutions and move to higher cost COTS and custom software when prudent.

six elements are critical to help define detailed data framework components that make up successful digital water research projects.

Structuring the DWS with Azure cloud (database and tools) as the "hub" and the other applications as the "spokes" provides for maximum flexibility and scalability. Purpose-built software used in a research project (e.g., SCADA, web Data, IoT and LIMS) move data in one direction to the database hub. Data leaving the hub is mainly connected to visualization applications (e.g., dashboards, reporting software).

The two-way data exchange with the hub is included for analytical models (e.g., statistics, models, AI/ML). This two-way data exchange is an important feature because an analytic engine, model, or algorithm can be separated but integrated in this space to connect directly with the database. By reading input/output (I/O) data, and performing complex computations outside the database, the two-way data exchange provides extensive flexibility in using any model with this DWS framework. Any other analytic engine (algorithm) where data can be input from the cloud and output returned to the cloud can work. It also allows other specific data (e.g., SCADA data) to be pushed to the models through the database and could provide for near real-time analysis and projections. ***Figure 1*** illustrates one example of how these systems can be integrated to form a DWS for research projects.

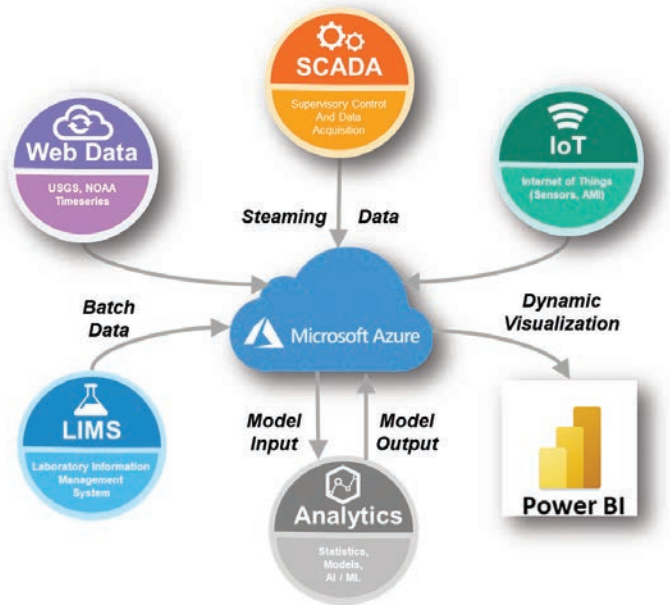


Figure 1. DWS interconnected system and dataflows. *Carollo Engineers*

Results

A "use case" in this DWS refers to an individual application that was developed to fulfill specific needs, such as management of multiple sources of data for a research project. Defining this use case helps develop data pipelines, dashboards and a data warehouse that serves specific data to each dashboard. Raw data was stored in Azure Blob Storage, which is used as a data lake to dump all types of structured and unstructured data in their original formats. Data was transformed and analyzed using low-code ETL tools, such as Azure Data Factory or Python/R scripts in Azure Databricks, where low-code ETL was not sufficient due to complex logic and advanced mathematical needs. Data was cleaned and transformed into star-schema tables and was stored in Azure SQL as the backend database. Power BI Pro was used to develop dashboards that connect to this database. This whole data pipeline was orchestrated and scheduled using Azure Data Factory. The data pipeline and dashboards were both developed in or published to the cloud.

The dashboard provides research personnel with better consolidated and reported information, allowing them to see historical trends as well as data in near real time. The researcher chooses the minimum time interval of the time series data (e.g., one hour). Lab results will be included as they are completed (e.g., one day). The SCADA data and lab data can then be integrated so that researchers can examine any parameters measured or sampled at the pilot facility in one tool.

Figure 2 illustrates two tabs within a dashboard used to analyze and visualize data coming from a SCADA system and lab results. The data for this dashboard includes hourly time series data measured at three treatment facilities for over two years, for 34 different parameters. The hourly data are automatically averaged from one-minute data that is measured by the SCADA system (and stored in the SCADA historian database). The SCADA data are then automatically averaged into daily, weekly, monthly and yearly trends. In this case, water quality, flows and precipitation are included in this one dashboard.

The top graphic in Figure 2 shows three measured time series of hourly data for the month of January 2023 measured by a SCADA system and automatically transferred to the DWS every night. The top trend illustrates dissolved oxygen, the middle is flow at the outfall, and the bottom is precipitation. Using this one screen, the user can select any time period between January 2022 and present date (the data are automatically updated every night from the SCADA and LIMS). The user can then select which treatment facility (or train) they want to examine and select a water quality parameter and a flow. These historical trends will help the researcher identify historical patterns in their data and analyze specific variables that will assist in the research objectives.

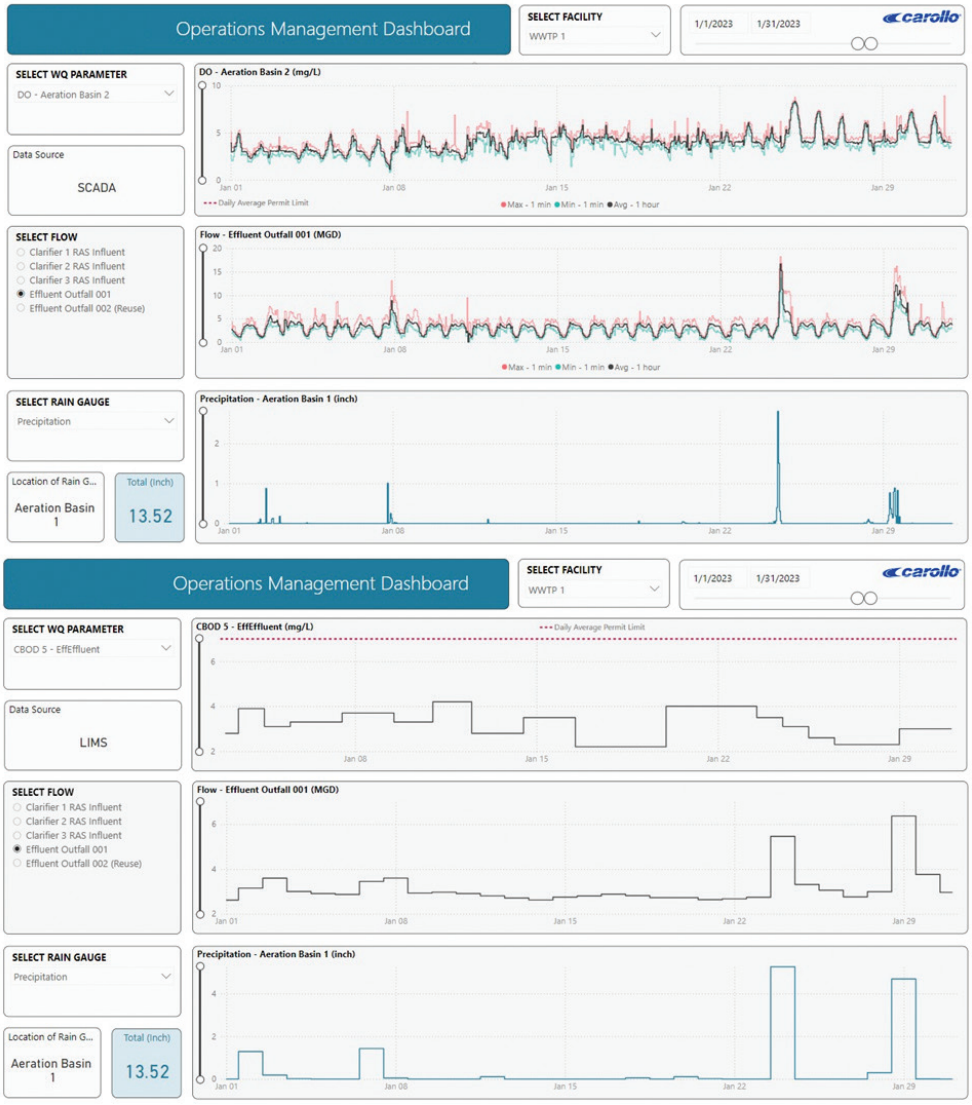


Figure 2. Flow and water quality dashboard examples. *Carollo Engineers*

The bottom graphic in Figure 2 is the same dashboard but is shown in another tab where the data are averaged to daily intervals. The top graph has been changed from dissolved oxygen (DO) to carbonaceous biochemical oxygen demand (CBOD) since CBOD is sampled every two to three days. Any parameters that are measured at the lab are transferred to the same database and therefore can be displayed in the same dashboard along with SCADA data. By visualizing both SCADA measurements (online sensors) and lab measurements on a daily basis, the trends can be further analyzed at any scale. The dashboard also automatically calculates daily, weekly, monthly and yearly averages each night from the hourly data.

