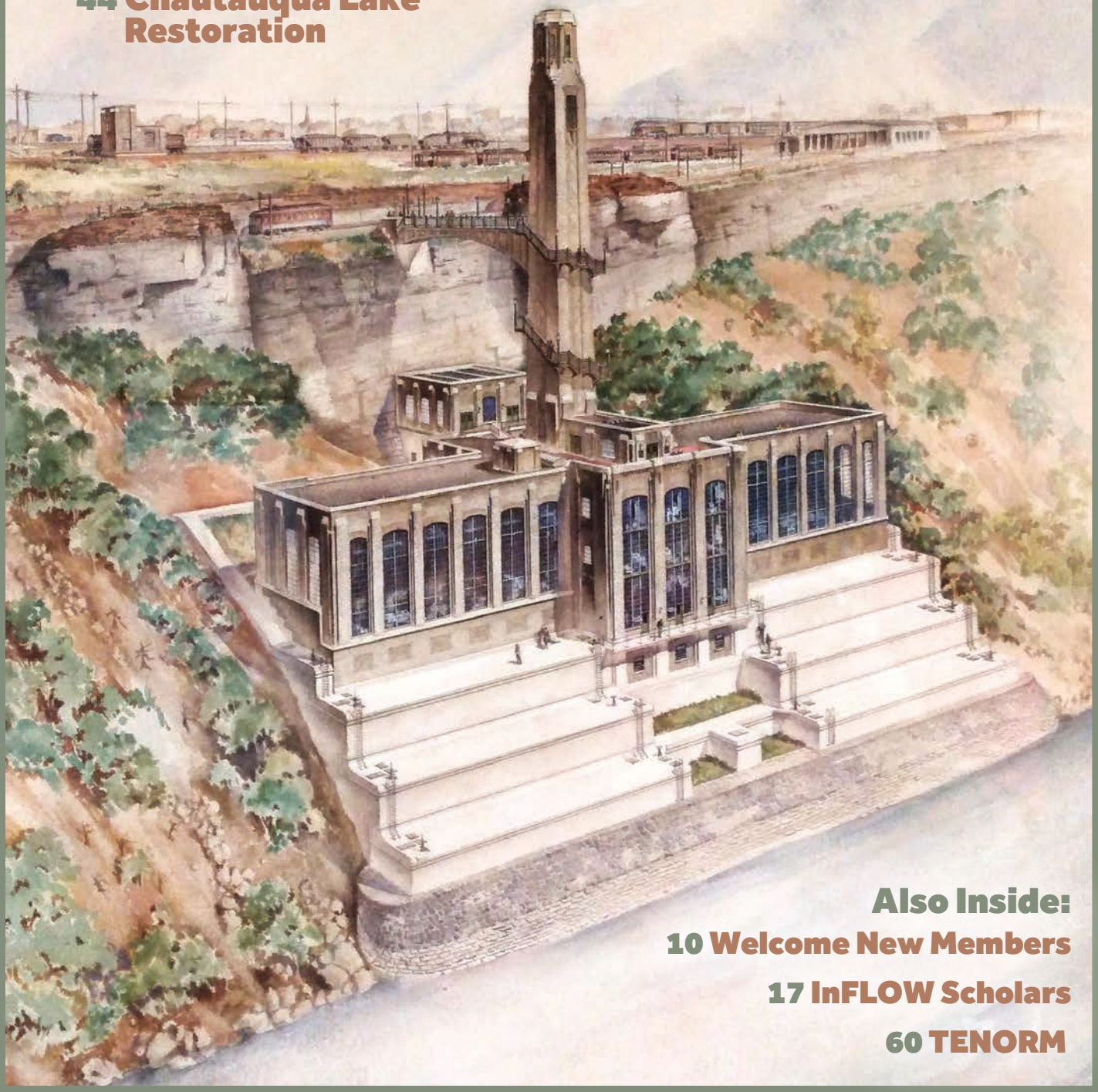
Winter 2023, Vol. 53, No. 4

New York Water Environment Association, Inc.

ClearWaters

Insights from Buffalo / Western NY



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Clear Waters

New York Water Environment Association, Inc.

Cover: Watercolor rendering of the Ashland Avenue Sewage Treatment Plant, City of Niagara Falls, New York.
George L. Watson, E.E., D.Eng., Consulting Engineer, New York City 1935. Photograph by Richard R. Roll.

The Ashland Avenue Sewage Treatment Plant was built during the Depression under the Works Progress Administration (WPA), and was the first treatment plant to serve the City of Niagara Falls. Its appearance, as envisioned in this rendering from 1935, is unlike most plants of the era, owing to its physical-chemical treatment processes. The conveyance of wastewater up and down the Niagara Gorge to this central location led to its construction down in the gorge, another unique attribute. The plant gave the best service that it could for 35 years with extremely chemical-laden influent from our industries of the day. But by the early 1970's, its deteriorated condition, higher environmental standards, and a lack of economic expandability on-site led to a successor facility being built elsewhere in the city. The plant was demolished to permit construction of the Niagara Falls Gorge Pumping Station, which is the subject of the article on Page 34.

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Hello, Friends!

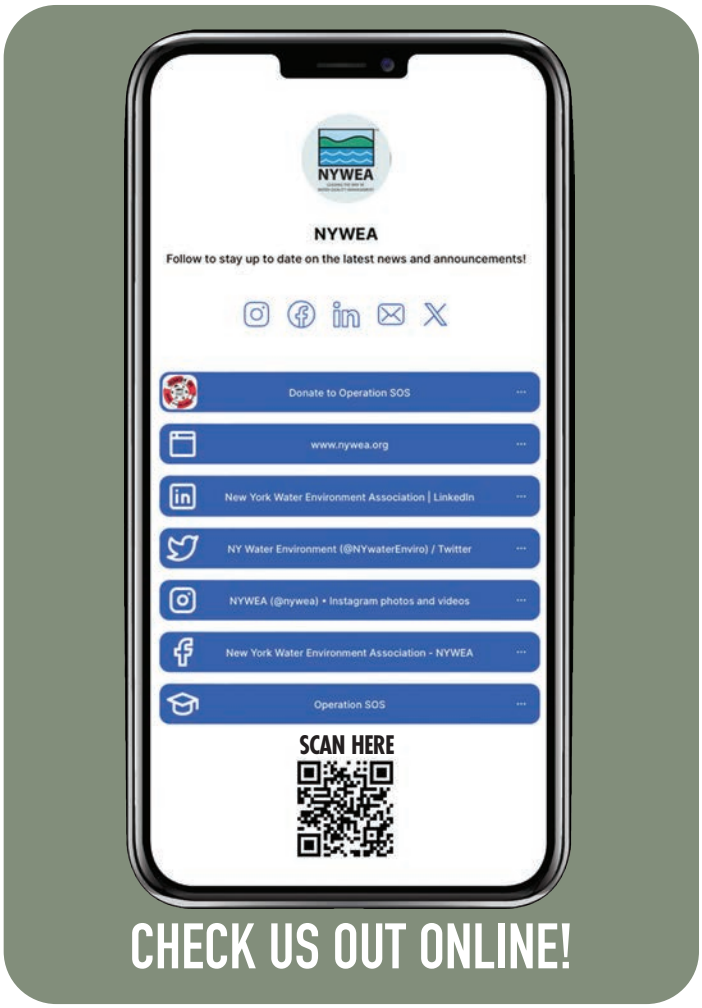
This year serving as NYWEA's president has flown by! Please indulge me as I take a moment to reflect on all that has transpired.

From the moment I stepped on the podium at last year's Annual Meeting to accept the gavel (which I love, by the way!), I was awed by the enormity of this position. I have so much respect for those who have come before me, and gratitude to you all for your support. Impostor syndrome is a real thing, and to be your president has been an honor. My sincere hope is that I leave this organization even better and stronger than it was when I came in.

This year, my focus has been to highlight the contributions of the front-line workers. So often these unsung heroes are tasked with the dirty, difficult and dangerous job of keeping our water clean and safe. I wanted to take this last opportunity as NYWEA's president to say thank you to everyone who has been stuck working double shifts on a holiday or is called out at 2 a.m. in the pouring rain to fix a broken pipe. I want you to know that you are heard, and you are seen. Your value to our community is undisputable, and I hope you are proud to say that you are someone who steps up to protect our environment.

Highlighting the Opportunities for Operators

NYWEA sees the value of our operators, so we have added new programs over the past few years to assist you through the certification journey, engage with your fellow water professionals, and celebrate your contributions to the water sector. My challenge to you is… APPLY!!!



We now offer three unique scholarship opportunities for operators. First, we have the Lucy Grassano Memorial Scholarship, which invites one operator from each chapter to attend both the annual and spring meetings. With this scholarship, your registration cost is waived, you receive up to $900 for a travel stipend, and you are invited to the President's Reception (I throw an outstanding party) and a dinner held in your honor while you are at the Annual Meeting. The deadline to apply is Dec. 1, so if you missed it last year, put it on your reminders list for this year!

Second, the Brian Romeiser Pre-Certification Operator Scholarship is available for 10 applicants (five in the spring and five in the fall) to receive $1,000 each to help pay for pre-certification training classes. The deadlines to apply for this scholarship are March 1 in the spring and November 1 in the fall.

Finally, our newest offering is the Michelle Koester Scholarship, which will contribute $2,000 toward costs for an operator who is accepted into WEF's Water Leadership Institute. This is an exciting chance to build leadership skills with a national group that spans the spectrum of water professionals. More information on this scholarship will be coming this spring.

NYWEA has also worked tirelessly to build new opportunities to recognize top performing operators. There is the Uhl T. Mann Award for excellence in treatment plant operations and maintenance, which recognizes the decision makers who maintain high standards at their facilities. Recently created is the Outstanding Operator of the Year Award. This award is designed to showcase the people that "make it work" with extraordinary dedication, day in and day out. We also have the Quarter Century Operators Club, which recognizes operators of wastewater treatment facilities for their service and dedication in a difficult and dangerous profession. The only criteria for this are 25 years of operations service and five years of WEF membership. The deadline for nominations for these awards is November 1, so please be sure to consider nominating someone in the coming year!

All of these wonderful programs (and the new ones that we are cooking up) cannot exist without funding, of course. That is why we are working diligently to fortify the Operator Scholarship Fund so that it can become self-sustaining and continue to do the good work in perpetuity. You are always invited to donate to the fund online (https://www.nywea-sos.org/). If you prefer to help in person, there will be some exciting opportunities at both the Annual Meeting in New York City and the Spring Meeting up in Buffalo!

In Closing…

Speaking of the Annual Meeting, I am looking forward to handing the reins over to our President-Elect Lisa Derrigan in February! Lisa has a long history of volunteering with NYWEA, and she brings her unique skills and perspectives to this position. Lisa has been extraordinary in her support for my initiatives, and I am excited to return the favor. I am certain she will find this job as challenging and enriching as I did.

I apologize for blathering on, but it's my last chance so I wanted every word to count! Thank you all for the love you've shown me this year. You all make this organization exceptional and it has been a privilege to be a part of your lives.

Donna Grudier
NYWEA President

Showing Up

The world is run by the people who show up.

I can't verify the attribution of this quote, but it is something a good friend of mine would often say. She is right, and she almost always shows up; she has gone great places and has accomplished great things because of it.

Another quote I like is, "want something done, ask the busiest person in the room."

That one never made sense to me until I realized I was the busiest person in the room! At one point I was on six boards (both professional and civic) while also holding down a full-time job and raising two boys! As they grew so did their requirements on my time. Maybe I was an "over achiever" but I loved it. I've given up almost all of those other commitments to sit through soccer games, take my son to ceramics class and help with homework, which is a challenge because I don't understand how they teach math these days!

Of course, dinner is always the most difficult decision of my day. Decisions at work are often a "slow burn;" decisions on dinner happen fast. Then later, after I put my kids to bed, I open up the laptop and get back to it with mindless TV in the background. Wine might be involved. I assume some of you can relate.

The reason I meander into this is that I know many of you feel similar pressures on your time. I want you to know that your efforts to engage with, support and work to keep NYWEA the strong and supportive organization that it is do not go unnoticed. I appreciate you. We all do.

That said, the work continues, and we need your help to keep up with it. The results of the work are immeasurable, truly, but they are felt by many more than the 2,400 NYWEA members who in one way or another contribute to what makes NYWEA magical.

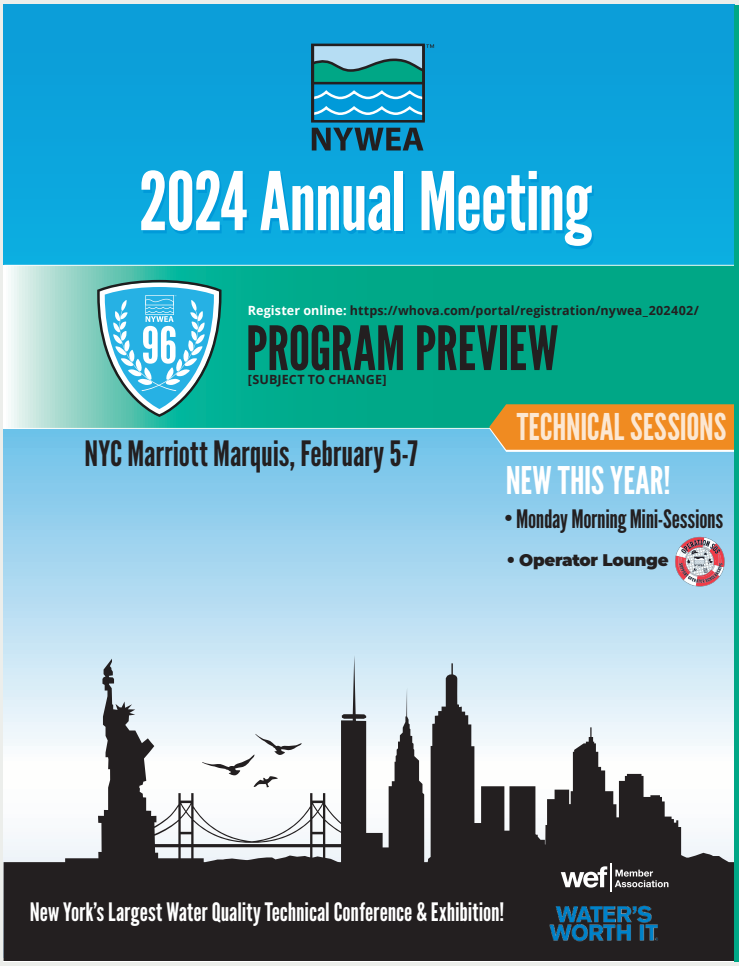
Looking Forward to the Annual Meeting

Speaking of magical, we've got our annual meeting coming up, and we've got some new things cooking! We'll have an operators lounge in the exhibition hall Monday afternoon and all-day Tuesday. Members who work for POTWs can use the space to sit back, relax and enjoy the amenities. This token of appreciation is part of President Donna Grudier's focus on our front-line workers this year.

We'll also have a more interactive opening session (with breakfast sandwiches!), and additional technical sessions Monday morning and Wednesday.

All of the things you always anticipate at this meeting will continue, including Monday's luncheon for new members, the past presidents' brunch in President Donna Grudier's suite and the exhibitors' reception. The YP reception will be held Tuesday. Wednesday we will gather at the awards lunch, where we will recognize the great work of our NYWEA volunteers. Believe me, the decision you make to volunteer your time, thought and effort to support NYWEA is easier than my decision on what to make for dinner. I thank you for all you do!

Khristopher Dodson
Executive Director
khris@nywea.org



Buffalo River Cleanup Driving Urban Revitalization

The Buffalo River of today is transformed from the version it was 60 years ago. Once used as a conveyance of untreated sewage and industrial waste to Lake Erie, the river's ecosystem has made a remarkable comeback and is driving waterfront revitalization and economic development in the region.

Reducing combined sewer overflows (CSOs) is crucial to the river's recovery. To date, New York has provided over $70 million in grants to the Buffalo Sewer Authority (BSA) to support their efforts to reduce discharges from CSOs to waters surrounding and within the City of Buffalo, including the Buffalo River. The U.S. Environmental Protection Agency and DEC required BSA to develop a Long-Term Control Plan (LTCP) to eliminate or significantly reduce the amount of combined sewage discharged to the Buffalo River annually. BSA has already completed several LTCP projects in the Buffalo River sewershed, including collection system improvements and installation of innovative green infrastructure. Over the next several years, BSA will invest an additional $300 million to install four CSO storage facilities, separate combined sewers into separate sanitary and storm sewers, and install green infrastructure in two CSO outfall sewersheds.

Initiated in 2010, the federal Great Lakes Restoration Initiative (GLRI) injected millions of federal dollars into the Buffalo River Area of Concern to clean up legacy contaminants and restore habitat. Over $100 million has been invested to remove 1 million cubic yards of contaminated sediments from the river. Twenty habitat restoration projects spanning 30,000 linear feet of shoreline were completed in the lower portion of the Buffalo River since 2013, supported by $22 million in federal GLRI dollars. New York leveraged this work with millions of dollars through the State Superfund, Brownfield Cleanup and State Voluntary Cleanup programs to advance and complete remedial work on over 20 sites spanning over 400 acres along the Buffalo River.

Year by year, as untreated sewage was reduced, contaminated sediments were removed, and habitat was restored, fish and wildlife — and people — found their way back to this urban river.

New York state has partnered with the City of Buffalo to dramatically transform the Buffalo waterfront over the last 15 years. According to a 2020 study, the cleanup of the Buffalo River and associated public access and amenity enhancements along the river corridor generated well over $400 million in waterfront development from 2012 to 2018. Vacant parking lots became the Canalside Entertainment District. Buffalo Harbor State Park, the City of Buffalo's first state park, was established and hosts a marina, restaurant, boat launches, playground and other amenities. Numerous economic development projects now dot the river corridor. With $10 million of state economic development funding, the Buffalo Blueway initiative is working to expand and enhance waterfront access at a number of sites.

These cleanup and revitalization efforts are leading to community reconnection to the Buffalo River. Once considered a lost cause, the Buffalo River now teems with new life and possibility.

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

Time After Time...

Today's world has more leisure time, but it doesn't feel like it. We have no time for rest and relaxation as we rush to complete everything we are expected to do. And we definitely need to take time for ourselves to re-charge and to have fun! To do "flow" activities where we are so caught up in the flow of doing them — and enjoying ourselves — that we lose track of time.

Nowadays we have a heightened awareness of time, probably because everything seems to have a digital clock built into it. Unfortunately, this awareness can cause us to underestimate how long a task will take, and then feel like a failure when we can't perform the task in the time we expected.