The two tabs of the dashboard shown in Figure 2 are just one example of how big data can be managed and visualized with a DWS. An Azure cloud-based solution can be a very effective tool to process, store, analyze and visualize the extensive amounts of time series data that are generated by many research projects. An open architecture system can provide the researcher and colleagues with a more efficient and cost-effective tool to analyze time series data to better draw conclusions about pilot treatment systems.

Shawn Dent, PE, is the principal technology lead for digital water and vice president with Carollo Engineers in Boston, MA, and may be reached at sdent@carollo.com. Pierre Mishra is an analytics and data engineer for the Digital Water Group with Carollo Engineers in Los Angeles, CA, and may be reached at pmishra@carollo.com.

Believe It or Not . . . Hard-to-believe yet True Stories in Our Profession

By Richard R. Roll and Hubert W. Schlientz

Robert Ripley started telling stories about fantastic people, places and events in single-panel newspaper bits. Over time, and since his passing, the stories have expanded to include books, radio shows, TV programs, museums and amusement centers.

There are also a great many hard-to-believe yet true stories in our profession. Here are a few of ours that we would like to pass on, and perhaps get you thinking about telling your own experiences to others.

Thievery Thwarted

Protection from vandalism and break-ins at remote lift stations is a continual challenge. In one instance, intruders connected an overhead crane hook to a pump's 400 horsepower motor and attempted to lift it off its base … while the motor was operating! Fortunately, the safeties on the crane tripped out first. Imagine the mentality of someone standing next to a corral of 400 angry horses and trying to kick the gate open!

The Laws of Physics

A preconstruction site walk was being held with the general contractor, his subcontractor, the owner's representative and the construction inspector. The subcontractor explained his plans to use a vacuum truck at ground level to loosen and remove debris from a large, surcharged rock interceptor tunnel … over 30 meters (100 feet) below ground level! After a pause, the inspector skeptically said, "You still have to make a believer out of me." The general contractor, responsible for performance, echoed the same concern.

We're Ready Now

Delays had been accumulating for the scheduling of surface wipe testing at a manufacturing facility. Eventually the owner's representative called the coordinating consultant to say the testing could commence … now that repainting of all the surfaces was completed!

Heads Up

There's an old saying: Don't flush the toilet when the train is in the station. Some larger pumping station lavatories discharge directly into their wet wells, usually an efficient arrangement. Except … when the wet well is offline, and workers are performing repairs within! One incident was enough to place everyone on guard and prevent a reoccurrence.

Party Central

Inspecting combined sewer overflow tunnels can uncover quite a variety of objects and debris. Finds can include marbles, plastic products, bones and nylons. One rough-cut rock tunnel with prominent ledges on the sidewalls held an impressive collection of tea candles and beer bottles! Apparently the cool and concealed environment provided an inviting private party spot for some local youth … at least in dry weather!

Can't Find Good Help These Days

Construction of a municipal facility required test construction of a masonry wall by candidate subcontractors. The first subcontractor tried and failed to pass acceptably. The second subcontractor tried and failed. Then the third subcontractor tried, with the same results. Finally, the prime contractor had enough … they personally bulldozed the three flawed walls and constructed the structure themselves!

Microcassette recorders with turning spindles were the norm back in the 1980s. *Rick Roll*

Budgeting Woes

Two municipalities were meeting to settle a specific monetary dispute. One attorney stated his confidence that the opposing party had already decided that they owed his client a settlement. The opposing attorney asked how he came to this conclusion. The first attorney replied that funds for the claim settlement were already allocated in the opposing municipality's general operating budget! No further progress was made that day.

Say It Again, Only Louder

An on-site meeting was being held to resolve a minor dispute that arose during construction. Partway through the meeting, a utility staff member observed an operating tape recorder atop the contractors file folders (yes, microcassette recorders with turning spindles were the norm back in the 1980s). Needless to say, the meeting came to an end when everyone was made aware of the recording! Conversation recording laws vary state-to-state; it is worth knowing them ahead of time and remaining vigilant.

The Cat's Meow

A resident complained that noise from a nearby tunnelling project was disturbing her cats, which would regularly go into a frenzy at 3 p.m. every workday. The inspector visited the resident to discuss her concerns toward the end of the day shift. As the time approached 3 p.m., one by one the cats started to show up and sit on the floor around him. Eventually there were seven sets of eyes patiently staring at him! No noises, no frenzy … and no more complaints, feline or otherwise!

Back in the Day

Need to subtly communicate a between-the-lines sentiment? There was

a letter to a regulatory representative that purposely had salty language whited-out on the hard copy before it was mailed via "snail-mail." … Yes, holding a bright light to the back side of such a letter reveals what was typed beneath the white-out!

"Creative" Problem-Solving

One pipeline contractor refused to go to the effort of installing well-point dewatering to deal with poor soil. His attempts to use conventional trenching with fabric resulted in pipe settlement of 15 centimeters (6 inches) overnight. This required the pipeline contractor to uncover and remove the pipe the next day and try again. After repeated failures with this approach, the pipeline contractor assured the construction manager that he'd come up with a good solution.

The next day, as the pipe was going in, the surveyor warned the construction manager that the grade was off and that the pipe was 15 centimeters too high. The pipeline contractor explained that this was his solution … by tomorrow the pipe would settle down into place! Unimpressed, the consultant appealed to the bonding company who replaced the pipeline contractor with someone less imaginative.

They Won't Miss It

A new building was being erected at a water resource recovery facility. The bricklayer was instructed to match the brick style and color of the existing plant structures on the new building. As construction was finishing up, the bricklayer realized he was a half pallet of bricks short. Noticing a nearby brick planter … the bricklayer deconstructed the planter to make up for his shortage! That afforded the owner the opportunity to prepare an epic and entertaining reprimand letter to correct the judgement lapse and have both structures completed.

One Way to Get the Point Across

A sewer cleaning project required bringing a large volume of sediment to the surface for draining and disposal. One resident of a nearby apartment building contended that fumes from the work were concentrating in her building and making her ill. A survey of the other residents found no other complaints. Dissatisfied with the results, the complaining resident emphasized her point … by vomiting over the inspector's vehicle!

My Project, My Rules

Remember the other Golden Rule: The one who has the gold makes the rules. On one large project the utility owner didn't just interview the candidate consulting firm's employees ... the utility owner also had influence over specific tasks assigned to them as well as their compensation from the consulting firm!

Grabbing the Bull by the Horns

Once there was a pumping station rehabilitation project where the general contractor went bankrupt halfway through. You can imagine the complications and concerns this created. One issue centered around the pumps and motors that were now left in unsecured storage at the bankrupt contractor's former place of business. Cutting through red tape and delays, the replacement contractor simply arrived at the unlocked outbuilding, loaded up the equipment, and transported the project materials to their shop. Cowboy antics or taking the initiative, it depends on your point of view!

Getting Around to It Eventually

An investigation into an apparent sewer obstruction uncovered a huge bulge-up from the invert, apparently caused by cold groundwater infiltration deforming a cure-in-place liner inward before curing was complete. Not the first time this has occurred anywhere, but … the post-construction video inspection tapes from 20 years earlier clearly showed the deformation! How and why was this left uncorrected?

Inspector Grimm pranks again! *Scott Jarvis*

Good Intentions

Public hearings are necessary for many of our projects. At one, the consultant was describing the environmental benefits of switching from septic tanks to a community sewer collection and treatment system. One resident became extremely upset when he found out that, despite paying extra for his oversized residential septic tank, the degree of additional treatment this afforded was negligible!

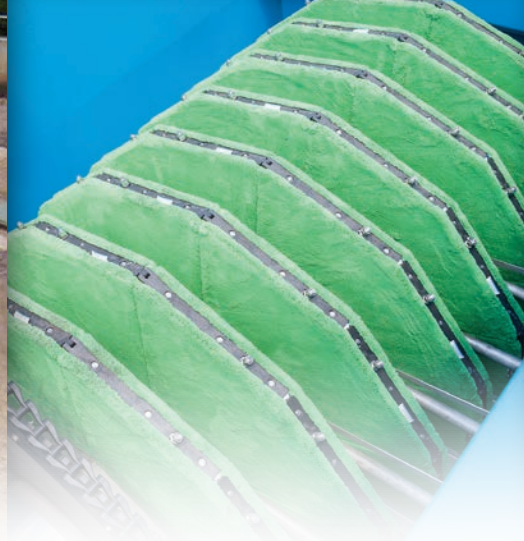
Workplace Pranks

How dull would the workplace be without occasional pranks, courtesy of your colleagues? One guy made the mistake of telling his officemates about a bat that found its way into his bedroom the night before, leaving him with scratches on his neck during the struggle to contain it. When he returned from lunch that day, he was greeted by a cardboard coffin, garlic, a crucifix and wooden stakes! One buddy claimed that he had no reflection in a hand mirror … but neglected to document it.

We expect these recollections have triggered some memories of your own; maybe you would consider sharing them with the rest of us?

Richard R. Roll, P.E., DEE, recently retired from full-time practice after 38 years in the water and wastewater field. Hubert W. Schlientz Jr. has been a construction inspector for 50 years.