Have you ever experienced the "yes-damn" effect? You are asked to do something, agree right away to do it, then are annoyed with yourself for not saying "no"? Maybe this happens because we think of our schedule for weeks or months ahead, while forgetting all the mundane tasks in the background of our lives. How could we avoid this? Maybe we could estimate how long the new activity will take and double it; our schedule will look far busier than it really is and prevent overcommitting. Or we could imagine that we have to do the new task tomorrow (!) — would we still take it on?

Technology should give us more power over time for both work and leisure. Yet, ironically, we end up working all the time; we are interrupted constantly by our smartwatches, phones and laptops. These seem like brief interruptions, but they chop up our time and create so-called "time confetti." **Is all this multi-tasking a time-saver? Actually, it isn't.** Our working memory can only handle one task at a time, so dividing up our concentration can make a task take longer — or worse, our divided attention creates more errors. Brief bits of distraction trigger the parietal lobe in the back of the brain, which constantly scans the environment for stimuli. But to deeply focus, we need to use the prefrontal cortex in the front of the brain. We can't really use both well at the same time.

What could we do about this problem? We could create blocks of time to do tasks so that we can really focus on them. For each task, we decide what we are working on and **consciously decide what we intend to accomplish.** Also, if a task could be completed immediately or very quickly (and we decide what "quickly" means), we could do it now rather than juggling more and more unfinished tasks.

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

Welcome to Our New

[New members added from June 1—December 14, 2023]

Yasmin Abdul-Malik
Erik Adcock
Gianfranco Affrunti
Michael Albrecht
Kerri Alderisio
Dale Alkinburgh
Brandy Americk
Phil Anderson
Rosaura Andujar-McNeil
Mackenzie App
Leman Ceren Aralp Kaya
Antonio Argudo
Neera Arjoon
John Belyea
Danelle Bishoff
Orlando Blanco
Philip Boehle
Giovalli Botello
Mitchell Brower
John Brunette
Gerard Burke
John Canning
Kirsten Cerro
Matthew Cervini
Jessica Chaplin
David Chase
Hongmei Chen
Mwale Chiyenge
Frank Cipriani
Amy Conley
Matthew Connelly
Cristen Crew
Tara Curley
Petra Daghestani
Luana de Brito Anton
Collin DeGuehery
Troy Delgrego
John DiGregiorio
Travis Earl
Joanna Ebrahim
Karrigan Ellison
Lori Emery
Christina Falk
Garrett Fanshawe
Eileen Feldman
Bridget Fitz-James
Salome Freud
Bill Fulton
Kurt Gabel
Daniel Galarza Lojano
Zachary Galella
Anthony Garigliano
Jason Garritt
Patrick Gaudet
Ryan Gift
Meghan Gilbert
Earl Gillette
Rick Goyette
Matthew Graveley
Steven Greseth
James Groom
Denny Halim
John Hanscomb
Madeline Harp
Liam Hawes
Maximillian Hernandez
Yuriy Hlovatsky
Liam Hogan
Caroline Holbrook
John Hornberger
Jon Horner
Sophie Huang
Sarah Hudi
Lucy Hurt
Aysha Iftikhar
James Irwin
Yuya Ishizuka
Nathaniel Jones
Benjamin Kalmanowitz
Sherin Kannoly
Molly Keleher
Kathryn Kelly
Kevin Kinder
William Kuhne

2023 Members

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Adam Kulaczkowski
Hannah Kushner
Cory Lapidus
Ferdinando Lezza
Yuchen Lin
Emily Liu
Wendy Mahaney
Valeriy Makarovskiy
Karthik Manchala
Sebastian Marra
Nathaniel Martin
Meredith Mathewson
Kevin Mazzella
Kevin McGarvey
Kevin McGarvey, Jr.
Grace McNamee
Michaela McNutt
Kevin Melnyk
Thorn Mendes
William Meredith
Ambar Melissa Mesa Polanco
Matthew Milich
Samantha Miller
Scott Miller
Matthew Mirdita
Anupama Mohanlal
John Montgomery
Daniel Mullaney
Gabrielle Murawski
Mallory Musterait
Randy Nava
Michael Nicholson
Alex Nolan
Andrew Norton
Kevin O'Connell
Kelly O'Connell
Matt Phillips
Jordan Ramos
Samia Rashid
Mikayla Regan
Tyler Richardson
Alexa Rinaudo
Sofia Rivera
Shannon Roback
Martha Robbart
Anne Roderer
Eric Rotila
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Leah Whaley
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Wastewater Surveillance Network Provides Forecasts of COVID-19 Hospitalizations to Local Health Departments and Other Stakeholders

By David A. Larsen

Each week of October 2023 around 15,000 people in the U.S. were hospitalized due to COVID-19. Surging COVID-19 hospitalizations are not only dangerous for people infected with COVID-19. They can overwhelm hospital staff and decrease the quality of care hospitals are able to provide other patients. Surging hospitalizations were particularly problematic during the winter of 2022, as a "triple-demic" of influenza, respiratory syncytial virus (RSV) and COVID-19 placed an enormous strain on our hospitals, doctors, nurses and other staff.

Forecasting hospitalizations is an important aspect of many infectious disease surveillance systems. As of March 2023, we have been providing local health departments with the number of hospitalizations forecast to occur in a week's time, based on wastewater surveillance data. Wastewater data is superior to clinical surveillance data — such as cases of COVID-19 or COVID-19 test positivity — for forecasting hospitalizations and the forecast estimates are typically 80-90% accurate ***(Figure 1).*** These forecast estimates provide hospitals with valuable information that allows them to plan with more certainty and provide better care for us all.

Our models are publicly available, now published in the scientific journal Infectious Disease Modeling (Hill et al 2023). We initially began with all the COVID-19 wastewater and hospitalization data from the beginning of the pandemic, but we observed a decrease in our accuracy during this past summer. With increasing immunity in the population, either from past COVID-19 infections or vaccinations, hospitalization has become less likely than it was at the beginning of the pandemic. We now use a rolling 90-day window to train our models to forecast hospitalizations. This approach accounts for time-varying immunity of the population and different variants that may arise. With these new models, we see improved accuracy of the forecast estimates over models built earlier in the pandemic.

COVID-19 will be with us forever. With good infectious disease surveillance, provided and fueled by wastewater, we will be more prepared for surges that threaten our public health.

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.

Reference

Hill, D.T., M.A. Alazawi, E.J. Moran, L.J. Bennett, I. Bradley, M.B. Collins, C.J. Gobler, H. Green, T.Z. Insaf, B. Kmush, D. Neigel, S. Raymond, M. Wang, Y. Ye and D.A. Larsen. 2023. "Wastewater surveillance provides 10-days forecasting of COVID-19 hospitalizations superior to cases and test positivity: A prediction study." *Infectious Disease Modelling.* Available online 31 October 2023, In Press, Journal Pre-proof (https://doi.org/10.1016/j.idm.2023.10.004).

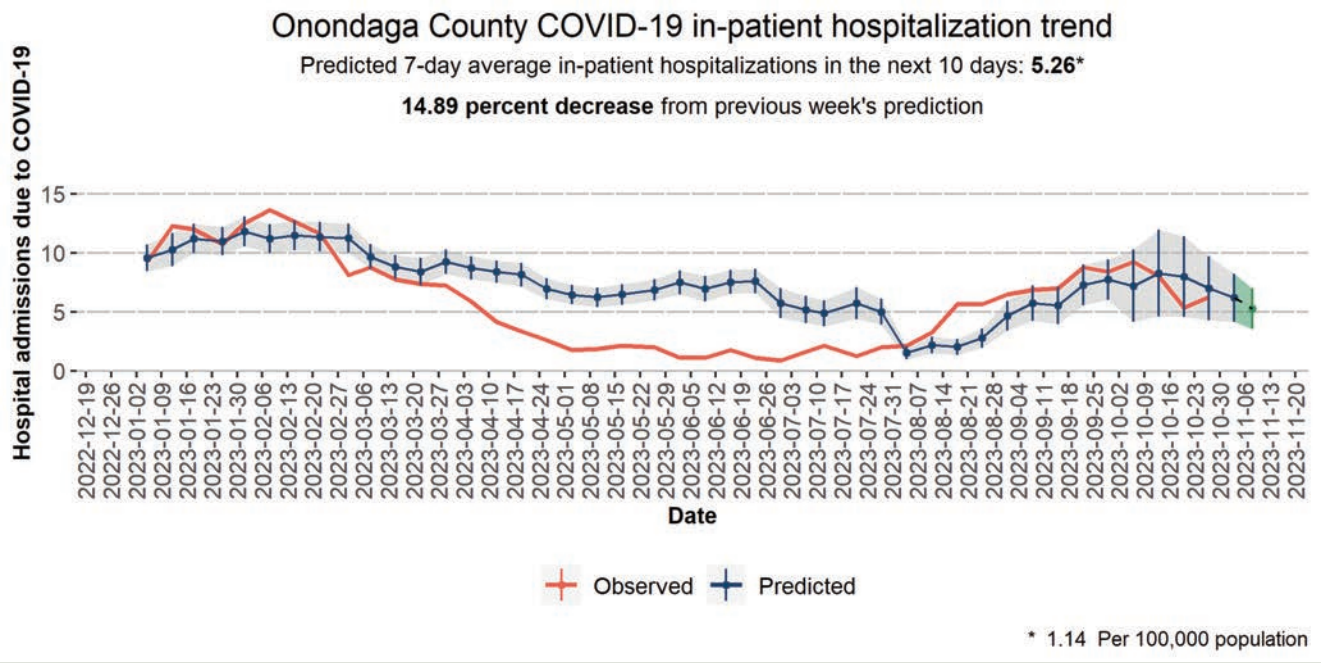

Figure 1. Observed versus predicted hospitalization trends using COVID-19 wastewater data. With increasing population immunity, hospitalization has become less likely than at the beginning of the pandemic. By using a rolling 90-day window approach, we can account for time-varying immunity and different variants. These new models have improved forecast estimate accuracy over models built earlier in the pandemic. *Dustin Hill*

STUDENT SPOTLIGHT: LIYA STEIN, NYWEA INTERN

NYWEA intern Liya Stein helps prep speaker gifts for the 2024 Annual Meeting. *NYWEA*

What is your hometown?
I am from Rochester, New York.

What university do you attend and what is your degree program?
SUNY College of Environmental Science and Forestry, and my degree program is environmental resources engineering.

What made you choose SUNY ESF?
My family owns an orchard, and it opened my eyes to the impacts of climate on the environment in real time, which drove my interest in pursuing environmental science. With that as a background, ESF was an easy choice, but I also decided that an engineering degree would give me more career options.

What year are you and when is your expected graduation date?
I am a junior at ESF, with an expected graduation date of May 2025.

Do you plan to do postgraduate work?
Presently, I have no plans for postgraduate work, but am not ruling it out. I will say that right now I am excited to join the workforce in 2025.

How did you come to apply to be an intern at NYWEA?
I was friendly with the previous intern, Katherine Flores, and she helped me navigate the application process and gave a recommendation to the NYWEA team on my behalf.

What types of support do you provide at NYWEA?
In addition to helping prepare for the annual meeting, I also help manage the filing system for operator certifications, and any other task that they need me to do.

What have you learned about the organization?
I have learned that NYWEA is an integral part of helping to provide clean water in New York, but more importantly that everyone on staff is super helpful and really nice.

What do you like best about interning at NYWEA?
I like the flexible schedule and the staff is very understanding of my coursework demands. The time spent at the office is always enjoyable. It's so interesting to see the behind-the-scenes activities that lead to operator certifications and putting on successful conferences.

Have you had other internships in the field?
Yes. Over the past summer, I interned at the Rochester branch of Arcadis. I learned how to lift a manhole cover, which was a very cool experience. I helped process submittals and got to see how engineering works in the real world. I was lucky enough to tour a wastewater treatment facility and get a firsthand look at how everything works — and also how much seagulls love water treatment facilities! At the end of the internship, I had the valuable experience of giving a presentation outlining my summer at Arcadis. I am excited to return again to Arcadis this coming summer. Hopefully, with more technical coursework behind me, I will get to participate in even more projects.

What are your career plans when you graduate?
It's still early, and I haven't made any concrete plans, but I chose engineering primarily so I could head into the workforce directly after completing my undergraduate degree.

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Spotlight on the Inaugural Class of NYWEA's InFLOW STEMPath Scholars

By Jamie L. Johnson and Madison M. Quinn

GBEC scholars and mentors. From left to right: Rebecca Carmine-Shaw (mentor, Hazen & Sawyer), Kristina Macro (mentor, Xylem), Emily Navarette (scholar, UB), Ashley Brito (scholar, UB), Kaitlin Weglarz (scholar, UB), Juliana Denney (scholar, UB), Noelle Sawicki (mentor, Town of Tonawanda), Regina Harris (mentor, Buffalo Sewer Authority). *Jamie Johnson*

The Western Chapter of NYWEA became the first chapter to incorporate a local InFLOW (Introducing Future Leaders to Opportunities in Water) program with their regional conference at the 41st annual Greater Buffalo Environmental Conference (GBEC) held March 14, 2023. The 42nd annual GBEC will be held March 5, 2024, at the Hyatt Hotel in Buffalo, New York, and will be host to the second annual GBEC InFLOW class.

About GBEC

The Greater Buffalo Environmental Conference (GBEC) is a one-day technical conference providing learning and networking opportunities for the water workforce throughout western New York and beyond. There are three sessions to choose from throughout the day with topics including treatment plant improvement, collection systems, ethics, regulatory updates, emerging contaminants, plant operations, asset management and beyond.

About InFLOW

NYWEA's Diversity Equity & Inclusion (DE&I) Committee began the state-level InFLOW Program in 2021, modeled after the very successful Water Environment Federation (WEF) InFLOW Program, which began in 2018. These programs aim to enhance diversity and inclusion in the water workforce.

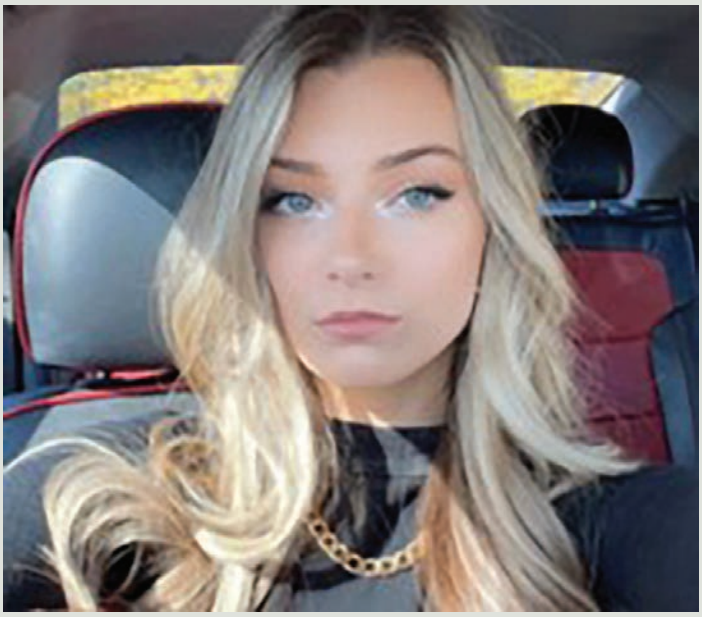
There are two tracks for InFLOW: CareerTech and STEMpath. CareerTech partners with community-based organizations to expose scholars in job-readiness programs to the variety of rewarding career possibilities in water quality. STEMpath identifies scholars from historically underrepresented groups enrolled in undergraduate or graduate degree programs in environmental science, engineering, math, chemistry, biology, physics and other STEM fields of study.

The NYWEA DE&I Committee launched the CareerTech InFLOW at the virtual 2021 Spring Meeting and began the STEMpath program at the virtual 94th Annual Meeting in 2022. The CareerTech and STEMpath InFLOW programs were held in person for the first time at the 2022 Spring Meeting and the 2023 95th Annual Meeting, respectively. For the 2023 GBEC InFLOW class, members of the DE&I Committee in the Western Chapter recruited four STEM scholars from the University at Buffalo (UB): Ashley Brito, Juliana Denney, Emily Navarrete and Kaitlin Weglarz.

Meet the 2023 GBEC InFLOW Scholars:

Ashley Brito

Ashley Brito is a junior at UB, majoring in environmental engineering (class of 2025). She is from the Dominican Republic, by way of the Bronx, New York, and was a transfer student from the State University of New York. Ashley was originally an environmental science major but changed her major to environmental engineering. She is interested in water quality issues and designing sustainable engineering systems for low-resourced communities. She is currently serving as the president of the Student Chapter of NYWEA at UB.



Juliana Denney

Juliana Denney is a junior at UB, majoring in environmental engineering (class of 2025). After participating in a water quality project for a community in Kenya, her passion shifted to environmental engineering. She wants to help disadvantaged communities that have water quality and water access issues. Juliana wants to have her own business someday, possibly an engineering firm. She is currently serving as the vice president of the Student Chapter of NYWEA at UB.

Emily Navarrete

Emily Navarrete is a sophomore at UB, majoring in environmental engineering (class of 2026). She hails from Chicago, Illinois. As a first-year UB student in 2023, Emily used the InFLOW experience to "test the waters" regarding potential careers in the water and environment sector.

Kaitlin Weglarz

Kaitlin Weglarz is a junior at UB, majoring in environmental engineering (class of 2025). She is originally from outside of New York City. Kaitlin transferred to UB from McGill University in Canada. Among many things, she is interested in hydroelectric facilities following a recent plant tour. She is currently serving as the secretary of the Student Chapter of NYWEA at UB.

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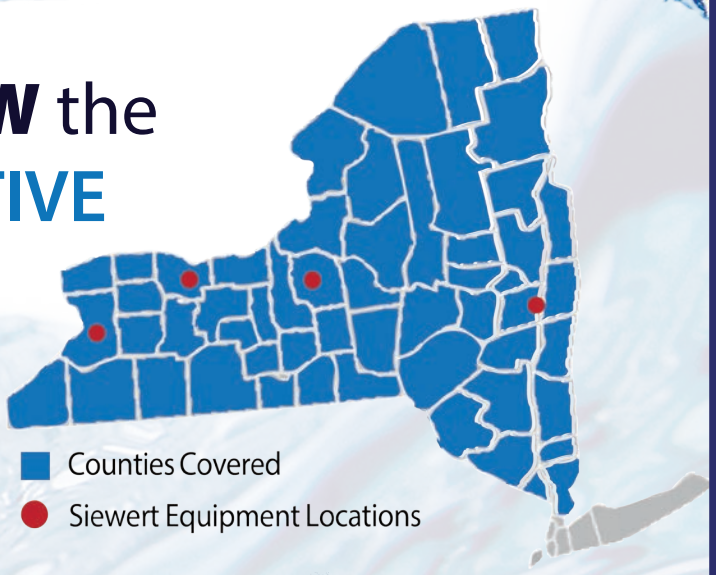

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GBEC InFLOW Program Highlights

As part of the program, InFLOW scholars receive a variety of benefits. Registration for the conference is included in the InFLOW scholarship, as well as one year of student membership in NYWEA and WEF and a small stipend. The students were assigned one-for-one mentors from the Western Chapter to help guide them during the conference and beyond.