TOTAL WATER MANAGEMENT SOLUTIONS



ADVANCED TREATMENT FOR CHANGING DEMANDS

Aqua-Aerobic Systems, Inc. provides advanced water and wastewater treatment technologies for both municipal and industrial applications. From primary treatment to nutrient removal, water reuse and disinfection, there's an Aqua-Aerobic solution that meets or exceeds the most stringent effluent objectives.

Aeration & Mixing | Biological Processes | Cloth Media Filtration | Membrane Systems | Process Control & Monitoring | Disinfection

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company
www.aqua-aerobic.com | 815-654-2501

SCAN ME

Represented By:

GP Jager Inc.

Corporate Office | PO Box 50, Boonton, NJ 07005
P 800.986.1994 | F 973.750.1181
info@jagerinc.com | www.jagerinc.com

Buffalo, NY Office | **Ryan Boshart**
P 716.697.5543 | rboshart@jagerinc.com

Syracuse, NY Office | **Dave Boshart**
P 315.256.3071 | dboshart@jagerinc.com

Upstate NY Consultant | **Randy Ott**
P 315.506.2137 | randyott@jagerinc.com

EMERGING CONTAMINANTS TASK FORCE
OCTOBER 2023 UPDATE

NYWEA has taken steps to understand and address pending legislation and regulatory policies related to emerging contaminants such as per- and polyfluoroalkyl substances (PFAS) compounds and 1,4 Dioxane. As part of NYWEA's efforts, an Emerging Contaminants Task Force was established in June 2023. Given how rapidly changes are happening in regulating some of these compounds, the Task Force would like to periodically share key information with our members. Below is an update on NYSDEC's latest actions and helpful resources.

PFAS Update

The New York State Department of Environmental Conservation (NYSDEC) has been addressing specific PFAS compounds and 1,4-Dioxane in our state waterways, and will be acting in the near future to continue to address these contaminants. Their actions are scientifically based and focused on waterways that are also a source of drinking water. **So far in 2023, NYSDEC has:**

- **Issued a new Technical and Operational Guidance Series (TOGS) 1.3.13 Industrial Permitting Strategy for Implementing Guidance Values for PFOA, PFOS, and 1,4-Dioxane** (see **https://www.dec.ny.gov/docs/water_pdf/2923togs1313.pdf**). This affects individual Industrial SPDES permit holders. As part of this effort, NYSDEC Department of Water (DOW) has already sent out Requests for Information (RFI's) to approximately 50 major facilities (10,000 gallons per day of sewage effluent or more) discharging into drinking water sources.
  - These dischargers have 150 days to respond to the RFI.
  - The data request and submittal are not part of the discharge monitoring reporting (DMR) system.
  - Approximately 500 smaller (minor or non-significant) industrial dischargers upstream of a drinking water source will receive RFI's in the future based on the priority industrial sectors identified in TOGS 1.3.13. (e.g., car washes)
- **Established ambient water quality guidance values for PFOS, PFOA and 1,4-Dioxane** (see the Addendum to TOGS 1.1.1: Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations **https://www.dec.ny.gov/docs/water_pdf/togs111addendum2023.pdf**)
- **Updated SPDES Permit Application Forms NY-2A and NY-2C.** In May 2023, NYSDEC modified these forms to include monitoring for 40 PFAS compounds (as measured by USEPA Analytical Method 1633) and 1,4-Dioxane.
- Along with the State University of New York College of Environmental Science and Forestry (SUNY ESF), **has initiated monitoring of POTWs influent/effluent and biosolids for PFAS compounds** (target POTW have approval or are seeking approvals for biosolid reuse).
- **Has expanded pilot efforts for the DEC ambient water monitoring program to include PFAS compounds** in the routine ambient monitoring program.
- **Issued DMM-7 Biosolids Recycling in New York** – Interim Strategy for the Control of PFAS Compounds targeting sampling and potential prohibiting biosolids recycling based on PFOA/PFOS concentrations.

NYSDEC plans in the near future

- Issuing a draft TOGS 1.3.14 that covers POTW Implementation Strategies for PFOA, PFOS and 1,4-Dioxane (tentatively, Fall 2023).
- New or newly modified permits with wastewater from identified priority industrial sectors will include short-term monitoring for 40 PFAS compounds and 1,4-Dioxane consisting of 4 samples over a course of a year (POTWs) or for 3 consecutive months (industrial).
- Facilities performing beneficial reuse of biosolids at permitted 361-2 and 361-3 locations will be requested to sample biosolids, plant influent, and treated effluent for emerging contaminants. NYSDEC Department of Materials Management (DMM) is moving forward on requiring solid waste landfill leachate receiving treatment onsite in lieu of raw leachate being discharged to POTWs.

Helpful links

NYSDEC's Emerging Contaminants in NY's Water page provides a summary of Department of Water's actions to date regarding specific PFAS compounds and 1,4 Dioxane, and links to additional information, including many of the documents referenced above. This page is found at **https://www.dec.ny.gov/chemical/127939.html**

NYSDEC's Per- and Polyfluoroalkyl Substances (PFAS) page provides general information regarding PFAS and why there are a concern and steps NYSDEC is taking to address PFAS. This page is found at: **https://www.dec.ny.gov/chemical/108831.html**

NYSDEC Sampling, Analysis, and Assessment of Per-and Polyfluoroalkyl substances (PFAS), Under NYSDEC's Part 375 Remediation Program, April 2023 is found here: **https://www.dec.ny.gov/docs/remediation_hudson_pdf/pfassampanaly.pdf**

A look at possible prioritized facilities can be found in this NYSDEC database, here: Division of Water PFOA, PFOS, and 1,4-D Information Portal **https://nysdec.maps.arcgis.com/apps/webappviewer/index.html?id=3f0b007925f14f418a605396b0c4015b**

If you should have any additional questions, please feel free to reach out to NYSDEC at **EmergingContaminantsDOW@dec.ny.gov.**
NYSDEC representatives have been and are providing updates at various local chapter meetings and conferences.

Preserving an Iconic Beach for Future Generations: Coney Island Turns 100!

By JoAnne Castagna

When Rifat Salim came to the United States from Pakistan as a young girl with her mother and siblings to reunite with her father after years of being apart, one of the first places he suggested they visit was Coney Island — a famous beach and amusement park destination in Brooklyn, New York City, that's visited by more than 5 million people annually.

She said, "Me and my brother and sisters were excited to go to the beach. We were wearing our ethnic clothes because we don't wear bikinis. When we got there, we ran towards the beach and put our feet in the cold water. I remember to this day the feeling of water and sand slipping away from my feet. It was a wonderful experience."

Coney Island was Salim's first impression of America and would continue to play a role in her life. After getting her citizenship, she became an engineer and now works for the U.S. Army Corps of Engineers, New York District, an agency that's helped to preserve this beach for future generations, including her own children.

The Army Corps does this not just because the beach is historic, but more importantly because it plays a role in protecting the community from coastal flooding and sea level rise.

History of Coney Island

Coney Island is a peninsular neighborhood of around 115,277 residents and is located on the southwestern section of the New York City borough of Brooklyn. The area is about 4 miles long and a half a mile wide and includes Coney Island Proper with Brighton Beach and Manhattan Beach to its east and Sea Gate, a private gated community, to its west.

The waterways in and around the peninsula include the Atlantic Ocean and Lower New York Bay to the south and west, and the Gravesend Bay and Coney Island Creek to the northwest.

Coney Island Beach extends 2.7 miles along the south shore of the peninsula and has a boardwalk that extends from Coney Island Proper to Brighton Beach.

Panoramic image of a portion of Coney Island Beach and amusement park May 2023. *JoAnne Castagna, Public Affairs*

The beach turns 100 years old this year and for the past century, the Army Corps has played a significant role in preserving it in collaboration with partnering agencies. Following is a brief history of the famous destination and the work the Army Corps has performed and continues to do today.

The Early Days

In the late 19th century, Coney Island was America's biggest and most visited seaside resort and amusement park destinations, boasting some of the largest and most luxurious hotels in the country, fancy fish houses and racetracks. It was so internationally famous that it was compared to the Eiffel Tower in Paris and the pyramids of Egypt.

The destination attracted millions of visitors annually to its several competing amusement parks that included Steeplechase Park, which had mechanical horses that carried guests around the grounds; Luna Park, which was considered a genuine fantasyland with large towers and camel and elephant rides; and Dreamland, in addition to many independent amusements.

Some of the attractions were so large that immigrants arriving from Europe by ship could see them from the water during the years before the Statue of Liberty was built.

Coney Island was also a place that showcased innovations. For example, it was the first place that many people experienced lightbulbs for the first time. In fact, Luna Park had 1,300,000 electric lights that enabled visitors to have fun for hours after dark.

The public's amazement of the park's lights even continues today. Salim said of her first visit there, "In the evening, it got so bright from all of the lights from the amusement park. It felt so festive."

Coney Island is also where modern American amusement was invented and was the first place to have rides, including having the very first roller coaster in the United States named the Switchback Railway.

In addition, Coney Island had the Wonder Wheel, a 150-foot-tall steel Ferris wheel; the Cyclone, a roller coaster with an 85-foot, 58-degree drop; and the 262-foot-high Parachute Jump. All of these attractions still exist today and are historic landmarks.

At this time, the beach at Coney Island was owned by adjacent landowners, but in 1923 it officially became a public beach and was expanded.

The New York City Department of Parks and Recreation increased the size of the beach by pumping sand onto the shore to build up the existing bathing area.

In addition, a boardwalk was constructed and named in honor of then Brooklyn Borough President Edward Riegelmann. This was done by erecting concrete piles and pile caps out in the water and laying timber stringers and decking.

This new boardwalk, as well as new subway service in the 1920s, helped to draw more visitors.

During this time, the park started to feature many sideshows and entrepreneurs, such as Nathan Handwerker who started selling hot dogs for a nickel; his business would eventually turn into the Nathan's Famous hot dog chain known today.

The Coney Island Beach boardwalk buildout in 1922. *Edward E. Rutter (Borough President Brooklyn Collection. NYC Municipal Archives)*

Mid-to-Late 20th Century

From the mid-20th century to the 1970s, Coney Island experienced a slowdown in its popularity but work still continued on maintaining the beach.

During the 1940s and 1950s, the Parks Department constructed boulder jetties off the beach to extend wooden ones already there to slow down erosion of the shore.

Jetties are long, narrow structures that protect the shoreline of a body of water by acting as a barrier against erosion from currents, tides and waves.

Sand erosion of the beach is a natural occurrence. Beaches naturally lose sand over time due to wave action and longshore currents. When hurricanes and coastal storms occur, breaking waves and elevated water levels can change the width and elevation of beaches and accelerate erosion, which can make a beach community vulnerable to storm risks.

During this time, the Parks Department also altered the boardwalk to accommodate the New York Aquarium that was relocated from Battery Park in Manhattan.

The aquarium still exists today, and Salim takes her children there often. She said, "My kids love to visit and observe sea animals, such as sharks, stingrays, dolphins, whales, and various fish."

Salim isn't the only Army Corps employee that has a connection to Coney. Years ago, Steve Weinberg lived in Coney Island and worked for the aquarium before he became an engineer for the Army Corps.

He said, "In the 1980s I was responsible for feeding the aquarium's Osborne Laboratory tanks and cleaning them on the weekends and during the summer." He's worked for the Army Corps for 35 years and today is the Chief of Civil Works Section, New York District, U.S. Army Corps of Engineers.

Weinberg added that they were expanding the aquarium while he worked there and during the construction that took place on the old Dreamland property, a lot of history was uncovered.

He said, "I've always loved the history of Coney and during the construction many interesting things were unearthed including old cups and bowls, a giant compressed gas tank that required calling the bomb squad, the foundation of one of the park's towers, and perhaps most mysteriously — a small boat found in the middle of the beach! Was it buried by rum runners? I eventually learned that most of the beach was artificial and constructed in the 1920s. Presumably the boat had sunk in the ocean and was buried when the city had built the beach."

Expansion of the beach continued in the 1960s, when the Parks Department extended the bathing area and boardwalk further east into the Brighton Beach area and constructed a public restroom. Several years later more public restrooms, new lifeguard stations, and a shade pavilion were established.

Brooklyn Borough President Howard Golden began replacing the boardwalk's decking in phases in the 1980s and this work continued over the next two decades.

Coney Island Shoreline Protection Project

In the early 1990s the Army Corps began working on the beach in collaboration with the Parks Department and the New York State Department of Environmental Conservation. They started the Coney Island Shoreline Protection Project to restore the beach that was eroding and was putting the coastal community at risk.

The Army Corps restored approximately 3 miles of the beachfront with dredged sand — increasing its height and width — and created dunes.

Replenishing sand and creating dunes on a beach can help to reduce future coastal storm risks. A beach's size, shape and sand volume help determine how well the beach can reduce risk to a developed community during a storm. Sand and dunes act as a buffer between the waves and stormwater levels and structures landward of the beach.

To slow down future beach erosion, the Army Corps placed 600 tons of stone and approximately 35,000 cubic yards of sand adjacent to a groin located on the western portion of the Coney Island peninsula in Sea Gate.

Groins are shoreline structures that are perpendicular to the beach that are designed to retain sediment from moving along the shore and help maintain the wide beaches by minimizing or slowing down erosion.

Placing stone and sand adjacent to the groin will help prevent storm induced waves from reflecting off the sides of the groin sideways along the shore, causing the shore to erode further.

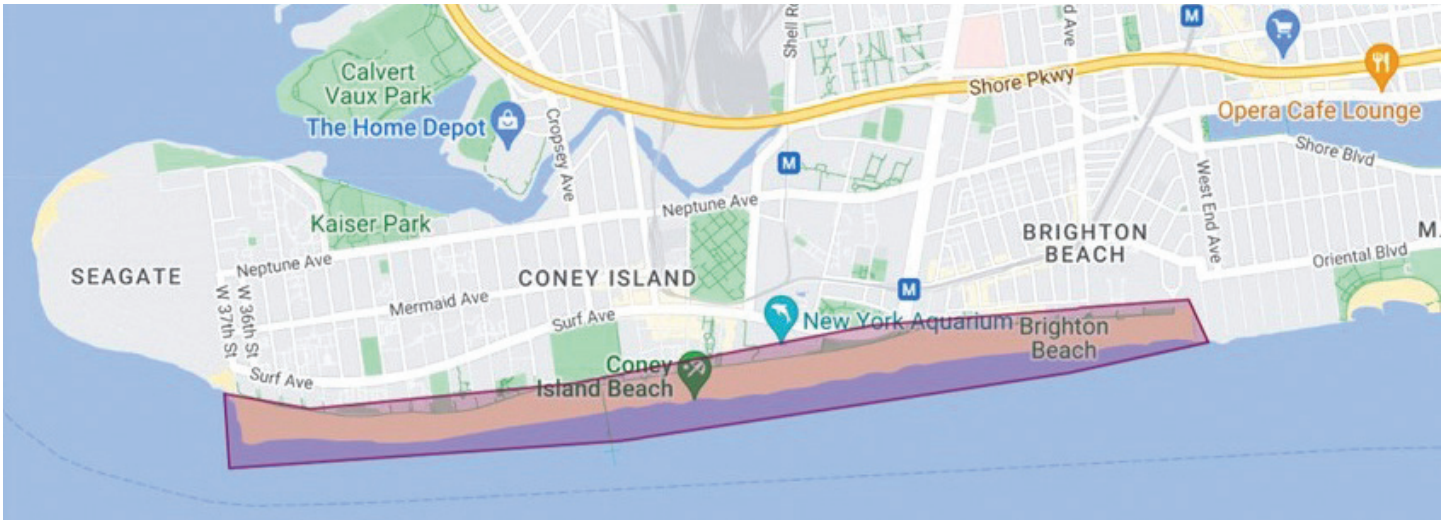
In 2001, a stone revetment was constructed near this groin to further slow beach erosion. A stone revetment is a wall that protects against erosion caused by wave action, storm surge and currents.

Hurricane Sandy

From the mid-20th century on, Coney Island went through some ups and downs — much like the rides it's famous for — that included World Wars, the Great Depression and urban change.

Even so, Coney Island, has proven to be resilient and in the early part of the 21st century was experiencing a revitalization that included constructing many new businesses and attractions, such as a new Luna Park on the grounds of the original amusement park and a new baseball stadium.

continued on page 53



Area Map of the Coney Island Shoreline Protection Project. *USACE*

continued from page 51

However, just as things were picking up for the historic park, it faced a new challenge in October 2012 — Hurricane Sandy, a storm like no other. Sandy's intense winds created an unexpected storm surge that created 14-foot-high waves that pushed sand and water up and over the boardwalk, merging with water from Gravesend Bay and Coney Island Creek, inundating the entire peninsula from every direction.

Almost every establishment was flooded with water and sand including the amusement park, aquarium, the subway system and the Coney Island Hospital, as well as many houses and high-rise apartment buildings.

The most destructive storm to arrive in New York City in recent history, Sandy left 43 New Yorkers dead and many without power, heat and hot water for months.

Immediately after the storm, the Army Corps was on the ground responding, both through its own response authorities and providing disaster response assistance for the Federal Emergency Management Agency.

Sandy's devastation also included extreme erosion of the shore, putting the Coney Island community vulnerable to future storms. Coney Island Beach lost 600,000 cubic yards of sand.

The Army Corps received funding and authority to restore Coney Island with the Hurricane Sandy Disaster Relief Appropriations Act of 2013 or "Sandy Bill."

The bill authorized the Army Corps to not only repair engineered beach projects by replacing the sand lost during Hurricane Sandy, but also to restore them to their original design profiles.