Pre-conference activities included a virtual meeting that allowed the students and mentors an opportunity to introduce themselves and ask any questions. The Buffalo Sewer Authority also hosted a tour of the Bird Island Wastewater Treatment Facility before the conference. For some of the students, it was their first time at a treatment plant!

During the day of the conference, the students were able to fully immerse themselves in the experience, attending presentations, networking with water professionals throughout the region, and ultimately building connections to the local water workforce.

Post-conference activities included a short survey to capture their thoughts on the experience overall. They also received their stipend for participating.

Since participating in the GBEC InFLOW program, three of the four scholars spearheaded the revitalization of the UB Student Chapter of NYWEA. With the help and support of the Western Chapter Young Professionals Committee and board of directors, these scholars are serving in leadership roles and helping to drive and shape the future of the organization.

The Future of InFLOW

The NYWEA DE&I Committee aims to expand the InFLOW Program to include the CareerTech track at every spring conference and to foster a STEMpath program with students from across New York state. The committee will provide support and guidance to the regional chapters that wish to host InFLOW programs at their regional conferences, following the model of the Western Chapter's GBEC InFLOW 2023 pilot program.

Jamie L. Johnson is an associate vice president and senior project manager at AECOM and may reached at Jamie.L.Johnson@aecom.com. Madison M. Quinn is the sustainability coordinator for the Monroe County Department of Environmental Services and may be reached at MadisonQuinn@monroecounty.gov.

References

"Introducing Future Leaders to Opportunities in Water (InFLOW) Program." Water Environment Federation website. https://www.wef.org/events--education/career-resources/wef-inflow/

GBEC InFLOW scholars tour the Buffalo Sewer Authority's Bird Island Wastewater Treatment Facility. From left to right: Sean Morrison (Buffalo Sewer Authority), Kristina Macro, Emily Navarette, Kaitlin Weglarz, Ashley Brito, Juliana Denney, Rebecca Carmine-Shaw, Dan O'Sullivan (Buffalo Sewer Authority). *Jamie Johnson*

The Southtowns Advanced Wastewater Treatment Facility — Past and Future

By Joseph Fiegl

Background

"Uncoordinated, uneconomical and unsatisfactory."

This was the state of sanitary sewer services in Erie County during the 1950s, according to a 1956 report titled "Progressive Sewer Systems for a Greater Erie County" (Nussbaumer and Clarke, Inc.). At that time, there were 42 public sewer systems with water resource recovery facilities (WRRFs) in various areas of Erie County — most of which were combined sanitary and storm systems. While some larger publicly owned treatment works were operational during that time, other WRRFs in that era were the responsibility of the equivalent of a neighborhood association. The universal assessment was that the existing facilities could not support the community and did not provide the level of service required to properly protect public health and the environment. Something needed to change to meet Erie County's future needs.

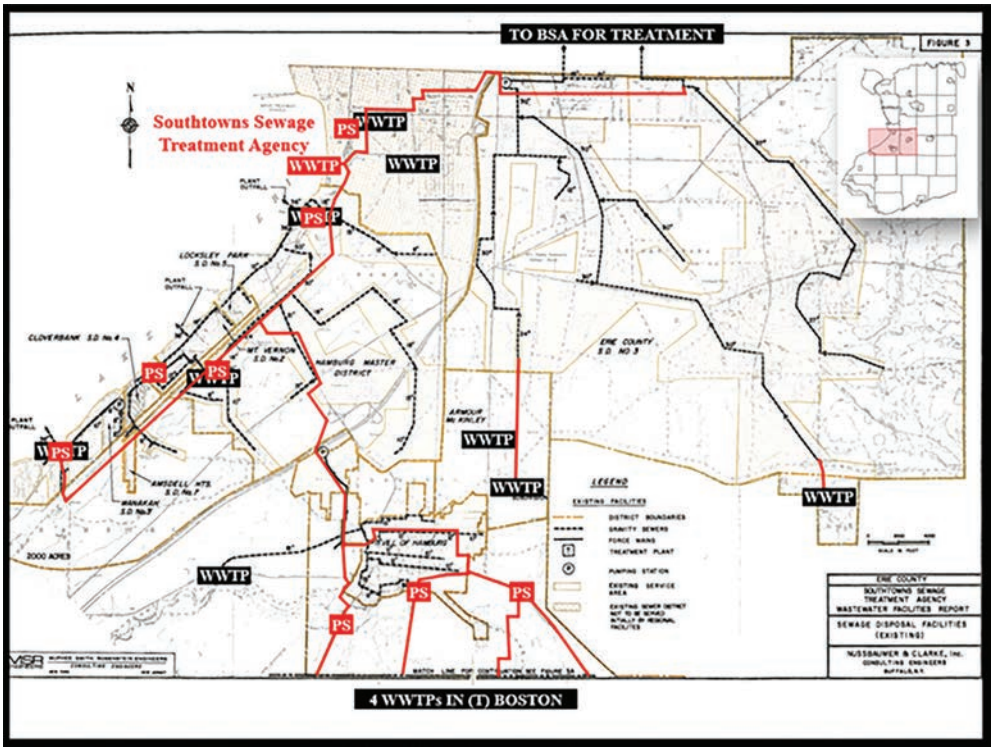

Figure 1. Infrastructure proposed in the 1975 "Wastewater Facilities Report" (in red) to eliminate flow to an overloaded Buffalo Sewer Authority system and eliminate numerous local wastewater treatment plants. *Erie County*

The 1968 "Report on Comprehensive Sewerage Study — Erie County, State of New York" (Greeley and Hansen) set forth a long-range master plan to address these deficiencies. In short, this study investigated options ranging from maintenance of 33 independently operated WRRFs scattered throughout the area to the recommended alternative: namely, a "metropolitan" system consisting of five large WRRFs providing treatment for most of the county, with an additional three smaller WRRFs servicing areas on the outskirts of the county where it would be cost prohibitive to incorporate into the more regional systems.

Not all agreed with the recommended approach and hence several municipalities advanced studies to assess the metropolitan system model's impacts on their locale. Subsequently Greely and Hansen were again retained in 1972 to reevaluate certain areas in Erie County, taking into consideration the information provided by these municipalities. This effort generally confirmed that the more regional metropolitan model should be pursued.

One such regional solution was in the suburbs immediately south of the City of Buffalo, colloquially referred to as the "Southtowns" area. To facilitate implementation of this approach, the Erie County Southtowns Treatment Agency (Agency) was formed at the end of 1974. This was first time upstate municipalities formed a regional entity of this type to manage sewer improvements. Soon after, the 1975 "Wastewater Facilities Report" (Nussbaumer and Clarke, Inc.; ***Figure 1***) was completed as the basis for planning the Southtowns Advanced Wastewater Treatment Facility (AWTF).

Original Construction

Construction of the Southtowns AWTF commenced Oct. 26, 1977, with the use of explosives to demolish the 220-foot-tall smokestacks that stood on the site of the former Penn Dixie Cement Plant on the shores of Lake Erie in Hamburg, New York. Before the concrete crashed to the ground, Agency Chair Leo Fallon commented, "This means that the illusive dream we had years ago has become a reality. This is a triumph of man over bureaucracy." Chair Fallon was referring to the challenges that were faced in patching together the Agency from the individual sovereign municipalities in the area. Many at the groundbreaking ceremony discussed ending years of frustrations related to the lack of adequate sewer services.

The $32 million spent to construct the Southtowns AWTF — along with the additional investment of approximately $90 million to construct pumping stations, interceptors, collector sewers and other appurtenances — was to be transformative for the local ecology and economy. In the decade prior to the Southtowns AWTF going online in December 1980, news stories reported fish kills in local streams due to sewer system problems. At the facility dedication ceremony (pictured right), the Buffalo Courier-Express Newspaper noted the guests of honor "all expressed the same hope that the Lakeshore Road facility in Hamburg would become the jewel of southern Erie County's environmental protec-

Agency Chair Leo Fallon, County Executive Edward Rutkowski, State Comptroller Edward Regan and Congressman Jack Kemp "starting" the Archimedes screw pumps during a dedication ceremony. *Buffalo Courier-Express, May 23, 1981*

tion system." The attendees expressed optimism that building moratoriums due to inadequate sewer capacity that had long upset local officials would be a thing of the past, allowing promotion of development and ultimately growth in their municipalities.

Original Design

The Southtowns AWTF was designed to meet traditional biochemical oxygen demand (BOD5), total suspended solids, and pH parameters as defined in the Clean Water Act. In addition, a phosphorus limitation of 1 milligram per liter (mg/l) was targeted and ultimately incorporated into the facility's State Pollutant Discharge Elimination System (SPDES) permit to address the eutrophication conditions pervasive within Lake Erie and other areas in the 1970s.

The Southtowns AWTF was constructed as a 16 million gallons per day (MGD) monthly average flow facility using modular components for several major treatment steps. The only means of preliminary or primary treatment within the original design were three influent bar screens. With no grit removal or primary clarifiers, influent sewage was conveyed via Archimedes screw pumps directly to the secondary treatment process.

Engineers had determined that aeration within a high-purity oxygen "UNOX" activated sludge system was the best technology for the aeration step at this particular facility. Each UNOX reactor was paired with a square clarifier with circular sludge collection equipment (colloquially referred to as the "squircles"), followed by anaerobic phosphate stripper (Phostrip) tanks. The final steps of the treatment process consisted of sand filtration, disinfection through chlorination, conveyance via effluent Archimedes screw pumps and discharge through a multi-diffuser outfall terminating almost 2,300 linear feet from the Lake Erie shore (***Figure 2***).

The design of the solids handling portion of the AWTF originally consisted of gravity thickeners, a sludge conditioning step utilizing ferric chloride and lime, plate and frame filter presses for dewatering, and fluidized bed incinerators with air pollution control equipment. No digesters were included in the design. The Southtowns site also included an on-site incinerator ash disposal landfill.

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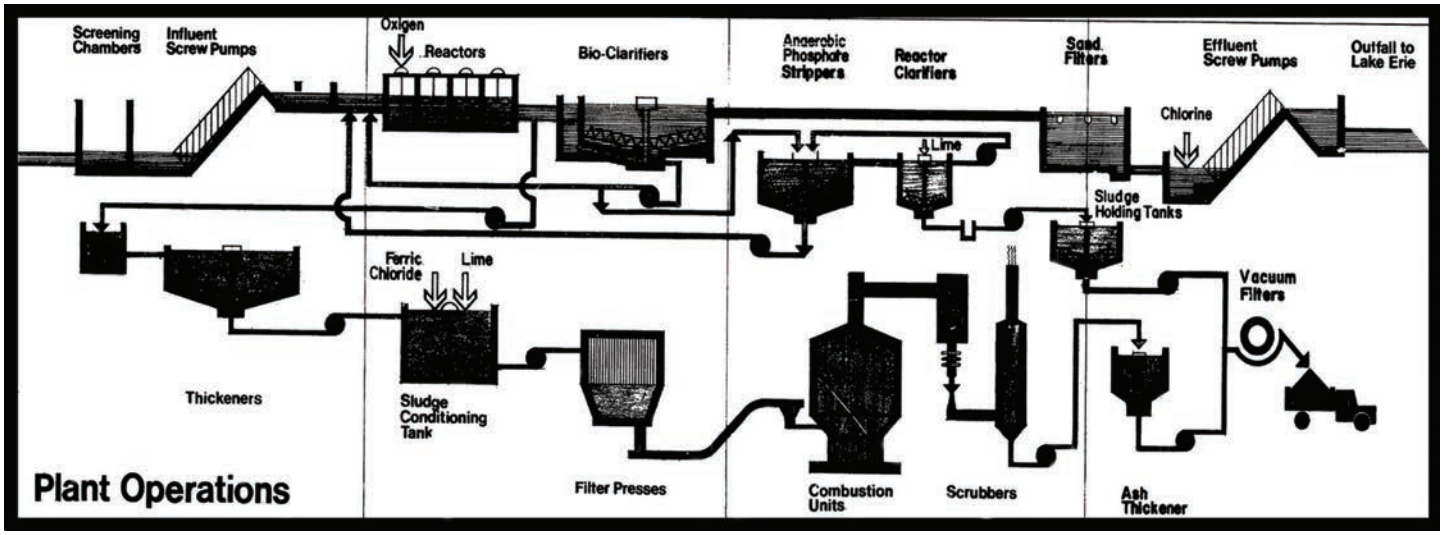

Figure 2. Original Southtowns AWTF Process Schematic. *McPhee, Smith and Rosenstein*

Partial List of Issues and Improvements in the Last 40 Years

- A local municipality that was not part of the Agency wished to join several decades later. After a merger of sanitary sewer services, a major capital project including influent pumping upgrades and other improvements was implemented to allow for elimination of the Blasdell WRRF.
- Due to the lack of a grit removal process, a regular procedure of draining and cleaning UNOX reactors became necessary to remove built-up materials and to maintain treatment capacity.
- The pure oxygen generation system was costly to operate and was subsequently replaced with a more energy efficient VPSA (vacuum pressure swing adsorption) system.
- Operation of the Phostrip tanks proved to be difficult at times and a ban on phosphorus in detergents and soaps decreased influent loads. As a result, chemical addition with ferric/ferrous chloride was implemented for phosphate precipitation and the Phostrip process was shuttered.
- The sand filters often "blinded" with solids and required a high frequency of backwash cycles. The filters were converted to a monomedia style to improve the operation, decrease the need for backwashes and increase flow throughput.
- The gaseous chlorine cylinders used for disinfection presented a potential hazard and were deemed a risk under SARA Title III. The disinfection system was converted to use sodium hypochlorite.
- An effluent turbine pumping system was constructed to manage low flows in a more energy-efficient manner.
- The solids handling process was cumbersome, had limited redundancy, and required significant operation and maintenance efforts. To address these issues:
    - o Ferric and lime conditioning was replaced with polymer.
    - o The incinerator feed system was replaced with a more robus Schwing pumping system.
    - o Various improvements were implemented to optimize the operation and efficiency of the fluidized bed incinerators.
    - o The air pollution control scrubbers were upgraded to meet new regulations.
    - o Because the ash landfill was not double-lined, it was subsequently closed and repurposed as an ash dewatering facility.
- A supervisory control and data acquisition (SCADA) system was developed and implemented for better process monitoring and control.
- Various energy-efficiency initiatives were completed.

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Over Forty Years of Operations

Since December 1980, when the Southtowns AWTF began operation, Erie County has attempted to continually improve the function of the facility. Although the various changes implemented at the Southtowns AWTF allowed for better operation, there were still limitations within the facility.

As one example, grit removal from the UNOX system requires taking down a tank. Due to certain aspects of the modular design of the Southtowns AWTF, a UNOX tank is directly paired with a clarifier. This means a full quarter of the secondary treatment process is unavailable whenever maintenance is performed on either component. If there were to be an issue in one UNOX tank and a separate issue in a clarifier it is not paired with, there are no means to route flows to a different unit and the AWTF would be down half of its process. The direct pairing of UNOX tanks and clarifiers has disrupted the ability of operators to manage the facility since the Southtowns AWTF went online.

There was also the need for greater capacity at the AWTF. Besides the design of the "squircles" constraining the ability of operators to manage peak flows through the secondary treatment process, the aforementioned 1975 "Wastewater Facilities Report" included planning horizons for the years 1975, 2000 and 2025, with the intention of expansion of the facility to service growth within the service area.

Erie County commenced the next stage of facility planning in the late 1990s, resulting in studies and reports that proposed the next phase of major upgrades at the Southtowns AWTF. The engineering work included in these reports addressed the need to provide additional treatment capacity, but also attempted to tackle other items such as the modular design limitations.

Delays with the implementation of the facility expansion were tied to the need for modifications to the Southtowns AWTF SPDES permit. The Southtowns AWTF was operating under a permit last updated in 1987. It would not be until 2012 when a modified permit was issued. Within the 2012 permit there were several changes, some of which directly impacted the potential expansion plans. Of particular interest were provisions regarding the management of peak flows, along with new limitations related to ammonia and total residual chlorine.

Ultimately a two-phase plan was developed to implement the expansion project (***Figure 3***). Phase 1 focuses on the components downstream of existing monomedia filter system, including:

- Construction of a new effluent pumping station for a peak throughput to 55 MGD.
- A new chlorine contact tank and upgraded sodium bisulfite facilities for dechlorination.
- The installation of new site piping to decrease head losses under peak flows.
- A new hydraulic relief point to mitigate against potential site flooding if peak flows coincide with 99% peak lake levels typically associated with seiche events.
- Outfall diffuser improvements.
- Replacement of electrical substation and plant-wide generator facilities.

Phase 2 includes the expansion of the secondary treatment process. After detailed engineering analysis, it was decided to abandon some modular aspects of the original design. To facilitate this change, the existing influent pumping systems will be reconfigured as part of Phase 2 construction to allow flow to be conveyed via force main to the opposite side of the UNOX system. The four existing UNOX reactors will receive structural / mechanical upgrades to renew these assets, to raise the mixed liquor levels, and to allow the flow circulation path within the tanks to change. As part of the expansion project, two new UNOX reactors will also be constructed, meaning with the increased levels in the tanks there will be more than a 50% increase in volume in the aeration step of the treatment process.

Flows from the UNOX reactors will be conveyed to a new distribution box allowing the UNOX reactors to be decoupled from individual clarifiers. Four new circular clarifiers, 145 feet in diameter each, are proposed to be constructed to modern standards as a complete replacement for the existing "squircles." A new pumping station will be installed for return activated sludge (RAS) and waste activated sludge (WAS), with new scum pumping facilities also provided. Flows from the new clarifiers will be conveyed to the existing monomedia filters and finally through the Phase 1 improvements.