Anthony Ciorra, chief of the coastal restoration and special projects branch with the New York District, U.S. Army Corps of Engineers, said, "In 2013, approximately 580,000 cubic yards of sand was placed onto Coney Island Beach, to repair damages caused by Sandy and to restore the project to its authorized design condition." Ciorra was the project manager for the Coney Island Shoreline Protection Project from 1995 to 2004.

Takeaways from Sandy

After Sandy, the Army Corps examined its beach nourishment projects across the northeast United States, to identify what projects were more effective in reducing storm risk to the shore communities.

Ciorra said, "The analysis showed that the communities located near beaches that had previously received beach nourishment and dune construction sustained less damages and saved billions of dollars in avoided damages."

Coney Island Beach was one of these beaches. The beach's sand was elevated to protect against storm surge and erosion. Hurricane Sandy's surge pushed sand and water up and over the beach's boardwalk, but the impacts behind the constructed project were not as bad as they could have been. "The beach's higher elevation avoided an estimated $494 million in damages to houses and structures," said Ciorra.

In 2016, the Army Corps performed additional measures in Sea Gate, to further reduce erosion. This work included constructing four stone groins and placing 75,000 cubic yards of dredged sand around them, as well as placing stone near an existing groin.

In addition, an existing dike received additional stone armoring. A dike is an onshore structure that protects low-lying areas against flooding. They are usually built as a mound of fine material with a gentle seaward slope in order to reduce the wave run-up and the erodible effects of the waves.

Lastly, accumulated sand was removed from in front of several bulkheads or retaining walls along the water. A retaining wall helps to stabilize a shoreline.

Coastal Storm Risk Management

After Hurricane Sandy, Coney Island bounced back, and the parks were able to reopen the following year, making that year's annual Mermaid Parade and Nathan's hot dog eating contest extra meaningful for visitors.

However, the Army Corps' work has not ended. It wants to make sure that the area can better withstand the wrath of future Sandy-like storms and sea level rise, so it's created the New York and New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study. The study provides a full range of coastal risk reduction measures for communities to contemplate and provide feedback on to the Army Corps.

The Coney Island Beach community has provided its feedback on the study that would affect every part of the peninsula. On the northside of the peninsula, sea walls, flood walls, and levees would be tied into a mechanical tide gate storm surge barrier to close off Coney Island Creek to prevent flooding. On the southside of the peninsula, the boardwalk would be raised 5 feet by adding a concrete walkway to prevent flooding from storm surge.

A Bright Future

This year, Coney Island Beach turns 100 years old and with the Army Corps' work it's sure to continue to be an iconic destination for future

continued on page 54

Aerial image of the Sea Gate portion of the Coney Island peninsula showing the completed T-groins in 2016. *USACE*

continued from page 53

generations and most importantly a safe place to live with the reality of more frequent stronger storms and sea level rise.

Ciorra said, "The most rewarding part of working on Coney Island for me was restoring an historic beach that benefits the local traditionally underserved communities in terms of providing coastal storm risk management measures to reduce the threat to life and property, as well as provides recreational opportunities."

Weinberg said, "Part of the honor of working for the Army Corps is how quietly and anonymously we do so much to preserve peoples' lives and property. My father, who lived in Coney Island, was also proud of our work. He's watched the Army Corps work from his terrace and called me every day with progress reports. My hope is that the beach continues to help protect people, and that it remains a place where a teen brings their date for day of fun and where a mother takes her children body surfing."

Today, Salim is one of those mothers. She takes her children to Coney Island every summer. She said, "There's so much to enjoy – the beach, rides and the aquarium. On the beach, the kids love to dig in the sand and pull out mole crabs. In fact, because of our frequent visits to the beach and aquarium, my teenage daughter has developed a strong passion for marine biology and is ecstatic about the possibility of volunteering for the New York Aquarium this summer."

She added, "Something we never miss during the summers is Coney Island's annual fireworks show on Independence Day, the Fourth of July." For a first-generation American who was greeted to this country by Coney's waves washing up and over her feet, this seems appropriate.

New York Aquarium on the Coney Island Boardwalk, May 2023.
JoAnne Castagna, Public Affairs

JoAnne Castagna, Ed.D., is a public affairs specialist and writer for the U.S. Army Corps of Engineers, New York District. She can be reached at joanne.castagna@usace.army.mil.

Coney Island History Sources:

Coney Island: *The History of New York City's Most Famous Amusement Park Resort*, by Charles River Editors.

Heart of Coney Island website (*https://www.heartofconeyisland.com/*)

Compendium of the 2023 NYC Watershed Science and Technical Conference

By Lisa Melville

The NYC Watershed Science and Technical Conference was created as an annual opportunity to bring scientists, professionals, and other experts together with watershed stakeholders and the public, to technically inform, exchange ideas, and unveil new information regarding the protection of the nation's largest unfiltered surface water supply.

This year's 2023 NYC Watershed Science and Technical Conference continued to showcase the most current trends, technologies and scientific developments in the arena of watershed protection and management. It is more important than ever to advance all science.

The Conference Call for Abstracts was made to agencies and stakeholders in and beyond the New York City watershed. The resulting responses were reviewed by the Watershed Technical Program Committee for technical merit and interdisciplinary utility, as well as temporal and substantive relevance. Abstracts chosen by the committee for presentation at this year's conference are summarized in this compendium.

In addition to our esteemed presenters and all those who submitted their scientific endeavors, we wish to thank the many agencies, professional organizations, and individuals who contributed to the success of this conference. It is our hope that all who attended were edified by the scientific data presented and inspired by the dedication and hard work of those who, each day, advance our insight into the science of protecting drinking water for 9 million New Yorkers.

Stormwater Control and Green Infrastructure

Creating an Equitable Stormwater Program from the Ground Up: Stormwater Authority of the City of Chester (SAC), Pennsylvania.

Managing stormwater is challenging for communities facing economic hardships. However, with determined leadership, federal/state support and efficient program management, communities can realize success. Highlights of the journey of one such stormwater authority in the City of Chester, Pennsylvania, will be shared, including how initial funding led to the creation of a stormwater utility that ultimately secured $40 million in loans and grants to construct stormwater improvements and enables the authority to maintain stormwater assets throughout the city.

— By Julie Stein (HDR).

Stephanie Drago. *NYSDEC*

How NYCDEP Ensures Proper and Efficient Construction of Thousands of Assets in the Nation's Largest Green Infrastructure Program.

This presentation will share the tools and guidelines New York City Department of Environmental Protection (NYCDEP) Green Infrastructure unit uses to ensure newly constructed green infrastructure assets in the right of way are constructed properly and efficiently. NYCDEP has been able to successfully construct over 10,000 green infrastructure assets throughout the city, making it the largest green infrastructure program in the country. Extensive training, multiple inspections, hydrant testing, and enforcement ensure proper functionality of all assets.

— By Stephanie Drago and Roopesh Joshi (NYCDEP).

Collaborating with Municipalities and the Public to Improve Green Infrastructure Design.

A sewer separation project funded by a unique inter-municipal agreement in upstate New York incorporated green infrastructure to best serve the community. The bio retention designs addressed the city's concerns for winter maintenance, safety, steep sloped topography and even resulted in cost savings. The design incorporated public feedback which improved hydraulic capture, preserved parking, and earned critical support. Community engagement led to an optimal green infrastructure design and will create a lasting environmental resource for the city.

– By Meghan Fitzgerald (Arcadis).

Maintenance Challenges Provide an Opportunity for Pragmatic Green Infrastructure Design Improvements.

This presentation will discuss feedback received from NYCDEP green infrastructure maintenance staff on the various green infrastructure assets constructed by the city. The unique perspective from the staff who perform day-to-day maintenance activities provided for design improvements such as: low-impact/low-cost sediment traps, pedestrian accessibility concrete strip and plant palette improvements.

— By Andres Garcia, Roopesh Joshi and Flavio Reyes (NYCDEP).

A Review of NYCDEP Right of Way Green Infrastructure Standard Design Iterations and Improvements in the Last 10 Years.

Adriana Kocovic. *NYSDEC*

This year, 2023, marks the implementation of over 10,000 right of way green infrastructure assets citywide. This presentation aims to provide an in-depth review of the first standard rain garden design and compare it to the design standards being used today, over 10 years later. The presentation will discuss the integral design iterations and improvements, coordination, design evolution and fast-tracked implementation, as well as the criteria considered when determining which standard green infrastructure typology to utilize in what scenarios.

— By Adriana Kocovic, Flavio Reyes and Roopesh Joshi (NYCDEP).

Treatment and Monitoring

Novel Intermittent Draining Floating Treatment Wetland for Nitrogen Removal.

A novel floating wetland design is proposed that removes nitrogen from water by amplifying naturally occurring bacteria, stimulating coupled nitrification-denitrification for efficient nitrogen removal.

— By Ellie Sangree (Hamilton College).

continued on page 56

continued from page 55

Filtration Pilot: A Look at Gravity-Driven Membranes.