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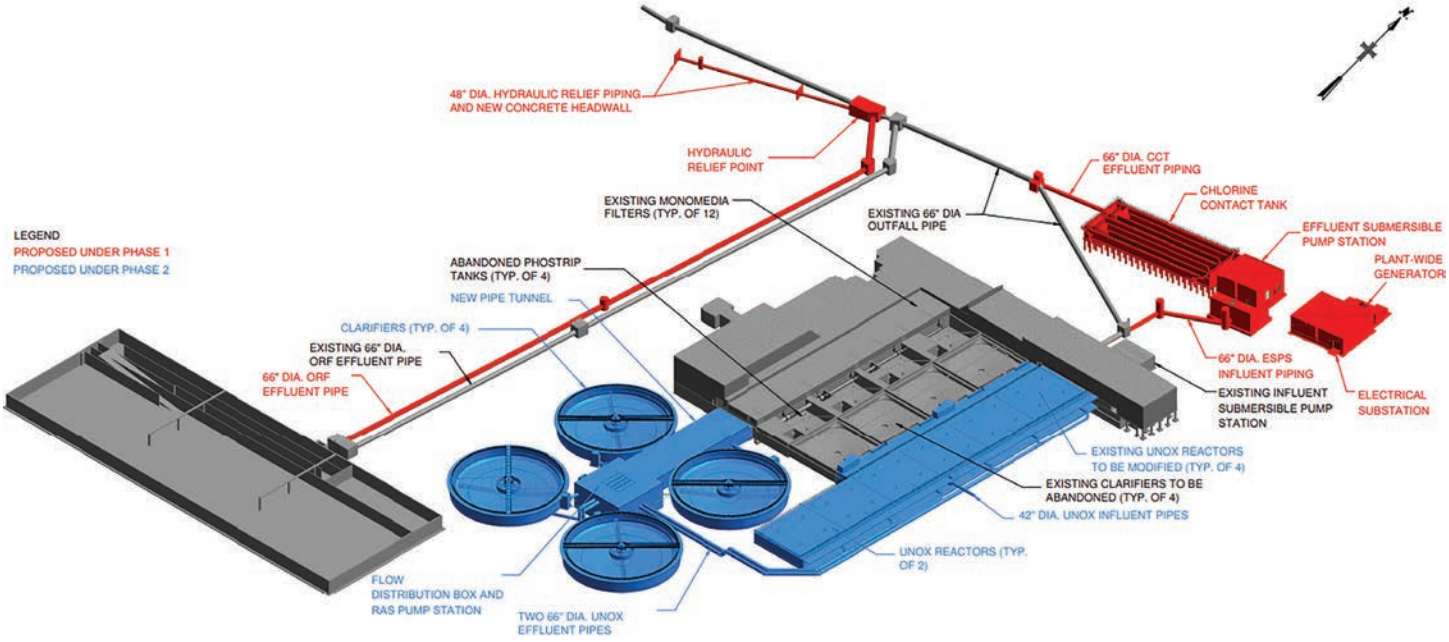

Figure 3. Rendering of Phase 1 (in red) and Phase 2 (in blue) Southtowns AWTF Expansion Improvements. *Arcadis*

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The Future

The start of the expansion project commenced with a procurement bid in spring 2023 for various electrical components for the project such as the plant-wide generator, load bank, transformers, substation and switchgear. These items were identified during design as critical equipment that may delay the project due to long lead-times.

At the time of this writing, bids were received and a contract awarded for the Phase 1 construction project in fall 2023. Phase 2 engineering work is ongoing, with the hope to bid construction in 2024 or 2025. In the meantime, ancillary improvements are ongoing in various areas of the facility, including replacement of the original Archimedes screw pumps and screens in the influent area, the facility roof, key HVAC equipment and the scrubbers for the incinerators.

New 27.5 MGD influent Archimedes screw pump being moved into Southtowns AWTF. *Erie County*

The optimism and excitement expressed by public officials over 40 years ago is being repeated. While not many have continued to refer to the Southtowns AWTF as a "jewel," it is undeniable that this facility continues to be an integral part of "southern Erie County's environmental protection system." The Southtowns AWTF, along with other upgrades implemented in the region in response to the Clean Water Act, have reversed the terrible conditions of Lake Erie in the 1960s and 1970s to the point that the State of New York created Woodlawn Beach State Park on a property adjacent to the facility in the 1990s.

The stewards of the Southtowns AWTF today are following the lead of the original Agency members. The successor to the Agency, Erie County Sewer District No. 3, is committed to continuing this legacy of protecting public health, improving water quality and supporting the community through critical investments in the Southtowns AWTF. The hope is the work performed in the next few years will enhance the operation and function of the facility and meet these needs for decades to come.

Joseph Fiegl, P.E., BCEE is deputy commissioner with Erie County's Department of Environment and Planning, Division of Sewerage Management. He can be reached at joseph.fiegl@erie.gov.

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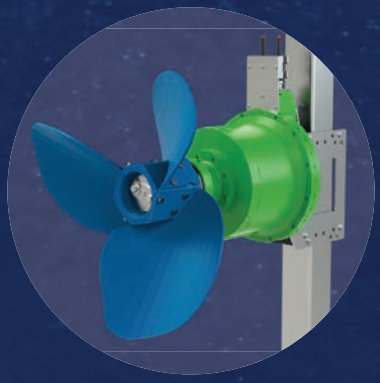

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A Journey of 35 Years: Buffalo Niagara Waterkeeper

By Jennifer Fee

Buffalo Niagara Waterkeeper is celebrating its 35th year as the guardian of western New York's fresh water. Since its inception as Friends of the Buffalo River, our organization has been a catalyst for positive change, tirelessly working to:

- Revitalize the Buffalo River
- Protect critical headwaters
- Empower students in environmental justice communities
- Advocate for essential policy initiatives

Our work covers the Niagara River/Lake Erie Watershed, which spans 1,440 square miles and five counties.

As the organization looks ahead at the next 35 years, we are setting our sights on the revitalization of our beloved Scajaquada Creek. We will continue to protect our headwaters, create sustainable public access, and advocate for environmental justice for our western New York waterways and communities. We will also continue to engage the young people in our communities to develop the next generation of water stewards.

Buffalo River Success Story

Our journey began with a vision to transform the Buffalo River from a polluted industrial waterway into a vibrant, thriving ecosystem. Over the years, Buffalo Niagara Waterkeeper has brought various groups and government agencies together to restore the river and achieve this dream. We have been recognized with the North American Riverprize and the Thiess International Riverprize for our work on the Buffalo River. Our successful leadership of partners in this restoration is one of the reasons we are the only nonprofit agency to hold the coordinator title for a U.S. Environmental Protection Agency designated Area of Concern in all of the Great Lakes.

Through extensive cleanup efforts, habitat restoration and community engagement, Buffalo Niagara Waterkeeper has succeeded in breathing new life into this once-neglected waterway. We have been able to remove five of the nine designated impairments on the river, with plans in place to have the rest removed and the Buffalo River delisted as an Area of Concern over the next two years. Our success on the Buffalo River has helped usher in an economic and cultural renaissance for Buffalo and western New York, with a revitalized waterfront and new economic development.

A once declared dead Buffalo River is now revived and activated by the leadership of Buffalo Niagara Waterkeeper. *Joe Cascio*

Cleaning up the Buffalo River has not only rejuvenated the natural environment, but has brought newfound opportunities for recreational activities as many people flock to our enhanced water access sites that are part of a waterway trail we call the Buffalo Blueway. These sites connect people to our water, expand community engagement and cause more people to be water stewards and stand up for better conditions. In turn that has bolstered the local economy as people seek to develop and welcome those who want to return to our region.

Protecting Headwaters

Beyond the Buffalo River, Buffalo Niagara Waterkeeper recognizes the importance of preserving the headwaters that feed our region's waterways. Our organization understands that protecting these sources

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Buffalo Niagara Waterkeeper creates public access Buffalo Blueway sites like this one at Ohio Street along the Buffalo River. *Scott Lawn Yard*

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Buffalo Niagara Waterkeeper and partners cut the ribbon on the newly installed culvert that allowed for successful fish passage to save the native Brook Trout in western New York's headwaters. *Buffalo Niagara Waterkeeper*

is crucial for maintaining water quality and the overall health of our ecosystems. Through various conservation projects and partnerships, we have worked to safeguard these vital areas, ensuring a sustainable future for the region.

Our work in the headwaters includes protecting land from development when it is near creeks and streams, in addition to restoring any impairments to ecological health of these critical source water streams. In 2022, after 10 years in planning, we opened up improved fish passage with a new, better positioned and wider culvert in Crow Creek, saving the native Brook Trout population with spectacular spawning results just months later.

Empowering Future Leaders

In these 35 years, we have found that it is important to cultivate future water stewards by reaching out to schools and students to promote environmental justice issues, particularly among communities that have been historically underserved. Our organization has developed educational programs that empower students with the knowledge and skills necessary to address environmental challenges in their neighborhoods. This new generation of environmental stewards will have the tools to continue protecting and preserving our natural resources.

We recently brought together alumni from our Young Environmental Leaders Program, which has been running in area high schools since 2016. We were blown away by their stories of how transformational our program had been in their young lives.

Advocacy

Lasting change requires not only grassroots efforts, but also effective policy and advocacy initiatives. Our team dedicates time to promoting critical environmental policies and challenging plans that would endanger our region's waters and communities.

Buffalo Niagara Waterkeeper has developed a year-round cleanup program, engaging thousands of western New York volunteers and removing tons of trash from our shorelines. This outreach keeps trash from entering our lakes and rivers, while also providing us with the needed data to push for legislative change. Our success has positioned us well to create and lead the Great Lakes Cleanup for the last three years, coordinating similar cleanups throughout the Great Lakes with 19 partners and counting.

In addition, we have developed strategic partnerships with local, state and federal legislators and agencies. By working collaboratively with various stakeholders and policymakers, Buffalo Niagara Waterkeeper has advocated for regulations and policies that aim to conserve and restore our watershed and create a healthier, better quality of life for the people of western New York and the Great Lakes region.

Scajaquada Creek

Now as we enter our 35th year, our ambitions have not waned. We feel bolstered by our past work and the community support we have built over

Hoyt Lake in Scajaquada Creek, part of the next large restoration project for Buffalo Niagara Waterkeeper. *Buffalo Niagara Waterkeeper*

three decades.

As we look to the future, our primary focus is the revitalization of Scajaquada Creek, a historically significant waterway that has faced its own share of challenges. We recognize that the creek and communities surrounding it are valuable assets that deserve renewed attention.

The transformation of Scajaquada Creek represents a new chapter in Buffalo Niagara Waterkeeper's legacy. The revitalization efforts aim to not only improve water quality and restore habitats, but also to foster economic development and community pride.

In 2023, we signed agreements and received funding with the Army Corps of Engineers and the National Oceanic and Atmospheric Administration to begin the process of connecting with residents, businesses and government agencies to create a collective vision for the creek's future that benefits everyone. We will soon have a community advisory group to better inform us of what people want. We are gathering data about the creek to see what can be changed. We are connecting with other community action groups to form partnerships so we have a collective voice in making changes that match the needs and desires of the people who will be impacted by our work.

Meeting New Challenges

It is amazing to think how much has been done since we started 35 years ago as the Friends of the Buffalo River. We have gone through a couple of name changes to better reflect our mission of protecting and restoring our watershed, while also connecting people to the water and inspiring them to take up the charge of supporting clean water initiatives. Each year we manage upward of 60 construction projects, community engagement programs and state and federal advocacy campaigns to ensure clean water for our families and for future generations. The ongoing success of our work — from new grant funding to fulfill projects and fundraising efforts to expand our goals — has been recognized locally, nationally and internationally.

Fall along the Niagara River, located in the 1,440-square-mile Niagara River/Lake Erie watershed, where Buffalo Niagara Waterkeeper focuses its water protection efforts. *Buffalo Niagara Waterkeeper*

Our past successes guide us to meet new challenges when it comes to our waterways and our western New York communities. We will joyously celebrate reaching the milestone of 35 years, but our work does not end. Here's to another 35 years of clean water for the western part of this Great Lakes state!

Jennifer Fee is the director of communications and marketing for Buffalo Niagara Waterkeeper and may be reached at jfee@bnwaterkeeper.org.

Tonawanda Creek at Ellicott Creek Park in Buffalo Niagara Waterkeeper's Niagara River Watershed. *Marcus Rosten/Buffalo Niagara Waterkeeper*

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In it for the Long Haul: Continuous Upgrades in Niagara Falls Provide Valuable Lessons

By Richard R. Roll and Casey W. Cowan

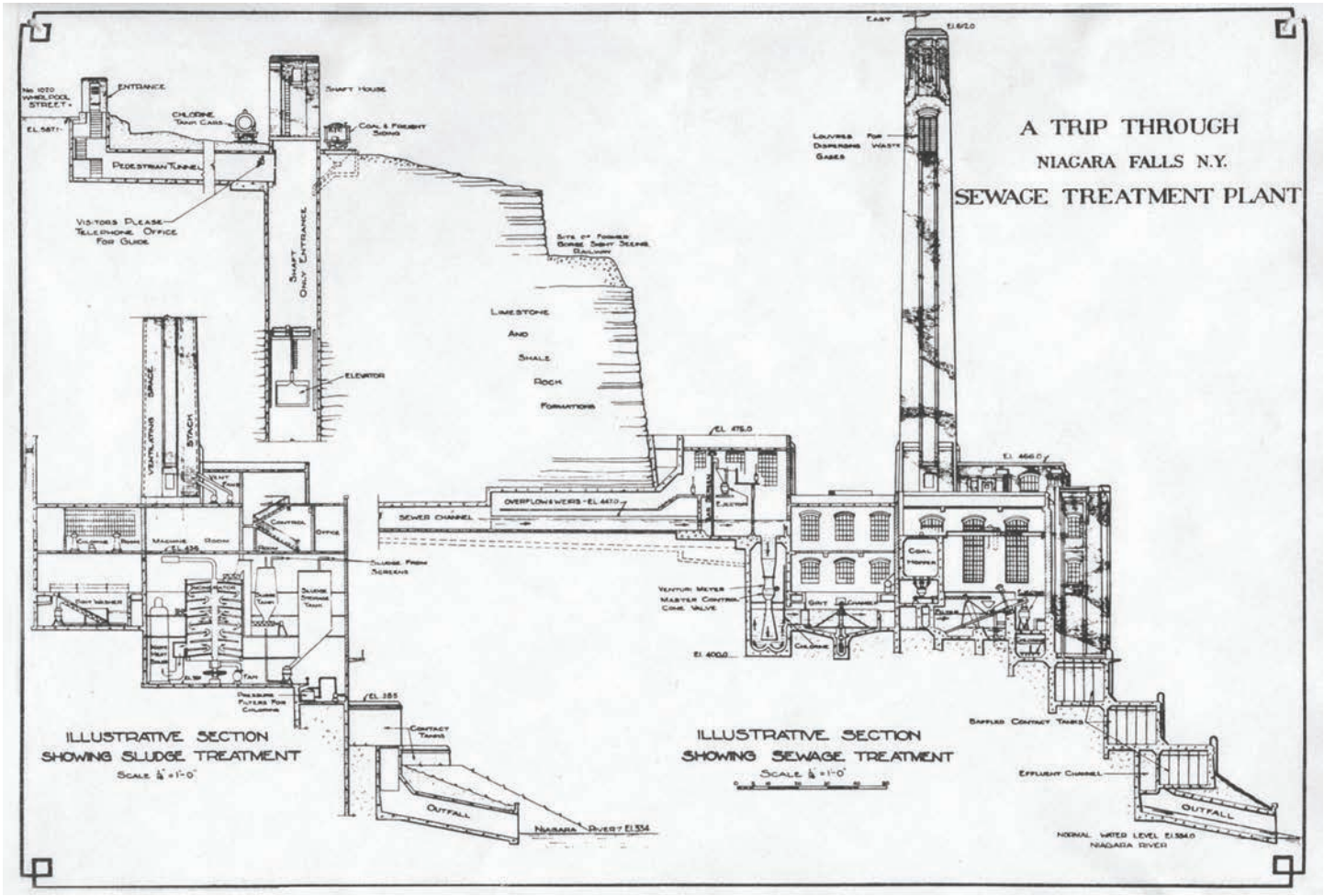

Figure 2. Illustrative section view of the Ashland Avenue Sewage Treatment Plant showing both sludge and sewage treatment sections. *NFWB*

The enduring need for maintenance and rehabilitation of the treatment facilities and conveyance systems currently entrusted to our care will surpass not just the current workforce's careers, but it will surpass those of the next generation and more. Regression is not an option in the face of evolving technology, aging infrastructure, and rising standards of public service and environmental stewardship. The world is traveling forward on a one-way street.

Along the way, the sector has had its share of success and qualified victories (let us not call them failures). Applying the lessons we have collectively learned remains a necessity for advancing efficient and effective utility management.

This progression of reuse and improvement is evident in the continuing rehabilitation of the Gorge Pumping Station (GPS), a principal component of the combined sewer collection system owned and operated by the Niagara Falls Water Board (NFWB). Work was recently completed on the third major rehabilitation project for the 1977 pumping station built on the site of a 1938 treatment facility.

Original Site Use

The Ashland Avenue Sewage Treatment Plant (AASTP) was constructed in the Niagara Gorge 1 mile downstream from Niagara Falls under the Depression-era Works Progress Administration (***Figure 1***). This location was selected along the alignment of a companion 1937 rock tunnel interceptor collecting wastewater formerly discharged directly to the lower Niagara River from eight sewers. The 90-million-gallon-per-day (mgd) AASTP treatment scheme, approved by the State Board of Health in 1934, incorporated coarse screening, grit removal, fine screening (with and without filter aids), and chlorination; captured solids were incinerated on-site in a coal-fired furnace (***Figure 2***).

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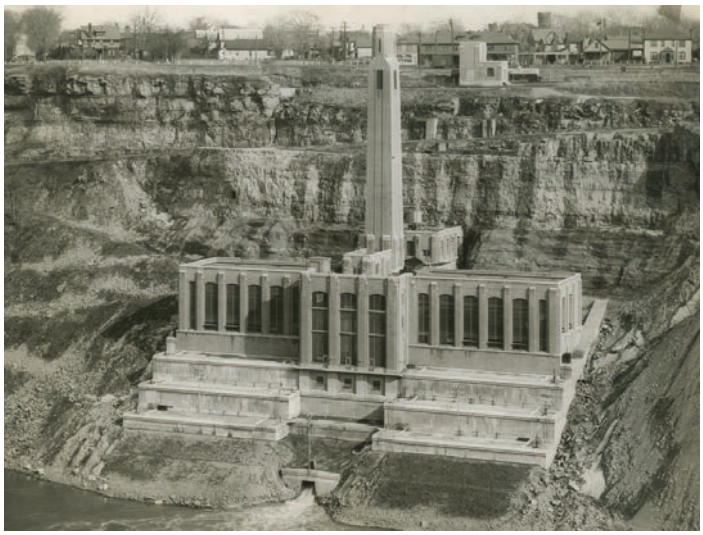
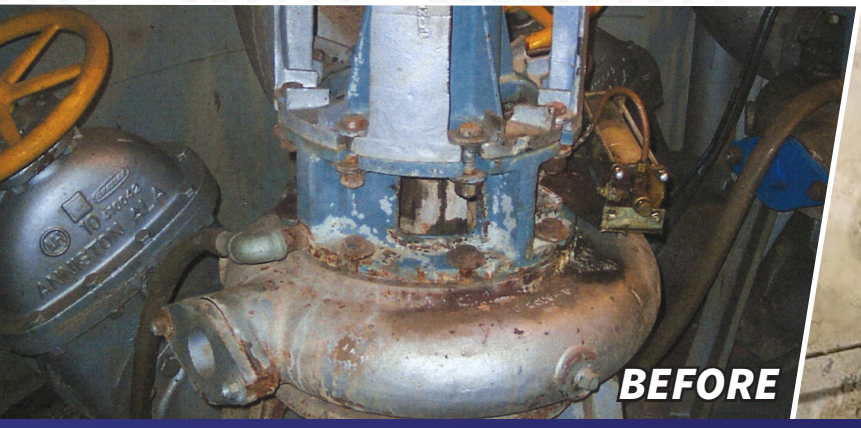


Figure 1. View of the Ashland Avenue Sewage Treatment Plant in 1938, from a vantage point across the Niagara River. *NFWB*

THE MODERN WAY TO REPLACE YOUR OLD DRY PIT PUMP



Easy to retrofit *old dry pit pump setup. The new pump setup slides out for easy inspection.*

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This physical-chemical facility served the City of Niagara Falls, New York, until the 1970s, when the federal Construction Grants Program enabled the construction of a successor physical-chemical activated carbon facility. That construction occurred just in time because 30 years of hard use with a heavily chemical-laden influent had taken its toll on both equipment and structures.

The tight footprint in the gorge precluded construction of an expanded facility on-site, prompting its location elsewhere in the city's industrial corridor. Since the existing interceptors fed the AASTP headworks, most of the facility was demolished, allowing pumping station construction on the same site (***Figure 3***). A 1.6-mile force main was built to convey wastewater to the new facility.

Figure 3. Gorge Pumping Station can be seen from Ontario, Canada, looking northeast across the Niagara River. *Rick Roll*

GPS Construction

The GPS was initially equipped with three, 400 horsepower (hp) pumps; two would be available for duty while the third was a standby for when another pump set was out of service for maintenance (***Figure 4***). Manually cleaned bar racks, with provisions for future comminutors, were placed ahead of quite small wet wells, owing to a scarcity of space on the side of a gorge. The wet weather overflow weirs and bypass channels of the AASTP were preserved and reused for the GPS, which remains one of the NFWB's six permitted combined sewer overflow (CSO) locations.

A bubbler system provided level information to a liquid rheostat (liquistat) system that adjusted pump speeds by the variable immersion of conducting plates in a caustic solution of sodium carbonate. Dissipated energy heated the solution, which was cooled by circulation through external jackets surrounding the pumping station discharge pipe.

Operators would visit the GPS on their daily rounds, checking on equipment, rotating pumps, raking the bar racks and addressing items of concern. Back in the 1970s there were six operators plus a supervisor on shift at the facility, permitting this level of operator attention. Despite its inherent peculiarities, the GPS functioned satisfactorily on a tight footprint with its pumps operating in a high head, high flow, high speed environment.

Standalone improvement projects in the mid-1980s included the replacement of the wet well and influent channel slide gates with more substantial sluice gates. The problematic caustic solution cooling jackets were also replaced with liquid to air heat exchangers.

First Rehabilitation Project

By the late 1980s, compounding difficulties with pumps, coupled with a court-ordered groundwater diversion that would increase dry weather GPS influent flow, prompted the first comprehensive rehabilitation project (***Figure 5***). All three 400 hp horizontal pumps were replaced with

Figure 4. Pump room with 400-hp horizontal pumps in 1989. *Rick Roll*

Drop Shaft Zero Revisited

The upstream CSO from which discharge reduction was necessary, both in the early 1990s and the early 2020s, was the NFWB's Falls Street Tunnel at Drop Shaft Zero, featured in the February 2020 issue of WE&T. At 75 feet below street level, a static regulator uses twin rectangular orifices and a weir to bifurcate tunnel flow between dry weather flow to the GPS and excess wet weather flow to the lower Niagara River. The recent GPS rehabilitation project used the general contractor to enlarge both orifices and construct a higher weir, greatly reducing CSO to the river at this outfall (located at the base of the international Rainbow Bridge and in a major tourist area). The anticipated disruption to bridge traffic and U.S. Customs and Border Protection inspection activities due to construction was mitigated by virtue of the pandemic, temporarily limiting cross-border travel.

Inspecting a new tunnel regulator diversion dam. *TJ Quarantillo*

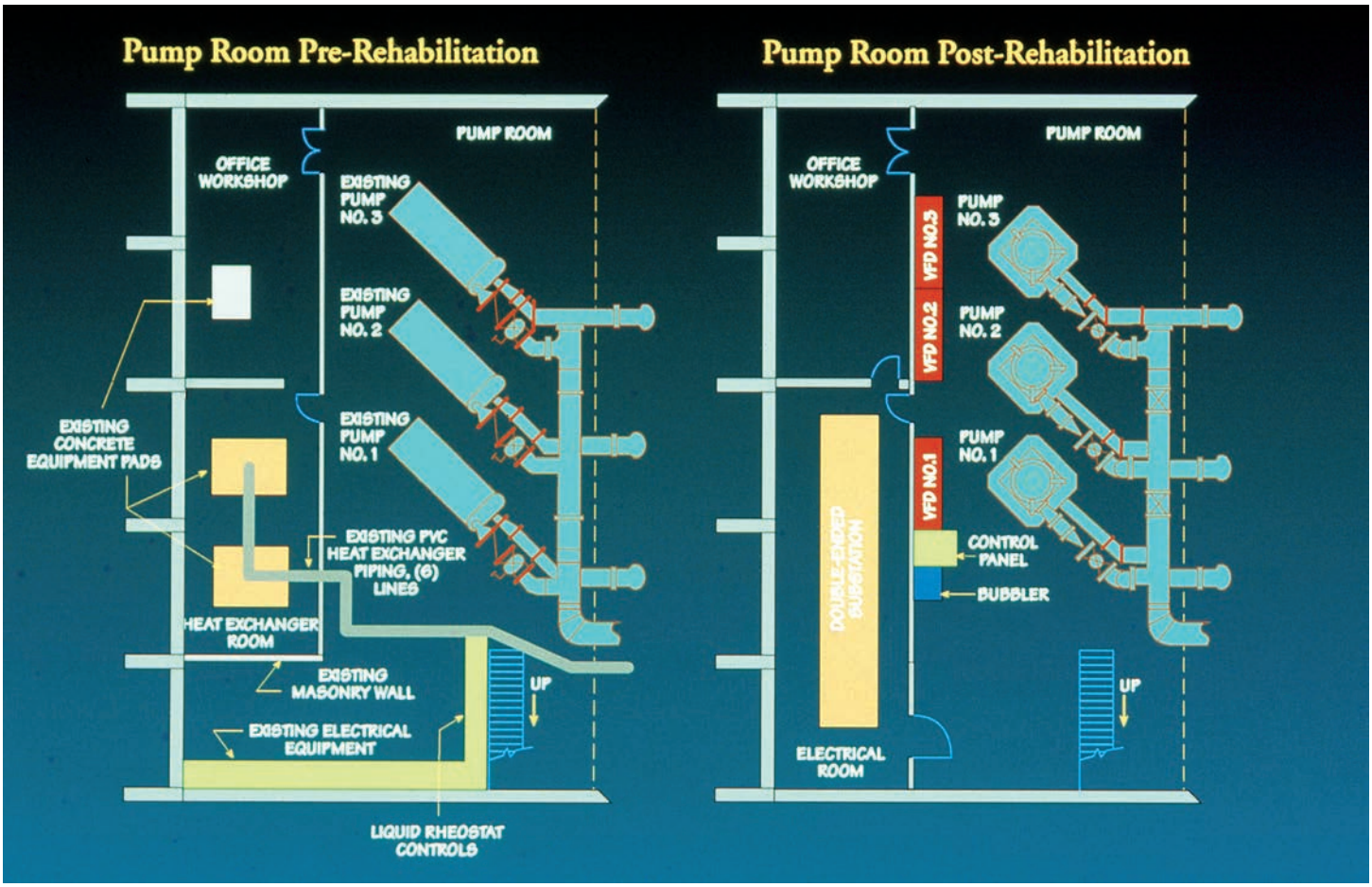

Figure 5. Diagrams of the pump room layout before and after the 1993 rehabilitation project. *Ramboll*

500 hp vertical pumps. Improved pump performance led to the motor upsizing, as the discharge force main capacity restricted maximum station output to the original 19.5 mgd.

The modified pump footprint and floor slab loading required an investigation into the structural integrity of the 1977 underlying beams and columns. An opening had to be cut into an external wall to permit access into the former AASTP grit chamber area for the inspection, which revealed no deterioration or other concerns. A steel frame and bolted hatch were installed in the opening to permit easier future access.

The aging and leak-prone liquistat system was replaced with variable frequency drives (VFDs) and a new bubbler system installed in the pump room. Removal of the heat exchangers made room for a new double-ended electrical substation with remote operation from a ground-level console. Automatic switching from one independent electrical feeder to the other averted the need for on-site standby power generation.

The original suction, discharge and check valves were found suitable for reuse, but new isolation valves were installed in the discharge manifold to assist with subsequent shutdowns.

Despite misgivings with the low bidder due to their performance on other projects, the contract award proceeded because all bidding and bonding requirements were satisfied. The general contractor, though, exhibited persistent difficulties conducting the project's work. Damaged equipment (including a dropped VFD due to mis-rigging), misaligned piping, hollows beneath the pump base plate, lack of coordination with other prime contractors, and liens from unpaid subcontractors and suppliers topped a lengthy list of problems. The city had to make out several progress payments to dual payees to satisfy various liens.

These problems always place the owner in a tough position, trying to work with the struggling contractor to complete the job yet recognizing the accumulating deficiencies affecting the quality of the finished work. Their financial and management issues grew to the point where New York state revoked their operating authority, prompting bankruptcy in the spring of 1993.

Was this a cataclysm to the project? No, it was a bright turning point, as the bonding company became empowered to retain a competent replacement firm. This completion contractor took possession of purchased equipment held in unsecured storage, corrected flawed and unacceptable work, and finished the remaining project requirements, permitting job acceptance that summer.

Project Aftermath

During pump startup, excessive pump noise was diagnosed as flow separation due to suboptimal inlet conditions. It was addressed with a manufacturer-recommended air injection system, intended to disrupt the high velocity stream asymmetrically entering the eye of the impeller.

Two years later, inquiries following observations of impeller damage revealed that prior factory fire damage to the master form resulted in an incorrect vane tip angle for all three pump impellers in service. Despite passing performance testing, the Niagara Falls order was the first since the form was improperly repaired. The manufacturer provided replacements, which resulted in improved pump performance.

Concurrently, a diminishing force main hydraulic capacity was prompting concerns. Hypochlorite and hydrochloric acid rinses did not provide lasting improvements, and countermeasures for potential air binding did not have a significant impact.

A GPS shutdown and force main entry revealed that a healthy biofilm had developed along the pipeline, indicating that the air injection system turned the downstream force main into a biological tube reactor.

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Growing biofilm by adding air to raw wastewater — go figure! The impeller replacement and increasing the wet well level setpoint by 10 inches allowed removal of the air injectors and gradual restoration of capacity.

A later project replaced the lower levels of the access elevator shaft structural steel dating back to the AASTP. The flanges of many I-beam sections exhibited "French Pastry" behavior, delaminating into crumbling flakes and dust, allowing the gradual deformation of the structure.

By the mid-2000s, pump wear and tear coupled with a diminishing reliability in support systems caused an increased frequency of dry weather overflows, drawing the attention of state environmental regulators. With each pump rated for discharging 13.5 mgd of raw wastewater at 160 feet of head and operating speeds of 1,188 revolutions per minute, the station has a particularly challenging duty and experienced more rapid degradation compared to a typical pumping station.

The pump room VFDs were also showing their age; one failure required an instrumentation technician and his soldering iron to repair a circuit board defect due to the lack of spare board availability. Given a variety of problems, an Order on Consent reliability analysis of the GPS was performed, whose results formed the basis for a second rehabilitation.

Second Rehabilitation Project

After weighing the pros and cons of replacing the pumps and motors for a 20-year longevity versus rehabilitating the existing ones for another 10 years of service, the rehab option was selected. During 2007, one pump at a time was removed and transported to the manufacturer's out-of-state facility for an original equipment manufacturer (OEM) overhaul while the motors were rebuilt in a nearby Buffalo shop.

The contract documents specified a minimum number of components in need of rebuilding or replacing. However, an allowance was also incorporated, anticipating additional work items following pump and motor teardown. Each pump and motor required use of this allowance to different extents, tailored to their specific needs.

The pump/motor combinations were each evaluated for their conformance with the specified -2%/+10% range of the original certified pump curves. Testing was also performed to confirm satisfactory vibration levels. Initial startup revealed several issues, requiring multiple pump shipments back to the factory to correct issues before acceptance.

The pump suction piping from their respective wet wells was upsized from 18 inches to 24 inches, improving the margin for net positive suction head (NPSH). Increasing the wet well operating setpoint by another 4 inches was instituted for the same reason.

Automatically closing suction knife gates to replace the manual valves were also added because one previous overflow event was linked to a stuck check valve, allowing backflow through an offline pump to the overflow channels. The 1977 check valves were presenting other problems and were all replaced. Iterative improvements involving weights and a shock-absorbing hydraulic cylinder were necessary to prevent valve slamming against the high discharge pressure.

New VFDs and control/telemetry equipment were located in their own temperature-controlled room, a clean and dust free area that formerly served as a workshop. Two air conditioner units were installed to maintain the electronics at a cool temperature, much cooler than the pump room in summer.

Other significant upgrades included replacing the bubbler system with ultrasonic level monitors, adding new gas monitors for the wet well and pump room, and replacing the manually cleaned bar racks with continuously operating twin grinders. This was a measure intended to reduce the extent of operator attention at the station. Improved telemetry back to the facility control room also helped with this.

A mis-manufactured grinder coupling fractured due to loose rock capture after an interceptor cleanout project, but replacement with one of proper orientation promptly brought it back to operation. That's one reason facilities are designed with fully redundant hot backups in critical areas.

The late 2000s brought the development of the NFWB's CSO Long Term Control Plan. While in presumptive compliance, a handful of beneficial improvements were identified, which eliminated two overflow locations, modified overflow weirs in another two locations, and added floatable retention baffles in the AASTP/GPS overflow chamber.

The new millennium also saw the twisted pair copper wire telemetry link back to the facility upgraded to fiberoptic cable, improving reliability and versatility.

Current Rehabilitation Project

As anticipated, the pumps gave better than 10 years of service until again exhibiting performance and reliability problems. Planning for improvements began in 2019. This time all three were slated for replacement with a similar model, although four-vaned impellers replaced the three-vaned style from the 1990s for improved pump hydraulics and gaining another 2.5 feet of NPSH benefit.

A detailed study was performed using finite element analysis (FEA) modeling to address lingering vibration concerns on the vertical pumps that had operated just within tolerances since they came online. Baseline testing determined that the pump floor is not infinitely rigid by foundation design standards and, instead of retrofitting costly reinforcements, the pump stands were redesigned to shift operating frequencies safely away from the natural harmonic frequencies of the building. This improvement is expected to mitigate vibration-induced wear, prolong pumping output and increase equipment longevity.

Although the VFDs continued to perform adequately, their 15-year-old age, spare parts availability, and reliability concerns prompted replacement with the latest VFD technology.

The NFWB made improvements to the overflow channels and their instrumentation due to a state directive to further reduce CSO activations at the same permitted upstream location closer to Niagara Falls. Both channels were opened and cleared of hard debris. The damaged overflow weir structures were removed and replaced with new weir plates. New bubbler tubes were installed and connected to recalibrated bubbler systems, required to monitor and document CSO volume.

The contract documents called for a factory rebuild of both headworks grinders, but an attractive cost proposal from the contractor led to their replacement with new in-kind units (***Figure 6***). Ancillary improvements addressed heating, ventilating and lighting needs. Three nonfunctional sluice gates from the 1980s were also replaced.

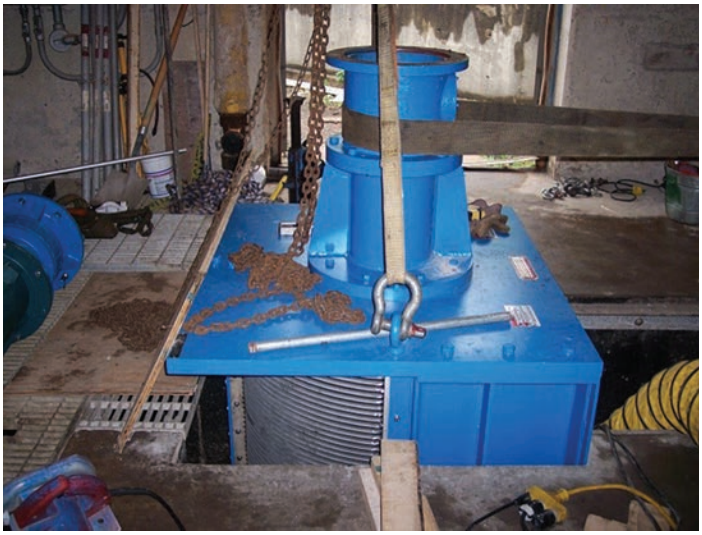

Figure 6. A crane lowers a new grinder into position, replacing manually cleaned bar racks. *Rick Roll*

Pandemic and supply chain impacts extended the expected construction period by well over a year. Slim timing led to one of the old pumps failing the week before the first new pump set was scheduled for startup, prompting the owner and contractors to expedite replacement efforts. The last old pump had to be continuously monitored to minimize operating time and bearing temperature as the contractors finished installing the second new pump set. The third new pump was started in late July 2022, allowing project closeout by fall (***Figure 7***).