This presentation will describe one of the alternative treatment technologies being studied as part of NYCDEP's Catskill–Delaware Ultraviolet Water Treatment Facility Filtration Pilot Project. Ceramic membranes are being piloted and are to be studied in this project.

— By Ronald Pena and Julie Herzner (NYCDEP).

Ronald Pena and Julie Herzner. *NYSDEC*

SCADA Monitoring at CDUV.

The presentation will describe how the SCADA system is designed, implemented and maintained to assist the operation of the CATDEL UV Facility.

— By Robert Knappenberger and Doug Walton (NYCDEP).

Status and Trends of Water Quality in the New York City Water Supply Watersheds.

Historical water quality monitoring data provide the foundation to investigate linkages between water quality trends and watershed management. We apply the Weighted Regressions on Discharge, Time and Season (WRTDS) approach to identify and evaluate changes in river water quality and flow in New York City's upstate water supply watersheds. This presentation shares some examples of water quality trends and graphical summaries to track and evaluate water quality in the New York City watershed over time.

— By Karen E.B. Moore, Ph.D., and Richard A. Kowalczyk (NYCDEP); and Elizabeth W. Boyer (Pennsylvania State University).

Karen E.B. Moore, Ph.D. *NYSDEC*

Turbidimeter Instrument Validation: Things to Consider.

The NYCDEP understanding of turbidity is critical to providing the highest-quality drinking water to customers. After more than 25 years of utilizing the same technology, NYCDEP was required to adopt another turbidimeter technology. A yearlong project was designed to evaluate potential seasonal, water matrix and watershed differences between historical and new turbidimeters. These paired results were statistically and graphically analyzed to determine potential differences between the two turbidimeters.

— By David Van Valkenburg (NYCDEP).

Emerging Contaminants and Microconstituents

Investigation of Alternative Management Strategies to Prevent PFAS from Entering Drinking Water Supplies and Wastewater.

This presentation will share results of The Water Research Foundation Project #5082: Investigation of Alternative Management Strategies to Prevent PFAS from Entering Drinking Water Supplies and Wastewater. PFAS removal technologies can be challenging and costly to implement. The goal of this project was to develop actionable strategies to help utilities identify PFAS sources (to wastewater or in our watershed) and lead to effective management or mitigation of PFAS.

— By Eva Steinle-Darling, Ph.D. (Carollo Engineers).

Eva Steinle-Darling, Ph.D. *NYSDEC*

The Occurrence of the Taste and Odor Metabolite 2-Methylisoborneol (MIB) and Control Efforts in the Croton System of the New York City Water Supply.

NYCDEP has periodically received customer complaints of musty/stale taste and odor in the drinking water derived from the New Croton Reservoir. The complaints coincided with elevated 2-Methylisoborneal (MIB) – an odor metabolite commonly associated with a relatively small subset of bacteria. In addition to evaluating likely sources and contributing conditions, the effectiveness of various treatments will also be discussed in this presentation.

— By Rich Van Dreason, Jason Railing and Dale Borchert (NYCDEP).

Rich Van Dreason. *NYSDEC*

Modeling

Watershed Scale Modeling of Dissolved Organic Carbon Export from Variable Source Areas.

The Soil and Water Assessment Tool (SWAT)-Carbon(C) model predicts dissolved organic carbon (DOC) export from variable source areas in the Neversink watershed. Use of remotely sensed data reduced uncertainty in model predictions. DOC predictions are sensitive to soil properties. DOC flux is more sensitive to increases in precipitation than to air temperature.

— By Rajith Mukundan, Ph.D., and Rakesh Gelda, Ph.D. (NYCDEP); Mahrokh Moknatian, Ph.D. (Hunter College, City University of New York); Xuesong Zhang, Ph.D. (USDA-ARS Hydrology and Remote Sensing Laboratory); Tammo Steenhuis, Ph.D. (Cornell University).

Modeling Source Water Disinfection Byproducts (DBP) Formation Potential and their Precursors using Environmental Variables.

For proactive management of disinfection byproducts (DBPs) in water supply system, we developed a two-component statistical model to predict the formation potential of two commonly regulated DBPs (DBPfp) in two source water streams using UV absorbance at 254 nm (a surrogate of organic matter) and routinely monitored environmental variables. Model results show different drivers of DBPfp levels in the two streams and highlight the importance of including additional water quality parameters in DBP precursor modeling.

— By Rakesh Gelda, Ph.D., and Rajith Mukundan, Ph.D. (NYCDEP); Kezhen (Jenny) Wang, Ph.D. (Hunter College, City University of New York).

Modeling the Impact of Septic Systems on Water Quantity and Quality - NYC East of Hudson Watersheds.

This presentation assesses the role of septic systems on hydrology and water quality of EOH watersheds. SWAT watershed model is used to quantify the impacts of more than 40,000 septic systems on stream water quantity and quality. Modeling scenarios of with and without septic systems are evaluated for selected watersheds.

— By Mahrokh Moknatian, Ph.D. (Hunter College/CUNY Institute for Sustainable Cities); Rajith Mukundan, Ph.D. and Rakesh Gelda, Ph.D. (NYCDEP).

Pathogens, Nutrients and Turbidity

Evaluation of Cryptosporidium Species and Genotypes in Wildlife Scat at Hillview Reservoir.

While there has been no evidence to suggest the New York City water supply has ever been a source of cryptosporidiosis, it is important to evaluate the potential sources of Cryptosporidium in relation to public health. A total of 355 scat samples were successfully collected and analyzed from 203 mammals and 152 birds over eight years. The types of Cryptosporidium species discovered in the respective scat samples and their potential impact will be discussed.

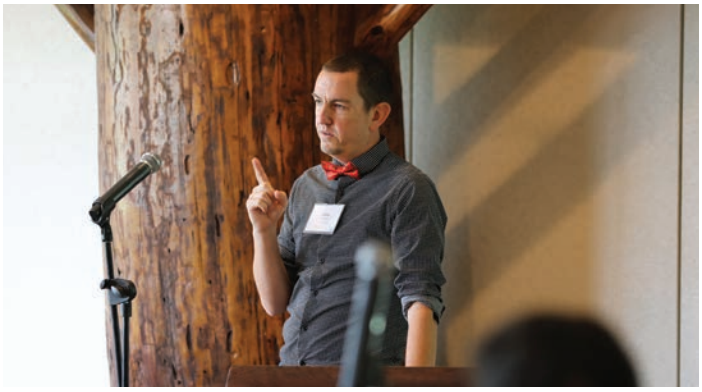
– By Kerri Alderisio, Christian Pace, Christopher Nadareski, Sean Camileri and Michael Reid (NYCDEP); and Dawn Roellig (CDC, Atlanta Georgia).

Kerri Alderisio. *NYSDEC*

Analyzing Historical Trends in Phytoplankton.

With increasing concerns surrounding blue-green algae blooms, understanding the composition of a watershed's phytoplankton community is vitally important. This presentation will dive into the historical trends of phytoplankton counts in the New York City watershed.

— By John Kaurich (NYCDEP).



John Kaurich. *NYSDEC*

Recreational Use, Forestry and Agriculture

Preparing for the Next 30 Years of Watershed Agricultural Programs; a Joint Presentation by NYCDEP and WAC (Part One of Two).

NYCDEP and the Watershed Agricultural Council (WAC) have recently celebrated their 30-year anniversary of successful partnership in carrying out agricultural, forestry and land conservation programs to control pollution, protect water quality, and support the economic viability of natural resource-based industries in the New York City watershed. This presentation will provide an overview of the agricultural program, the in-progress FAD-required metrics assessment and brief of Columbia University's new study on Climate Challenges to Agriculture and Water Quality in the New York City watershed.

— By Sara Storrer, Michael Vander Werff and Tom Ganz (NYCDEP); Connor Young and Gibson Durnford (Watershed Agricultural Council).

Sara Storrer. *NYSDEC*

From an Abandoned Rubble Fill to a Sand Seepage Wetland - Restoration and Ecological Uplift of Teaneck Creek Park within Bergen County's Overpeck County Park.

Teaneck Creek Park in Bergen County, New Jersey is surrounded by urban development and was previously used as a rubble fill and as a place to discharge uncontrolled stormwater. Under the direction of Bergen County Department of Parks, Biohabitats led the ecological transformation of the site through innovative nature-based stormwater management and restoration strategies including regenerative stormwater conveyance and 20 acres of sand seepage wetlands. This

continued on page 58

continued from page 57

presentation will discuss project design, construction, future management and lessons learned.

— By Kevin Dahms (Biohabitats), Adam Strobel (Bergen County Department of Parks), and Joe Berg and Ted Brown (Biohabitats)

Infrastructure

Invasive Species: Impacts on Infrastructure and Budgets.

Infrastructure damage due to invasive species has an under-reported cost to agencies. Lack of maintenance can reduce the life-cycle length of infrastructure and dramatically increase capital expenditures. This presentation will showcase cost data from around the country to illustrate the impacts of invasive species and discuss management techniques.