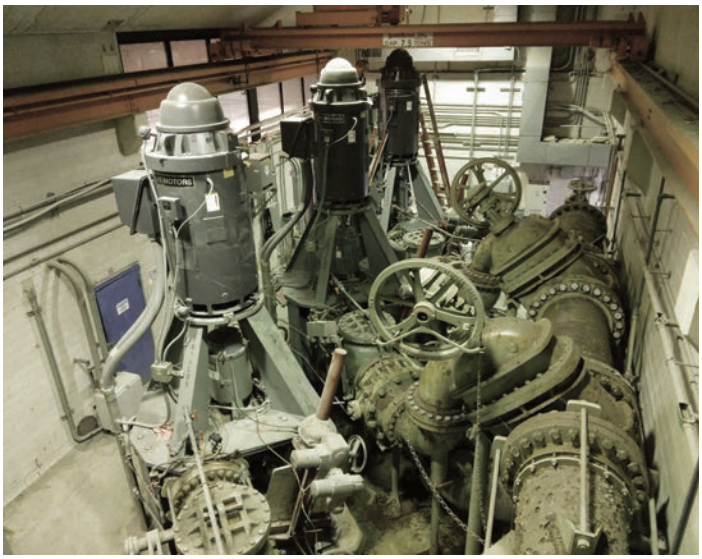

Figure 7. Although delayed by pandemic supply chain issues, the new pumps and motors were finally up and running in 2022. *Rick Roll*

The station has been returned to its design pumping capacity with all three of its new pumps successfully operating at low vibration levels. All indications are pointing toward reliable operations into the 2040s.

Lessons Learned

Several lessons have been learned — and relearned — over the past 45 years of GPS operation, maintenance, repairs and rehabilitation projects. The principal lessons include:

- Don't venture too close to the published pump limitations. Successive measures increasing available suction head have stretched the operating comfort zone. Remember that new pumps and piping systems are only new once — they degrade in performance and condition from there on, behaving differently.
- Air injection as a pump inlet hydraulic mitigation measure may have its applications, but not here. The response to a symptom of a problem created new problems in the downstream pipeline.
- Even if electronic equipment is operating within temperature limitations, a cooler environment, also clean and dust free, will promote happier equipment and happier owners.
- Similarly, lower pumping system vibration levels will provide greater longevity than pumps operating close to the edge of accepted limits. Vibrations are insidious, seeking out and exploiting system imperfections.
- Build some flexibility in specifications when rehabilitating existing equipment that can have more problems buried within. Chances are, they do.
- Valves installed as construction measures must still be exercised if there's any chance of using them as future construction measures. The same goes for other valves. And sluice gates. And any equipment from which movement is expected.
- Plan equipment selection and maintenance needs with the operator in mind. Making a procedure easy will help its enduring adoption. If in doubt, an operator can identify an easy way to implement a new procedure or directive.
- Don't fear contractor bankruptcy as the death of your project; it can bring new life and a successful conclusion.
- Vigilance with your ventilation systems can squeeze more longevity from equipment expected to endure nasty conditions. Yes, it has to keep operating to do the equipment any good.
- If your facility is in a remote area, think like a vandal. Louver screens, replacing windows with concrete block, welded hinge covers, padlocks with no exposed shaft, and security cameras have all been used at the GPS.
- Resist having current design efforts unnecessarily limit future flexibility and choices. You can't anticipate every change the next crew will need to make.

As the saying goes: The only constant in this world is change. That's a good thing!

Richard R. Roll, P.E., DEE, recently retired from full-time practice. Casey W. Cowan, P.E., is an associate in the Buffalo, New York, office of GHD Consulting Services Inc. (Sydney, NSW, Australia).

Tips for Success and Lessons Learned for a Municipal Rain Barrel Sale

By Mary Rossi MacSwan

The Erie County Department of Environment and Planning (DEP) is lead agency for the Western New York Stormwater Coalition (WNYSC), a group of 43 municipal agencies that are subject to New York State Pollution Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Municipal Separate Storm Sewers Systems (MS4s). WNYSC membership includes 29 municipalities in Erie County, 10 municipalities in Niagara County, two counties, a university and a transportation authority.

Since 2002, WNYSC members have collaborated on numerous regulatory requirements in the MS4 permit. As the chief environmental specialist at Erie County DEP, I have coordinated WNYSC since its inception in 2002 and provided a variety of technical and compliance assistance to the members. Among my responsibilities are WNYSC's shared public education and public involvement and participation initiatives, employee trainings in illicit discharge detection and elimination, construction site inspections, stormwater management practice inspections and pollution prevention for municipal operations.

In this article, I will focus on a key strategy WNYSC utilizes to meet the Public Involvement and Participation requirement in the MS4 permit. Beginning in 2016, Erie County, in partnership with WNYSC, initiated sales of rain barrels and compost bins to help to reduce stormwater pollution. I will also highlight some of the lessons learned through this program.

Backyard rain barrels conserve municipal water supply and cut water bills up to 40%. *erie.compostersale.com*

Benefits of Rain Barrels and Compost Bins

Using rain barrels to capture roof runoff directly from downspouts and gutters reduces the volume of stormwater runoff that flows over impervious surfaces on its way to municipal storm sewers and ditches that discharge directly to surface waters. When contaminants such as sediment, debris, fertilizers, pesticides, automotive fluids or bacteria are present on those surfaces — or even adjacent grass or gardens — stormwater runoff flowing across them will transport them to our local waterways. Reducing the volume of contaminants discharged to bodies of water will improve water quality, help to prevent algae overgrowth and harmful algal blooms, and protect aquatic habitats.

In developed areas with extensive impervious surfaces, such as the municipalities regulated by the MS4 permit because they are geographically within U.S. Census-defined "Urbanized Areas," large volumes of water enter the storm sewer systems every time it rains or a snowmelt occurs. While precipitation events cannot be controlled, there are actions that can help to decrease runoff such as reducing impervious area in development and re-development, diverting stormwater runoff to treatment and/or infiltration practices and, at the residential level, engaging in practices that reduce runoff.

Widespread use of rain barrels on residential properties is a key strategy to reduce individual inputs and actively engage the general public in stormwater pollution prevention solutions. A one-inch rainfall event on a 1,000 square foot roof, yields 625 gallons of rainwater. Between April and September, the western New York area receives around 20 inches of rainfall; therefore, over six months one 55-gallon rain barrel could divert up to 12,500 gallons of rainwater.

This scale of diversion, coupled with widespread use of rain barrels, not only reduces surface runoff and potential pollutant transport to municipal storm sewers, but it can also help to reduce the frequency and volume of sanitary sewer overflow events in areas where sanitary sewer systems are susceptible to infiltration and inflow. From a wastewater treatment perspective, reducing stormwater inputs to sanitary sewers is crucial to minimize or eliminate overflow discharges of sewage to local waterways and to prevent sewage from backing up into homes and businesses. To this end, widespread use of rain barrels is far more cost-effective than other remediation solutions, such as construction of larger capacity sanitary sewers or overflow retention facilities that are astronomically expensive in comparison.

Beyond the advantages of reducing pollutant loadings to surface waters, using harvested rainwater for watering lawns, gardens and potted plants helps to conserve water. Yet another bonus is the natural nutrients in rainwater that make it far better for plants than tap water, which has chlorine and fluoride in it. With a rain barrel, gardeners can decrease or eliminate their use of chemical fertilizers as well as the potential for those chemicals to contaminate runoff.

Home composting is a simple way to restore nutrients to soil, so compost bins are also included in the annual sales. The addition of compost enriches soil, stimulates plant growth and diminishes the need for chemical fertilizers. Less chemical fertilizer translates into less potential for those chemicals to impact local water quality. Composting yard trimmings and food scraps also has the added benefit of keeping those wastes out of our local landfills.

Each year, with each sale, Erie County DEP has gained valuable experience promoting the sale, structuring the sale webpage to minimize potentially time-consuming issues with customer databases, and managing product pickup and shipping. There has been a heap of unforeseen complications through the years and although the lessons learned improve the process, invariably a new glitch seems to surface!

Promoting/Advertising the Sale

Through the years, advertising consisted of expensive yet almost minuscule advertisements in local newspapers that were delivered at no-charge to thousands of households on a weekly basis; it was a cost-effective way of reaching many households in targeted areas. WNYSC's partner municipalities also promoted the sale with public meeting announcements, and posters and flyers in public spaces. County news releases were also

used and were extremely effective when they were printed or announced. However, because it was initially referred to as a "sale," increasingly we noticed the news releases were not being printed or announced.

Our only objective in selling the products was to promote the environmental benefits associated with their use. There was no profit ever for our efforts. To change the profit-motive perception, wording that referred to "sale/selling" was eliminated in favor of terms such as "offering."

Fast forward to present day personal email accounts that pre-sort incoming messages. This same language issue also affects promoting the opportunity via an email notification list that we maintain. If our messages allude to anything considered a sale or marketing, it goes straight to a folder with a multitude of similar emails that I, for one, never read. In the end, creative wordsmithing is the solution for both news releases and emails.

Enter the age of social media. Although I do not engage to any great extent on a personal level, I have come to love social media! Using our county's social media accounts, our webpage traffic and sales have increased with every post. Social media is a cost-effective method to advertise our sale; it is nearly effortless, and its reach is astoundingly far and wide.

Sale Webpage

Our first sale in 2016 was conducted using mail-in forms and checks for payment. The forms were printed in weekly newspapers and available online. At the time, Erie County was dealing directly with the manufacturer, and this was the only option. Today, it goes without saying that online sales are far less time consuming and the only way to go. Fortunately, the manufacturer started working with Brand Builders LLC, a New Jersey firm that coordinates rain barrel and compost bin sales throughout the United States. Working with this firm was advantageous because they established and maintained the sale webpage, collected sales tax, arranged shipping, and provided customer lists.

The sale webpage system did have its share of glitches. First, the customer databases were overly complicated because depending on the pickup location selected, different nomenclature was used for product descriptions. The database fields merged a lot of the information needed that then had to be split to enable sorting. This presented a time-consuming process to generate pickup lists but was easily fixed with the distributor.

Second, to offset issues with the sale webpages, careful and somewhat time-consuming reviews are absolutely necessary before the links go live. This process entails proofreading for clarity as well as mock purchasing for each product being sold from start to finish, and a "purchase" of at least one item to examine the confirmation details and information (later refunded by our distributor). I continue to do this every year, as it is easier to fix at the onset than to correct after hundreds of sales.

Customer Communications

The rule of thumb for communicating distribution information is: "there is no such thing as overly explicit." Confirmations need to include the location, dates and times for pickup and other pertinent details. The details should be streamlined as much as possible, and the most important information should be accentuated as needed. We need to remind customers that they must arrive with an empty vehicle — or to send someone else if they cannot pick it up — and that distribution is not available outside of the scheduled dates and times (unless it is of course). Lastly, a few days prior to distribution, an email reminder is sent. For our large volume sales, the reminder noted we were expecting hundreds of people to pick up, and if possible, they should follow the alphabetically staged pickup times we added to minimize congestion.

Customer Pickups

Distribution locations for customer pickups have included county parks, municipal building parking lots and a large, under-utilized shopping mall parking lot. Primary considerations in selecting a site are traffic flow, worker and customer safety for loading, secure product storage and unclaimed product storage. It is best to select a site with more space and parking than you anticipate needing. Fortunately, as items are pre-ordered, the volume of cars expected is known and organizers can plan accordingly. Our most recent sale was subsidized by two grants and sales were unprecedented in number. We expected a greater response and therefore planned two pickup dates; when sales hit between 800 to 900 customers for Day One, we eliminated that date for subsequent orders.

The majority of our sales have been drive-thru style, lining up cars, checking off customers and filling orders. This requires signage, safety cones to direct traffic and safety vests for staff. For smaller sales, this works well; customers remain in their vehicles, staff load the product and off they go.

For our subsidized sale, we utilized a mall parking lot, cordoned off our staging area with safety cones and had customers park their vehicles and walk over to the staging area (***Figure 1***). Customers lined up to check in, obtained an order slip (***Figure 2***) with their order/quantities

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Figure 1. Rain barrel distribution staging. *Jeffrey Brown, Brand Builders, LLC*

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of items marked and then proceeded to the product distribution area where a worker filled the order and assisted with loading as needed. This distribution flow worked perfectly! No one waited more than five minutes and we did not have to worry about traffic backing up onto public roads.

For sites such as mall parking lots, access to bathroom and hand-washing facilities cannot be overlooked. We opted to use portable johns and hand-washing stations at the mall and used on-site facilities for our distributions at parks and municipal buildings.

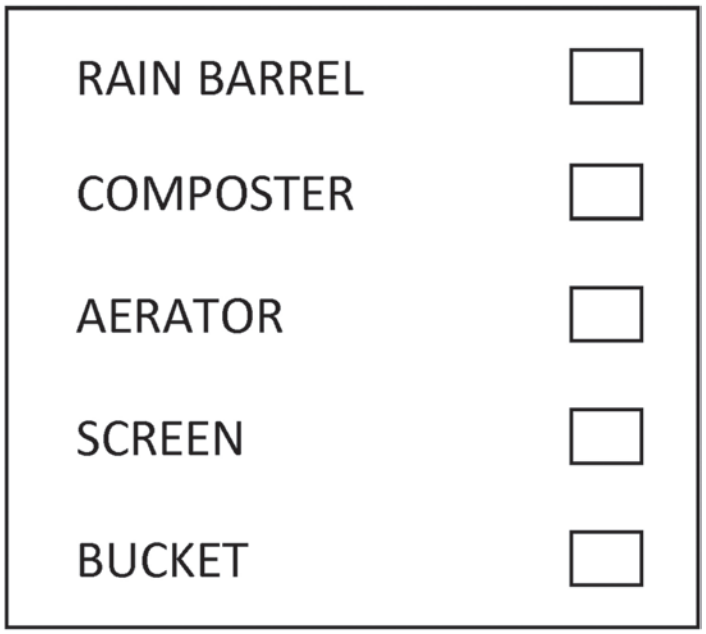

Figure 2. Customer slip used to fill orders at large volume events. *WNYSC*

The most troubling issue with product distribution is customers that do not pick up their pre-paid orders. Once the distribution is underway, our primary objective is to get every item picked up on the scheduled dates. It is not an easy task to find storage space for rain barrels and compost bins; even though they stack well, they are large, bulky and very heavy when stacked.

If the distribution location does not have a secure storage option, then any unclaimed inventory needs to be moved. For our most recent sale consisting of 2,150 rain barrels and 600 compost bins (that is three tractor trailers and over 1,500 customers) 183 people did not pick up on the scheduled date they selected when they purchased. Therefore, at the end of two consecutive 9.5-hour days of laboriously setting up product and distributing, we had to move 18 pallets to one of our highway garages at the end of the sale. To date, after four additional pickup opportunities, numerous email reminders and a reminder post card, there are still 78 customers that have not picked up their products. As the garage bay at the highway department needs to be empty before the first snowflake falls, we have little choice but to re-sell the remaining inventory to new customers on our waitlist with explicit instructions regarding the necessary pickup timing. For the 78 no-show customers, we will let them know that they can pick up their products at our next distribution event. Otherwise, if they do not request a refund and they no longer want the product, we will donate their purchase to a community group.

Shipping

Shipping and receiving present unique challenges. Clearly, the product absolutely must be delivered before the distribution date. After a few sales where deliveries were as close as one day before distribution, we now schedule sales to end two weeks prior to the event. This allows more leeway in scheduling deliveries for three to four days ahead of distribution.

We also learned to be explicit with our expectations for delivery. There are no loading docks, forklifts or pallet jacks readily available at the sites we use. Our first deliveries were unloaded by the driver, so when a truckload arrived with no liftgate or pallet jack, it was a scramble to correct.

When using municipal buildings for distribution, we relied on assistance from parks departments or public works — in the form of loaders with a fork attachment — to unload. For our large sale, the trailers of product were left in the lot for the weekend and the distributor provided workers to offload to the ground. On a final note, be very clear about the hours for delivery, too, as the last challenge you need is a call requesting to unload after hours.

In closing, our solutions may not be foolproof, but if your agency is considering a similar sale, we hope they are helpful. We are willing to provide information and files for the processes and materials we have developed, as well as advice anytime you need it.

Mary Rossi MacSwan, M.S.; CPESC, is the chief environmental compliance specialist with the County of Erie Department of Environment and Planning, where she has worked for 24 years. Her primary responsibilities are to coordinate the administration and activities of the Western New York Stormwater Coalition and to provide compliance assistance to the 43 municipal entities that comprise the organization. She may be reached at mary.macswan@erie.gov.

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Lake Restoration through Infrastructure Extension

By Paul McGarvey, Jacob Kocic and Tom Walsh

Chautauqua Lake is situated in Chautauqua County and, at 17 miles in length, is the largest inland lake in western New York. The lake is best known for its recreational uses including boating and exceptional fishing. The immediate shoreline and areas surrounding the lake are well-developed with both full-time and seasonal properties. Wastewater facilities surrounding the lake include five sewer districts, four publicly owned treatment works (POTW), pumping stations, privately owned wastewater treatment systems and approximately 1,200 individual septic systems. ***Figure 1*** shows the current Chautauqua Lake Sewer Districts.

The Challenge

In 2004, the New York State Department of Environmental Conservation (NYSDEC) designated Chautauqua Lake as an impaired water body per Section 303(d) of the federal Clean Water Act. A Total Maximum Daily Load (TMDL) phosphorus allocation was subsequently determined for the lake in 2012. The NYSDEC identified various sources that contributed to the lake's phosphorus levels, one of which was private septic systems utilized by properties not served by a POTW. Many of the septic systems that serve shoreline property around the lake do not meet current standards and are nearing the end of their useful life. In 2014, a Sewage Integrated Management Plan was prepared by O'Brien & Gere Engineers, Inc. that identified various potential improvements including the extension of public sewers to unsewered areas around the lake.

As a result, the South Chautauqua Lake Sewer District (SCLSD) began the necessary planning and prepared a Sewer Extension Report in 2015 to extend sewers north along New York State Route 394 to the southern boundary of the North Chautauqua Lake Sewer District (NCLSD). Phase 1 of the Westside Sewer Extension was initiated in 2017 and extended the SCLSD north to the Hamlet of Stow. Construction of the Phase 1 facilities is substantially complete and individual residences are in the process of connecting to the system. The SCLSD has initiated Phase 2 of the Westside Sewer Extension, which involves extending the district from the Hamlet of Stow to the NCLSD in the Town of Chautauqua. ***Figure 1*** shows the location of the SCLSD Phase 2 Westside Sewer Extension. The Phase 2 Extension is approximately 90% designed and the SCLSD will soon being submitting the design for regulatory approvals.

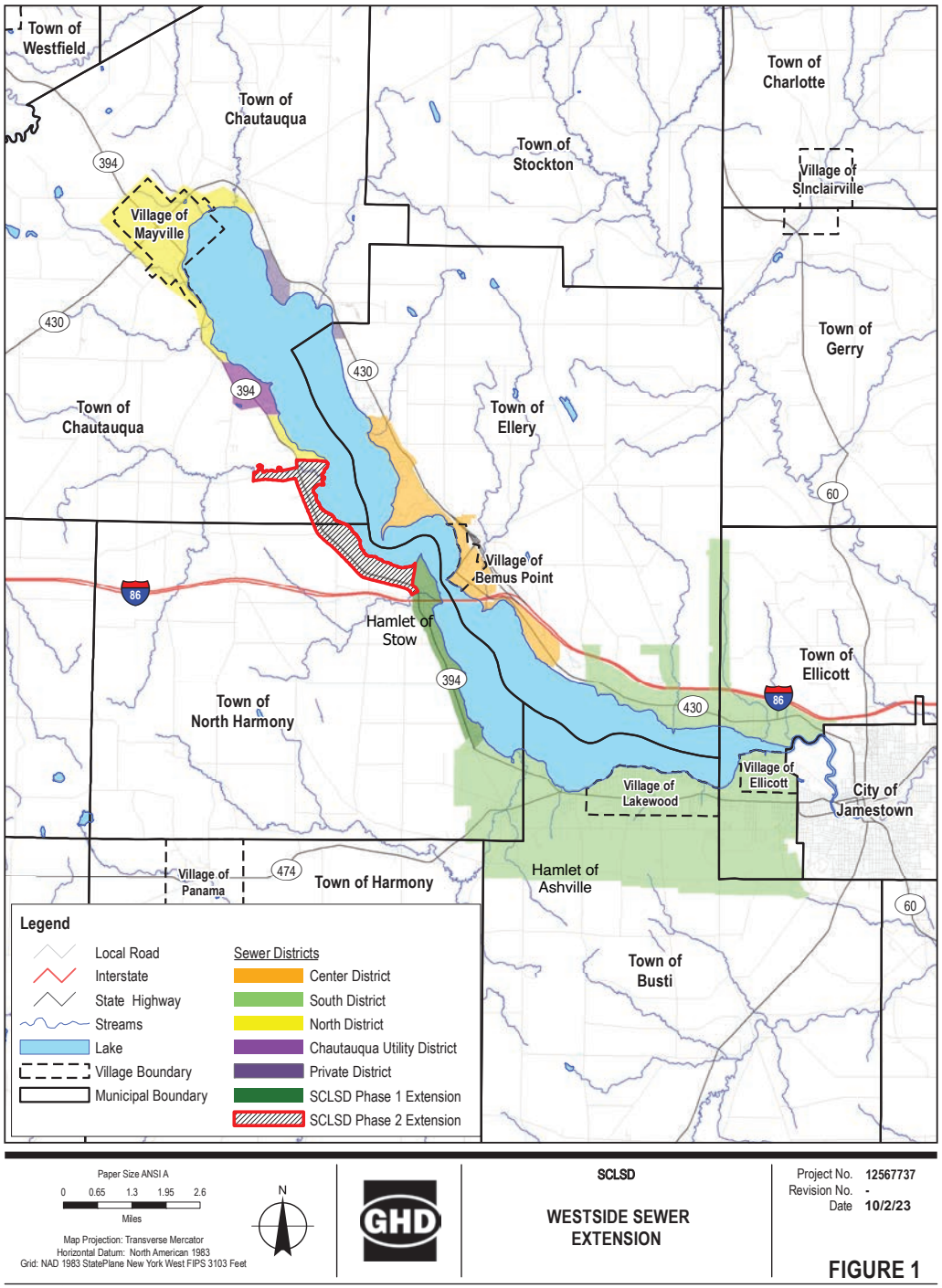

Figure 1. Map showing the location of the West Side Sewer Extension project, Phases 1 and 2. *GHD*

Breadth of the Project

The project had a clearly defined goal to connect all the homes and businesses along the west side of the lake to a public sewer system and convey the flows to the existing South & Center Chautauqua Lake Sewer District wastewater treatment plant at the southern end of the lake. The SCLSD decided early in the program development to break the work into multiple phases, to accommodate financing constraints and to develop bid packages that were not too large as to preclude regional contractors from pursuing the work.

The West Side Sewer Extension program to bring public sewers to the remaining properties along the western side of the lake is planned to

consist of three phases. The Phase 1 Extension started at the northern extent of the SCLSD collection system and progressed north along the west side of the lake to the Hamlet of Stow (see ***Figure 1***). The Phase 2 Extension continued the public sewer infrastructure from the Hamlet of Stow north to provide sanitary sewer service up to the southern boundary of the NCLSD. The final phase of the program, the Phase 3 Extension, will address the sanitary sewer needs of the Hamlet of Ashville. Services areas are summarized in ***Table 1.***

Table 1. Services Areas.

Parameter	Phase 1 Extension	Phase 2 Extension	Phase 3 Extension*
Estimated Parcels to be Served	507	522	88
Total Feet of Anticipated Sewer	79,000	82,000	11,000

* Final scope still to be confirmed

How to Bring the Infrastructure

After clearly identifying the program needs and areas to be served, the SCLSD identified and evaluated alternatives to meet the program goals in the most cost-effective way. The results of this investigation were summarized in the 2015 Sewer Extension Report by O'Brien & Gere. The following six alternatives were evaluated:

- Alternative 1 – Septic Tank System (No Action)
- Alternative 2 – Gravity Collection System
- Alternative 3 – Grinder Pump/Low Pressure System
- Alternative 4 – Vacuum Sewer System
- Alternative 5 – Effluent Sewer Systems:
    - Septic Tank Effluent Pumping System
    - Septic Tank Effluent Gravity System
- Alternative 6 – Cluster/Decentralized System

Alternative 3 — Grinder Pump/Low Pressure Sewer Collection System — was identified in the 2015 Sewer Extension Report as the preferred alternative as it was deemed to be the most efficient and cost-effective means to address phosphorus loadings to Chautauqua Lake from residences and businesses in the service area.

During the preliminary design of the Phase 1 Extension, the combination of low-pressure sewers and gravity sewers were investigated by GHD to optimize long-term operational costs of the program. A conceptual layout of gravity sewers in the varying terrain of the service area included sewers in excess of 12 feet deep. A number of soil borings were performed as part of a subsurface investigation to determine the conditions where these relatively deep sewers would be located.

Results of the subsurface investigation indicated mostly moist silty-sandy overburden and high groundwater table in some areas 5 feet below ground surface. With construction required in close proximity to the lake, there were concerns that with the high groundwater table, it would be very challenging to keep excavations dewatered during construction. Borings also indicated bedrock at 10 to 13 feet below ground surface in some areas, which could require rock excavation for some areas of gravity sewer installation.

Due to higher construction risks and increased project costs associated with these types of subsurface conditions, the SCLSD concluded a gravity sewer system near the lake was undesirable and therefore the system should be a completely low-pressure system with most pipes being installed at approximately 5 feet below ground (below the frost-line).

With the decision made to proceed with a fully low-pressure system, design progressed to layout individual grinder pumping stations to serve residences, campgrounds and businesses. These simplex grinders are owned and maintained by the SCLSD. Due to the topography, several booster pumping stations were necessary to lift the sanitary flows from the lakeside homes up to the state highway where the main trunk sewer would be located. Two more traditional pumping stations were designed on the main trunk to convey flows once the pressure dropped too low for successful pumping due to hydraulic losses. The Phase 1 Extension infrastructure is summarized in ***Table 2.***

Table 2. Phase 1 Extension Infrastructure.

Parameter	Quantity
Estimated Parcels Served	507
Simplex Grinders	265
Booster Pumping Stations	6
Traditional Pumping Stations	2
Total Feet of Force Mains	79,000

COVID Creates an Additional Challenge

In many cases the simplex grinders owned by the SCLSD needed to be installed on private property to minimize grinder depth and to allow for gravity flow from homes to the grinder well. To minimize cost to the customer, the SCLSD and GHD minimized the number of simplex grinders by identifying as many grinder locations as possible where one grinder could serve two properties. In situations where one simplex grinder served two properties, and where it was located on private property, two easements were needed. In these situations, the simplex grinder was placed on the property line with half the construction and maintenance area being granted from each adjacent property owner.

In addition to the easements needed to place simplex grinders on private property, easements were necessary when mainline sewers needed to traverse private property to access residences served by private roads. In total, the Phase 1 Extension required 315 easements from private property owners.

The COVID-19 pandemic created significant challenges interfacing with the public and obtaining easements for the Phase 1 Extension. The original plan of multiple public meetings where the need for easements could be explained — and even have some easements executed — needed to be adjusted because people were not gathering in large groups. Easement packages that included a written description and map of the requested easement area were mailed to property owners after identifying the preferred simplex grinder location and/or need to traverse property for a mainline. Efforts were made to inform property owners through one limited in-person public meeting with an available online livestream, Chautauqua County website postings, a Facebook page and notifications in newspapers. Despite these efforts, for some property owners the first time they thought about where a simplex grinder would be located was when the easement package arrived in the mail.

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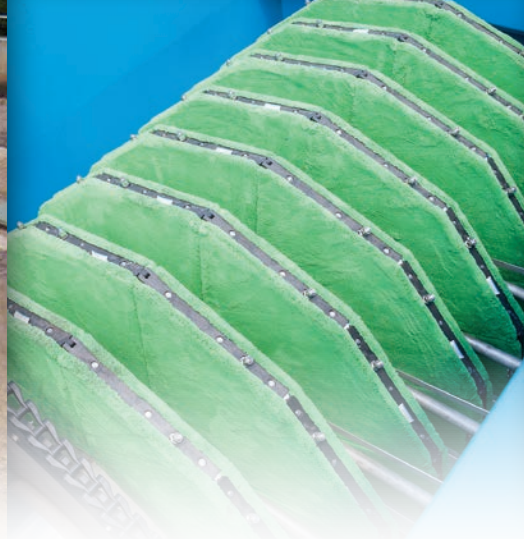
Simplex grinder installation. *GHD*





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Coordinating with property owners was further challenged as it was estimated that up to 70% of the residences in the Phase 1 Extension are seasonal and only occupied during the summer. Significant effort was put forth to contact property owners at their full-time or winter addresses and eventually all the required easements were obtained. As an example of the commitment by the entire team, one county employee got an easement signed while visiting Ohio. Truly a great group effort was put forth.

COVID-19 continued to challenge the Phase 1 Extension project. After the contract was bid and awarded to a general contractor, material and labor availability created issues. As with many projects, material pricing was very fluid at the time of bid. To help the situation, the county stated in the bid that they would execute an agreement within 14 days of receiving approvable insurance, bonds and the signed agreement from the low bidder. We understand from the general contractor that this quick turnaround allowed the pipe supplier to hold their price until material could be ordered post contract execution. With nearly 80,000 feet of pipe, this was a significant risk for the contractor. The general contractor ordered and received the entire project's pipe quantity early in the project and was paid by the county at the time of material delivery, further reducing risk due to price fluctuations.

Main line sewer installation. *GHD*

Once construction commenced, there were occasional slower periods with limited staff on-site, but overall, the general contractor did a great job of staffing the project and working through two winter seasons. Construction of the Phase 1 Extension was substantially complete only one month beyond the original project schedule developed five years prior. A major success considering the impacts of COVID-19!

Phase 2 Extension Status

The Phase 2 Extension will continue public sewer infrastructure north from the end of Phase 1 in the Hamlet of Stow to the southern boundary of the NCLSD. Design documents are 90% complete, and the team is preparing to submit them for regulatory approvals before the end of the year.

Design of the Phase 2 Extension has been built upon the approach and details used in the Phase 1 project. We have also learned from the experiences in Phase 1, most notably with a new approach to locating simplex grinders and obtaining easements.

The Phase 2 Extension schedule was developed to allow for identifying the best location for simplex grinders during the summer months, which allowed the team to work much closer with property owners while they were at their summer homes. The team was in each neighborhood during the summer knocking on doors and speaking with residents about options for locating the simplex grinders. If an understanding was reached with the resident, a stake was driven into the ground where the simplex grinder would be located. The stake was then geolocated with handheld equipment in case the stake got moved. The survey team would then locate the property boundary and confirm the simplex grinder was on the property line if it were to serve two homes. The survey team then worked with office personnel to develop a legal description and map for the easement package. The team worked to generate and issue easement packages throughout the fall with the goal to obtain signatures before the end of the year.

The SCLSD plans a summer 2024 bid for the Phase 2 Extension project with construction complete by the end of 2026.

Conclusion

Chautauqua County, the SCLSD, GHD and the entire team have been excited to bring public sewer infrastructure to the west side of Chautauqua Lake currently served by septic systems, thus reducing phosphorus loading to the lake. The program is a large investment that could not have been done without significant funding provided by New York State and Chautauqua County. It is anticipated that the Phase 1 and 2 Extensions will have a total capital cost of over $40 million, with more investments to be made with the Phase 3 Extension.

Sunset at the Celoron Lighthouse on Chautauqua Lake. *Bernadette van der Vliet/Shutterstock*

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Bird Island Treatment Facility Wet Weather Capacity Project

By Dan Casper, Jamie L. Johnson, Walter A. Walker, Rosaleen B. Nogle and Tim Blake

The Buffalo Sewer Authority (Buffalo Sewer) operates treatment facilities and collection systems for the City of Buffalo. To improve the ability of the combined sewer system and the Bird Island treatment facility to adequately handle and treat wet weather flows, Buffalo Sewer has enacted a 10-year Wet Weather Capacity Project. This article provides a background of Buffalo Sewer and its facilities and collection systems, the processes and decisions leading to the Wet Weather Capacity Project, and a summary of the three phases of the project.

History of the Buffalo Sewer Authority

Buffalo Sewer, a public benefit corporation, was created by an Act of the Legislature in the spring of 1935 and delegated the responsibility for providing an effectual means of relieving the Niagara River and other tributary streams from pollution by sewage and waste. Buffalo Sewer accepted and fulfilled its responsibility in full conformity with the intent and spirit of the mandate. It provided a system of intercepting sewers to bring the sewage of the city to a then modern (1938) and efficient primary sewage treatment plant where solid matter was removed and incinerated, and all liquid matter chlorinated (***Figure 1***). This facility today is known as the Bird Island Wastewater Treatment Facility (WWTF).

Figure 1. Bird Island WWTF circa 1950s. *Buffalo Sewer Authority*

With respect to the collection system, the City of Buffalo constructed a then state of the art combined sewer system that collected and transmitted sanitary and stormwater within a single pipe system. By design, the combined system was constructed with several overflow points, referred to as combined sewer overflows or CSOs, which relieved the system during rainfall events when the large amounts of water (stormwater primarily) could have damaged the treatment plant and private property. For decades following its construction, the system served the city and surrounding suburbs well and continues to do so today.

However, with the increasing national awareness of the need to protect our water resources more fully, in 1966 New York state directed further improvement of the Bird Island WWTF by providing secondary treatment. With the help of federal and state grants, secondary treatment facilities were constructed and placed in service in 1981 (***Figure 2, Figure 3***). Throughout these improvements, the collection system continued to operate adequately with few modifications.

Figure 2. Construction photo of settled wastewater effluent pipes circa 1970s. *Consoer, Townsend, & Associates via Buffalo Sewer Authority*

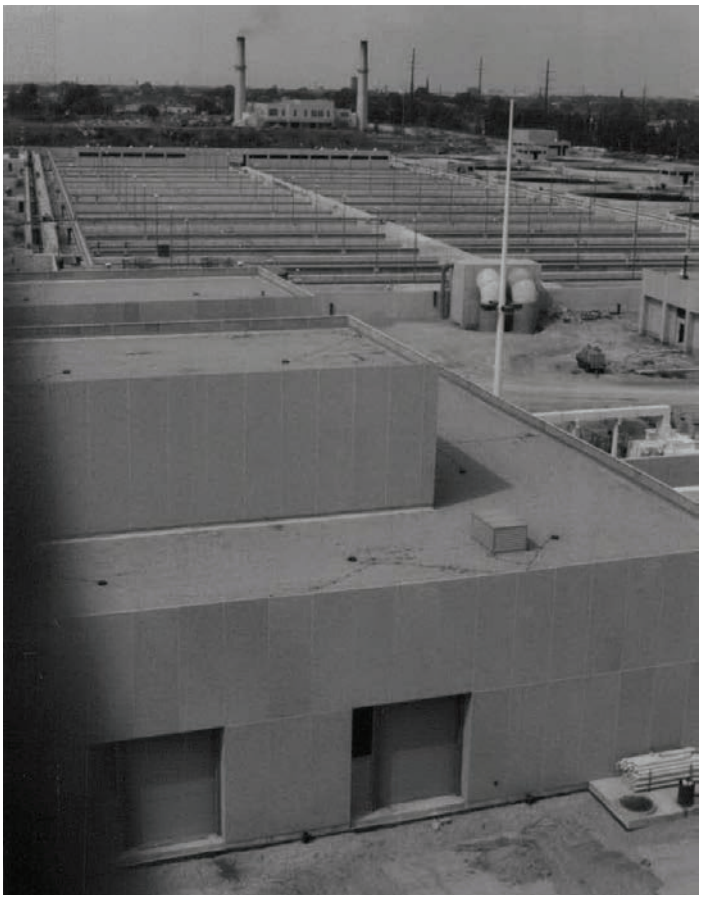

Figure 3. Construction photo of secondary treatment system circa 1970s. *Consoer, Townsend, & Associates via Buffalo Sewer Authority*

The CSO LTCP

In the early 1990s the regulatory focus shifted from the treatment facilities to the collection systems. Not only in Buffalo but across the United States, emphasis was being placed on the impacts of sewer overflows and on their reduction. With a keen sense of self-awareness, Buffalo Sewer recognized the general inadequacy of their own combined sewer system and treatment facility in terms of their ability to adequately handle and treat wet weather flows.

As part of a comprehensive plan to preserve the environment and continue its mission to close the health disparities gap, Buffalo Sewer developed a Combined Sewer Overflow Long-Term Control Plan (CSO LTCP) to increase the capacity of the sewer system and of the Bird Island WWTF over a period of 20 years. Since that time, Buffalo Sewer has been actively working toward compliance with the LTCP. Areas of formerly prevalent basement and surface flooding have been eliminated throughout the City of Buffalo, along with the removal of several of the originally designed CSOs. While the CSO LTCP focused primarily on the collection system, the Bird Island WWTF is an integral part of the overall success of the plan. Overall, the goal of the CSO LTCP is to have over 97% of all sanitary and stormwater flow captured and cleaned at the Bird Island WWTF.