— By Barbara Barnes (HDR).

Barbara Barnes. *NYSDEC*

Using Data Science to Achieve Cost Effective and Equitable Lead Service Line Replacement Programs.

The Lead & Copper Rule Revisions (LCRR) have established several new requirements for water utilities. The LCRR rule requires utilities to develop an inventory and replacement plan by Oct. 16, 2024. This presentation will examine how several water utilities are employing data science techniques to achieve compliance, despite their limited resources.

— By Bhavin Bhayani and Stephen Waldvogel (GHD).

Operator Training

Preparing to Operate in the Dark

This presentation will discuss practical steps for planning and practicing a SCADA Outage event. For many utilities, the newer generations of staff have become reliant upon automation for daily operations, they have not operated a facility in manual nor experienced a significant event requiring operation without automation, and it is common that the staff with the experience have never transposed that knowledge to written plans (they just know what to do).

— By David Brearley and Jeff Monforton (HDR).

Development of a NYS DOH-Approved Drinking Water Operator Training Program for Supervisors.

The hills and valleys of developing Advanced Operations and Supervisory Management courses for NYCDEP Water Treatment Operations will be presented.

— By Michelle Rissolo (NYCDEP).

Lisa Melville is the New York City Watershed Programs Coordinator with the New York State Department of State.

Operator Quiz Fall 2023 – Test Your Knowledge on Grit Removal

The following questions are designed for individuals/trainees pursuing certification as they prepare to take the ABC wastewater operator test. It is also designed for existing operators to test their knowledge. Each issue of *Clear Waters* will have more questions from a different process of wastewater treatment. Good luck!

1. **Grit washing is done in order to…?**
   A. Remove inorganic matter
   B Remove odor
   C. Improve settling
   D. Remove organic matter

2. **How long must a grit channel be to allow for proper settling given the following: Flow velocity = 1.92 ft/sec, Water depth = 32 inches, Particle settling rate = 0.15 ft/sec**
   A. 18 ft
   B. 14 ft
   C. 21 ft
   D. 9 ft

3. **One of the major purposes of grit removal is …?**
   A. Odor control
   B. Equipment protection
   C. Solids thickening
   D. Volatile reduction

4. **The ideal flow rate in a grit channel is usually…?**
   A. 2 ft/sec
   B. 5 ft/sec
   C. 1 ft/sec
   D. 5 ft/sec

5. **Flow proportional weirs are used in grit basins to…?**
   A. Measure flow
   B. Maintain a constant flow rate
   C. Maintain a constant velocity
   D. Prevent a buildup of grit behind the weir

6. **On average the WRRF collects and disposes 18,000 lbs. of grit per month to the local landfill. If the landfill charges $56.00 per ton what is the average annual cost of disposal?**
   A. $12,096
   B. $504
   C. $6,048
   D. $8,064

7. **All of the following will influence the settling velocity of a particle EXCEPT…?**
   A. Size
   B. Shape
   C. Color
   D. Density

8. **In a vortex grit basin, paddles may be used to…?**
   A. Create the vortex
   B. Keep grit in suspension
   C. Achieve proper separation
   D. Increase detention time

9. **In a vortex type grit basin, grit is typically removed…?**
   A. With a chain and flight system
   B. Manually with shovels
   C. With the use of a grit pump
   D. With a screw conveyor

10. **When using a grit basin with a grit pump, _____ can be used to separate the grit and organics from wastewater.**
    A. Belt conveyor
    B. Screw conveyor
    C. Grit cyclone
    D. Clamshell bucket

Answers:

1. (D) Remove organic matter **2.** (A) 18 ft
3. (B) Equipment protection **4.** (C) 1 ft/sec
5. (C) Maintain a constant velocity **6.** (C) $6,048
7. (C) Color **8.** (C) Achieve proper separation
9. (C) With the use of a grit pump **10.** (C) Grit cyclone

For questions concerning operator certification requirements and scheduling, please contact Carolyn Steinhauer at 315-422-7811 ext. 4, carolyn@nywea.org or visit www.nywea.org.

ANNUAL & SPRING 2024 MEETINGS, AND OPERATION SOS
SPONSORSHIP, EXHIBITING AND ADVERTISING

- **1,200 Annual Meeting attendees** expected in New York City, Feb. 5-7, 2024
- **400 Spring Meeting attendees** expected in Buffalo, June 4-6, 2024

NYWEA
LEADING THE WAY IN WATER QUALITY MANAGEMENT

Choose from six primary levels of sponsorship and multiple sponsorship options

Sponsorship Levels

- ❍ **Geyser*** $7,000 SELECT 8
  Geyser Sponsorship includes Opening Session of Annual Meeting and Spring Meeting
- ❍ **Waterfall** $5,000 SELECT 6
- ❍ **River** $4,000 SELECT 5
- ❍ **Lake** $2,500 SELECT 3
- ❍ **Stream** $2,000 SELECT 2
- ❍ **Pond** $1,000 SELECT 1

*Geyser level benefits:

- Prominent logo display and verbal recognition in the Opening Session of the Annual and Spring Meetings
- Special mention in the onsite program
- Your company name and link to your website to be included in all attendee confirmation emails
- Eight additional sponsorship opportunities of your choice

96th Annual Meeting Sponsorship Options

- ● **Opening Session**
- ❍ **Exhibit Hall Coffee Breaks**
- ❍ **Young Professionals Reception**
- ❍ **Awards Luncheon**
- ❍ **Exhibitor Reception**
- ❍ **Student Luncheon**
- ❍ **Student Design Competition**
- ❍ **New Member Meet & Greet**
- ❍ **Monday Opening Session Breakfast Sandwich**
- ❍ **Tuesday Lunch**
- ❍ **InFLOW Scholars**

● = **Reserved for Geyser Sponsors**

Sponsorship Link: http://tinyurl.com/sponsor23-24ny

Spring Meeting Sponsorship Options

- ● **Opening Session**
- ❍ **Exhibit Hall Coffee Breaks**
- ❍ **Operations Challenge**
- ❍ **Facility Tour**
- ❍ **Exhibitor Reception**
- ❍ **Young Professionals Reception**
- ❍ **Monday & Tuesday Lunch**
- ❍ **InFLOW Scholars**

SPONSOR LINK
SCAN ME

Limited Availability

- ❍ **Lanyards**
  (LIMITED TO 3 SPONSORS FOR EACH MEETING)
  ADDITIONAL $3,000 (AM)
  ADDITIONAL $2,000 (SPR)

OTHER

- ❍ **Website Presence Sponsorship Banner**
  (TWO MONTHS)
  ADDITIONAL $350

Operation SOS Sponsorship

- ❍ **Operation SOS**
  ADDITIONAL $500

The Geyser, Waterfall and River sponsor levels also include prominent display of your logo on the Events Page of **www.nywea.org**

SPONSORSHIP/EXHIBITOR/ADVERTISING APPLICATION

To submit online use Sponsor link. To exhibit use Exhibitor link. To advertise use Advertising link.

Company Name _____

Contact Person _____ Date_____

Address _____ E-Mail _____

City _____ State _____ Zip _____ Telephone _____

Company website _____

Sponsorship Level: ❍ Geyser $7,000 ❍ Waterfall $5,000 ❍ River $4,000 ❍ Lake $2,500 ❍ Stream $2,000 ❍ Pond $1,000 **TOTAL $** _____

Exhibitor Level: Go to **https://shows.map-dynamics.com/nywea2024/?register**

Advertising Level: ❍ Full Page ❍ Half Page ❍ Quarter Page ❍ Back Cover ❍ Inside Front Cover ❍ Inside Front Right Page ❍ Inside Front Left Page ❍ Inside Back Cover ❍ Inside Back Left Page ❍ Inside Back Right Page **TOTAL $** _____

PAYMENT:

❍ Check (Please make payable to NYWEA) Your Check # _____

❍ Credit Card ❍ MC ❍ VISA ❍ AMEX Card Number _____ Exp. Date _____ V-Code _____

Print Name _____ Authorized Signature _____

Please make checks payable to: NYWEA, Inc., mail to NYWEA, 525 Plum St., Suite 102, Syracuse, NY 13204, email to mgk@nywea.org or fax to 315-422-3851.

EXHIBITOR OPPORTUNITIES

Don't Delay! Secure Your Exhibit Booth Now!

MEMBER and NON-MEMBER*

*INCLUDES 1-YEAR AFFILIATE MEMBERSHIP.

BENEFITS INCLUDE:

- One booth during 96th Annual Meeting.
- Company logo and description in program.
- Link to company website.
- Two complimentary registrations.

BOOTH WIDTH	MEMBER (before 10/31)	NON-MEMBER (before 10/31)	MEMBER (after 11/1)	NON-MEMBER (after 11/1)
8'	$2,000	$2,200	$2,250	$2,450
8' SPECIAL	$2,150	$2,350	$2,400	$2,600
10'	$2,250	$2,450	$2,500	$2,700
10' SPECIAL	$2,400	$2,600	$2,600	$2,800

EXHIBITOR LINK

Exhibitor link: https://shows.map-dynamics.com/nywea2024/?register

SCAN ME

ANNUAL MEETING ADVERTISING OPPORTUNITIES

SPRING MEETING ADVERTISING OPPORTUNITIES

MEMBER and NON-MEMBER GET SAME GREAT RATES!

ANNUAL MEETING ADVERTISING RATES
FULL COLOR ADS

- ❑ Full Page (7.5" x 10"). $1,000
- ❑ Half Page (7.5" x 4.875") $550
- ❑ Quarter Page (3.625" x 4.875") $350
- ❑ Back Cover (7.5" x 10"). $1,500
- ❑ Inside Front Cover (7.5" x 10"). $1,400
- ❑ Inside Front, Left Page (7.5" x 10") (opposite Table of Contents). $1,375
- ❑ Inside Back Cover (7.5" x 10") $1,200

(A bleed ad size is 8.75" x 11.25", keep text and important graphics within center 7.5" x 10" of page.)

SPRING MEETING ADVERTISING RATES
FULL COLOR ADS

- ❑ Full Page (7.5" x 10"). $600
- ❑ Half Page (7.5" x 4.875") $400
- ❑ Quarter Page (3.625" x 4.875") $125
- ❑ Back Cover (7.5" x 10") $1,000
- ❑ Inside Front Cover (7.5" x 10"). $800
- ❑ Inside Front, Left Page (7.5" x 10") (opposite Table of Contents). $825
- ❑ Inside Back Cover (7.5" x 10"). $700

(A bleed ad size is 8.75" x 11.25", keep text and important graphics within center 7.5" x 10" of page.)

AD LINK

Annual AND Spring Meeting Advertising Link: http://tinyurl.com/AdvertiseAM24

SCAN ME

For more information about any of these programs, please contact **Maureen Kozol at mgk@nywea.org**

wef member association

Fall 2023, Vol. 53, No. 3

ClearWaters

New York Water Environment Association, Inc.

2023–2024 Upcoming NYWEA Meetings and Seminars

DECEMBER 2024

12 Biosolids Management Virtual Webinar – Thomas J. Lauro Member Education Training

FEBRUARY 2024

5–7 96th Annual Meeting Technical Conference & Exhibition Marriott Marquis, New York City

NYWEA™
LEADING THE WAY IN WATER QUALITY MANAGEMENT

Visit nywea.org for more information.

OPERATION SOS — SUPPORT OPERATOR SCHOLARSHIPS — NYWEA

THANKS TO OUR SPONSORS AND DONORS

Over $40,000 Raised!

CORPORATE SPONSORS

FLEET

KOESTER 50 — CELEBRATING 50 YEARS · EST. 1973

VEOLIA

HDR

GP Jager Inc.

SIEWERT EQUIPMENT — A Division Of CUMMINS-WAGNER — 100% Employee Owned

CDM Smith — listen. think. deliver.

INDIVIDUAL DONORS

Adamski, Bob 💧
Akman, Cinar
Arjoon, Neera
Arneth, Jon
Atkins, Joe
Badillo, Nicholas
Blum, Tara
Borchert, Dale
Boyle, Christopher
Bryant, Jeff
Buckley, Eugene
Cannizzo, Jill
Cerro-Reehil, Patricia
Clayton, Tim
Colangelo, Vincent
Coppola, Tony
Davignon, William
Davis, Scott
DeGiorgio, Rob 💧
Derrigan, Jim
Derrigan, Lisa 💧
DiGregorio, John
DiNottia, Angelo
Dodson, Khris
Dunning, Rich
Falkowski, Vincent
Fangmann, Steven
Fenichell, Alex
Fiegl, Joseph
Fitzgerald, Meg
Foster, Seth
French, Angel 💧
Goebel, Maria
Gomez, Marissela
Grandner, Billy 💧
Grogu 🛟
Grudier, Dale 💧
Grudier, Donna 🛟
Hintz, Angela
Hoose, Maggie
Hoyt, Mike
Hurteau, Craig 💧
Johnson, Jamie
Knappenberger, Rob
Koester, Mark
Lacey, Junior
Livermore, Lauren
Loonie, Stephen
Lyons, Richard
Mariani, Joyce
Martino, Steve
McCormick, Kevin
McGreevy, Daniel
Melville, Lisa
Minassian, Vatche
Munoz, Kristin
Nogle, Rosaleen
Nylic, William
O'Sullivan, Dan 🛟
Oates, Alan
Obey, Kevin
Oster, Matt
Padasak, Mary
Perry, Patrick
Quinn, Madison 💧
Rago, Frank
Rhoads, A. Tom
Robinson, Howard 🛟
Robison, Zachary
Rourke, Daniel
Rusin, Karen
Russell, Isaiah
Sachs, Darcy
Salvagno, John
Savoia, Anthony 💧
Shaw, Greg
Shaw, Rebecca
Simpson, Maggie
Slate, Jay
Spirydonava, Mariya
Steinhauer, Carolyn 💧
Steinle-Darling, Eva
Streeter, Meredith
Taber, Tim
Thomas, Abigail
Thompson, Scott
Timokhina, Irina
Vu, Kevin
Walker, Walt
Wither, Robert
Yarbrough, Elaine

CHAPTER DONORS

Capital
Western
Central
Metropolitan

💧 Indicates 2 dontations
🛟 Indicates 3 or more donations

NYWEA
LEADING THE WAY IN WATER QUALITY MANAGEMENT

ClearWaters

The New York magazine dedicated to water quality management.

Established: 1971 as the official publication of the New York Water Environment Association, Inc.

Circulation: 3,200. Approximately 10 percent to out-of-state and international subscribers. Members Only access on-line.

Frequency: Quarterly

Readership: Water quality engineers, treatment plant technicians, scientists, government officials, regulatory agency personnel, manufacturers and their agents, libraries, universities, and groups concerned with environmental protection.

Reproduction: *Clear Waters* is a full color magazine.
Media: Emailed artwork
Ad File Formats: Please send ads as high resolution (300 dpi) jpg, pdf, uncompressed tif file, or complete InDesign files (all screen and printer fonts provided, images at 300 dpi at final size, Mac-preferred).

Publication Schedule Dates

Issue	Publication	Order Deadline*
Spring	April	January 28
Summer	July	April 28
Fall	October	July 28
Winter	January	October 28

**Subject to change.*

2024 Advertising Rates

Color Ad Rate

Size	Per Ad	Ad measurement is width x height.
		The finished size of *Clear Waters* is 8.5 x 11 inches.
Full Page	$800	7.5 x 10 inches, non-bleed
w/digital link	$900	8.75 x 11.25 inches, full bleed
Half Page	$600	7.5 x 4.875 (horizontal format) or
w/digital link	$700	3.625 x 10 inches (vertical format)
Quarter Page	$500	3.625 x 4.875 inches
w/digital link	$600	
Covers: Inside Front or Inside Back	$1,200	Same as full page ad specifications (Please indicate if bleed or non-bleed.)
w/digital link	$1,300	
Centerfold Spread.	$2,000	Same as full page ad *non-bleed* specifications
w/digital link	$2,100	16 x 10 inches, non-bleed 17.25 x 11.25 inches, full bleed

Notes

Please note: Agency commission is not deductible from listed rates.

Please email artwork to cboyle@nywea.org.

Event Sponsorships

Interested in sponsoring an event at one of our meetings? Contact Khris Dodson at khris@nywea.org.

Scan for a PDF of This Form

Web Banner Advertising

Consider a banner advertisement on the NYWEA homepage!

Member Rate	Non-Member Rate
$800/Bi-annual	$1,600/Bi-annual
$1,200/Year	$2,400/Year

Ad Size: 185 px width x 70 px height; resolution 72 dpi, RBG color format; file types: gif or jpg

Classified Ads for Jobs Available

Advertise your job openings on NYWEA's website.

$50

Send Word file to Maureen Kozol at mgk@nywea.org.

Note: Payment is due with ad submission.

NYWEA is a Member Association of the Water Environment Federation.
525 Plum Street, Suite 102, Syracuse, NY 13204 • (315) 422-7811 • Fax (315) 422-3851
Email: khris@nywea.org • Website: www.nywea.org

wef member association

New York is built on resilience. It's in the water.

From iconic rivers and bridges to historic aqueducts and reservoirs, New York's ties to water run deep. And so do ours. For 90 years, Carollo has focused on nothing else. This means we bring unparalleled experience in all things water -- from water and wastewater treatment to residuals and biosolids to reuse and One Water. But more than that, we have the creativity, expertise, and vision to help you adapt to the new normal of extreme weather, sea level rise, and other current and emerging threats. To learn more about us, visit carollo.com.

800.523.5826 / carollo.com

carollo® 90 YEARS