The No Feasible Alternatives Analysis – Wet Weather Capacity Project

The current rating of the Bird Island WWTF primary system is 160 million gallons per day (mgd) whereas the current rating of the secondary system is 320 mgd. As designed, influent flows up to the secondary system capacity receive full physical and biological treatment and disinfection prior to ultimate discharge (Normal Mode). Flows greater than the secondary system capacity are treated through the original primary facilities and chlorinated before ultimate discharge without biological treatment (Wet Weather Mode).

Treated plant flows are discharged to the Niagara River via two permitted outfalls: Primary Effluent Outfall 001 in Wet Weather Mode and Final Effluent Outfall 002 in Normal Mode (***Figure 4***). A third emergency outfall (01A) exists upstream of the raw wastewater pump station at the Bird Island WWTF but is only used to protect the WWTF in the event of extreme weather or equipment malfunction.

As part of the CSO LTCP efforts — and recognizing the problematic multiple modes of operation — a No Feasible Alternatives analysis was developed. This analysis would confirm the WWTF wet weather capacity and evaluate feasible alternatives, if any, to reduce the volume of (or provide additional treatment for) the wet weather flows currently bypassing the secondary treatment and discharging directly to the Niagara River following primary treatment and disinfection in the primary clarifiers.

Three alternatives were evaluated to provide a total treatment capacity of 560 mgd through the Bird Island WWTF.

- Alternative A: Maintain the secondary capacity at 320 mgd and increase the primary system capacity to 240 mgd.
- Alternative B: Increase the secondary capacity to 360 mgd and increase the primary system capacity to 200 mgd.
- Alternative C: Increase the secondary capacity to 400 mgd and maintain the primary system capacity at 160 mgd.

Ultimately, the decision was made to move forward with Alternative C, now dubbed the Bird Island Treatment Facility Wet Weather Capacity Project. The Wet Weather Capacity Project will be undertaken in three phases and is expected to take approximately 10 years to complete.

Phase I will rehabilitate the WWTF's biological systems to improve treatment of current flows and upgrade outdated equipment.

Phase II will rehabilitate and upgrade the WWTF's physical treatment system to improve treatment of current flows and provide a new disinfection facility to improve the water quality of discharges into the river during wet weather events.

Phase III will further expand the WWTF's biological system to handle more flow through the WWTF during wet weather.

The project will be designed and implemented to protect public health and the environment, as well as comply with regulatory requirements to achieve LTCP goals. In addition, the project will maximize community benefits by improving odor control, strengthening public participation

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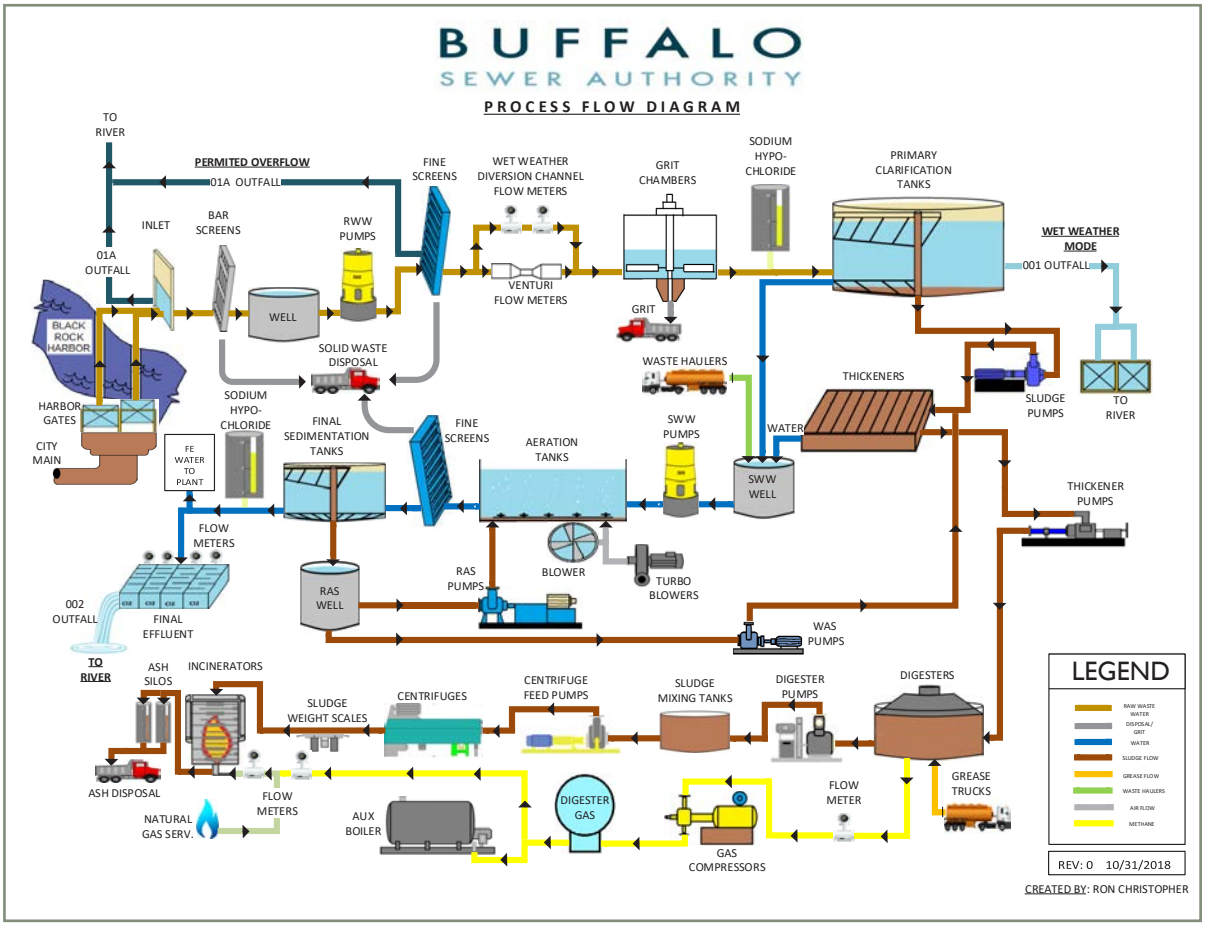

Figure 4. Bird Island WWTF process flow diagram. *Buffalo Sewer Authority*

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and understanding of water infrastructure, and committing to meaningful participation of disadvantaged/minority/women business enterprises (D/M/WBE).

The Bird Island Treatment Facility Wet Weather Capacity project represents the largest investment in clean water infrastructure in western New York in over 40 years.

Phase I – Secondary System Rehabilitation and Upgrades Project

The first phase of Buffalo Sewer's Wet Weather Capacity Project is the Secondary System Rehabilitation and Upgrades Project (***Figure 5***). This first phase serves to rehabilitate the Bird Island WWTF's biological systems to improve treatment of current flows (320 mgd). Some processes and equipment included in the Phase I project are nearing 50 years old, well beyond their useful life. Ultimately, it is expected that this project will yield a fully refurbished secondary treatment system to meet modern codes and comply with the No Feasible Alternative of the CSO LTCP.

Figure 5. Phase I Secondary System Rehabilitation and Upgrades Project groundbreaking event, October 2022. *AECOM*

The target outcomes for this project are to improve treatment efficiency, restore hydraulic capacity and provide improved operational flexibility.

Affordability to Buffalo Sewer and the City of Buffalo residents is also an important goal. An ideal funding package has been secured for this $60 million to $70 million project. Phase I will be funded through a combination of federal and state loan and grant programs including the New York State Clean Water State Revolving Fund Program (CWSRF), Bipartisan Infrastructure Law (BIL) funds, the Water Quality Improvement Project (WQIP) grants, and a Water Infrastructure Improvement Act (WIIA) grant, all administered by the New York State Environmental Facilities Corporation.

Secondary System Rehabilitation and Upgrades Overview

Engineering design services were awarded to AECOM in November 2019, with an original schedule for the construction contract to advertise for bid in August 2020. The project was initiated with AECOM performing an inspection of the secondary system's existing facilities including piping, channels, valves, and ancillary system (***Figure 6, Figure 7***).

Upon inspection, it became evident to both the engineer and owner that the extent of rehabilitation required for Phase I to restore capacity to 320 mgd exceeded what had previously been communicated to the regulatory agencies. Further, the capital dollars allocated would be insufficient to fund the full extent of the project. As such, in parallel to performing preliminary engineering investigative efforts, AECOM and Buffalo Sewer engaged in negotiations with the regulatory agencies to expand the scope of Phase I, increase the funding allocated, and adjust the compliance schedule accordingly.

As part of the preliminary engineering efforts, AECOM reviewed five years of plant operational data and record documents to create both a hydraulic model and a biological process model of the secondary system to comprehensively represent the characteristics of the plant's hydraulic and treatment capacities. Through the hydraulic and process modeling exercises, AECOM substantiated what they already knew to be true: the secondary treatment system was in poor condition, warranting a nearly full rehabilitation of the system, in addition to upgrades necessary for proper isolation.

Figure 6. Bird Island WWTF aeration tank influent channel with accumulated grit and debris. *AECOM*

Figure 7. Bird Island WWTF final settling tank influent channel with damaged air header. *AECOM*

Secondary System Rehabilitation and Upgrades Design

Upon receipt of necessary approvals from the regulatory agencies,

the Phase I project was released for bidding in August 2020 as one large General Construction contract. However, due to several extenuating circumstances only one bid was received. Based on conversations with the local contracting community at that time, the perception of Phase I was that the bonding capacity required was too expensive and risky for the smaller, local contracting companies, while at the same time the project was too small to attract the larger, outside contracting companies. As such, Buffalo Sewer elected to reject the bid received in favor of providing more opportunity for the local contracting community to work on this groundbreaking project. Ultimately, the Phase I project was re-released for bidding in April 2021 as five separate construction contracts (***Table 1***).

Table 1. Phase 1 Construction Contracts.

Contract	Description
Contract A - Piping	• Upgrade the return activated sludge (RAS) system with new ductile iron pipe, butterfly valves and actuators, gate valves and flow meters. • Replace the influent wastewater butterfly valves, actuators and flow meters. • Upgrade the waste activated sludge (WAS) system with new butterfly valves and actuators.
Contract B - Cleaning	• Remove and dispose of accumulated grit and debris in the aeration tanks. • Clean the influent and effluent wastewater pipes of grit and debris. • Clean the settled wastewater wet well and drainage wet wells of grit and debris.
Contract C - Gates	• Install 90 new sluice gates at the influent and effluent pipes in each aeration tank. • Rehabilitate the existing aeration tank and final tank influent channel stop log gates. • Replace the existing chlorine contact tank sluice gates and actuators.
Contract D - Diffusers	Upgrade the entire aeration system by: • Installing new fine bubble diffusers in the 16 aeration tanks. • Replacing and installing new coarse bubble diffusers in the aeration tank influent and effluent channels, and in the final tank influent channel.
Contract E - Electrical	Consists of all the electrical, instrumentation, and controls work to accommodate the upgrades associated with the other four contracts.

Secondary System Rehabilitation and Upgrades Construction

In June 2021, Notices of Award were issued to the five responsible low bidders. An unfortunate side effect of having five separate construction contracts is the amount of paperwork and coordination required to execute the contracts. Each contractor has D/M/WBE goals to meet and paperwork to submit, with ultimate approvals coming from the state agencies. And in the case of the Phase I project, adjustments to the funding package were being made well after Notices of Award were issued, causing further delay and some confusion.

On top of that, think back to what the world was like in fall 2021. As a community we were still reeling from a pandemic, we were experiencing an unprecedented strain on the raw materials market, there was unforeseeable volatility in the construction industry, and a war in Ukraine. However, Buffalo Sewer persevered and Notices to Proceed for construction were issued in September 2022.

As of the time of this writing, the construction work for Phase I is ongoing. The first major phase of work, which will require half of Buffalo Sewer's secondary treatment system to be taken offline for 26 weeks, is scheduled to commence in June 2024. The work now focuses on prepping for that major shutdown including procurement and delivery of materials, construction and contractor staging, and equipment relocations and removals (***Figures 8 through 11***). Ultimately, it is anticipated that final completion for this project will be issued in March 2027.

Phase II – Primary Treatment Renovation and Upgrades Project

The second phase of Buffalo Sewer's Wet Weather Capacity Project is the Primary Treatment Renovation and Upgrades Project. Phase II will rehabilitate and upgrade the WWTF's 160 mgd primary treatment system to improve treatment of current flows and provide a new disinfection facility to improve the water quality of discharges into the Niagara River during wet weather events.

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Figure 8. Bird Island WWTF chlorine contact tank sluice gates prior to removal. *AECOM*

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Figure 9. Bird Island WWTF chlorine contact tank sluice gates during removal. *AECOM*

Figure 10. Bird Island WWTF large diameter ductile iron pipe delivery. *AECOM*

Figure 11. Bird Island WWTF large diameter ductile iron pipe fittings staged for installation. *AECOM*

Currently, the Bird Island WWTF primary treatment system includes four primary settling tanks, a sludge pumping station and ancillary equipment. As part of this Phase II project, the primary tanks will be fitted with a new odor control system — which also addresses a local community environmental justice issue — and a new high-rate disinfection pumping station and chlorine contact tanks will be constructed. Ultimately, it is expected that this project will yield a fully refurbished primary treatment system to meet modern codes and comply with the No Feasible Alternative of the CSO LTCP.

The target outcomes for this project are to modernize the treatment facility, originally constructed in the 1930s, and improve process efficiency and general facility operations.

As with Phase I, affordability is another goal of Phase II. Favorable funding terms for this $70 million to $80 million project have been pursued to ensure an equitable cost burden for Buffalo Sewer and the people of the City of Buffalo. This phase will be funded entirely through grants and low-interest loans, including the CWSRF program and BIL funds, WQIP grants and WIIA financing.

Primary Treatment Renovation Overview

Engineering design services proceeded with Greeley and Hansen in April 2021, with a current schedule of construction bid advertisement for the first quarter of 2024. The project initiated with numerous site visits and fieldwork to assess the existing conditions of the project area. Plant operations and designers worked together to:

- Plan/sequence the inspection of the four primary settling tanks.
- Plan and safely execute the dive inspection of the outfall structure and conduit.

1 Primary Sedimentation Tanks
- New sludge and scum collection equipment
- Improved efficiency for sludge settling and removal
- Concrete repair and coating for corrosion protection
- Safety improvements with new handrail and toeboards

2 Sludge Pumping Station
- New pumps, piping, and valves
- New HVAC equipment to meet current ventilation codes and standards
- New electrical and control equipment for improved automation and operations flexibility
- Concrete and masonry repair and improvements while maintaining original building design
- New personnel spaces and lighting

3 Odor Control
- New effluent trough covers for the Primary Sedimentation Tanks
- Odor capture at various chambers
- New FRP piping to convey odorous air to odor control units for treatment prior to being released into the atmosphere

4 High-Rate Disinfection System
- New Chlorine Contact Tank provides 5 minutes of contact time at 160 MGD
- High-Rate Disinfection Building includes chemical storage and feed equipment
- Five new 40 MGD submersible pumps to convey disinfected Primary Effluent through Outfall 001 to the Niagara River

5 Bypass Structure Gates
- Gate 17 installed with new actuator
- New gates and actuators to automate wet weather sequences and provide operational flexibility for Authority staff

6 Outfall 001 Repair
- Restoration of multi-use riverwalk/trail
- Installation of landscaping along public-facing utility bike/pedestrian path along Niagara River
- Repairs to Outfall 001 overflow structure, and connection of HRD pump station pipe to the outfall structure

Figure 12. Overview of Primary System Rehabilitation and Project Upgrades. *Greeley and Hansen*

- Share lessons learned such as reliance of operations internal knowledge of processes.
- Outline an overview of the maintenance of facility operations plan for the construction phase.

The project team also coordinated with the Phase I Secondary System Rehabilitation and Upgrades Project design team to understand overall plant flow limitations during construction and to transfer knowledge of best practices to incorporate in the contract documents. An overview of the renovation project is presented in ***Figure 12***.

Key Elements of the Phase II Primary Treatment Renovation Design

The key elements for Phase II are:
- Primary settling tanks and sludge pump station inspection.
- Outfall 001 inspection.
- Odor sampling in primary settling tanks.
- Developing and advancing a Public Participation Plan.
- Securing project funding.
- Coordinating with regulatory stakeholders.

Primary Settling Tanks and Sludge Pump Station Inspection

The design team conducted structural and mechanical tank inspections from June through August 2021, and developed a Health and Safety Plan. Only one tank shutdown could occur at a time, so it was imperative for the team to plan and adapt around wet weather events. The design team worked side-by-side with Buffalo Sewer's Maintenance and Operations staff for tank shutdown, dewatering, cleaning, and safe entry for design team inspections (***Figure 13***).

Figure 13. Primary tank inspection. *Greeley and Hansen*

Outfall 001 Inspection

The high-rate disinfection pumping station force main will tie into the existing Outfall 001 structure. The existing Outfall 001 overflow structure and conduit were inspected by a third-party partner consultant to verify they are structurally competent to facilitate the proposed renovation (***Figure 14***).

Odor sampling was conducted in the primary settling tanks to determine the odor control design. The design will consist of a hybrid system

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Figure 14. Outfall 001 inspection. *Greeley and Hansen*

of carbon column and biotrickling filter (***Figure 15***), which will reduce the frequency of carbon media replacement and save on carbon media replacement costs. It is also more effective for treating the large range of hydrogen sulfide concentrations that Buffalo Sewer experiences. The system will pull air from the bypass and control chamber, primary settling tanks and inlet chambers. The renovated primary settling tanks will have launders covered along the perimeter weirs.

Developing and Advancing a Public Participation Plan

The Public Participation Plan laid out an approach to providing education on the value of water and being a good neighbor, centered around water equity and environmental justice. The plan also discusses minimizing construction disturbances and getting community buy-in and feedback for the project (***Figure 16***).

Securing Project Funding

Project funding has been secured as grants and low-interest loans through the CWSRF and BIL funds, WQIP grants and WIIA financing.

Coordination with Regulatory Stakeholders

The project team coordinated with the New York State Department of Environmental Conservation and the U.S. Environmental Protection Agency to gather their feedback and acceptance of the basis of design and implementation schedule. The project team has also coordinated with city agencies for work and detours in public areas, such as the Niagara Riverwalk.

Phase II Schedule

The final design for the Primary Treatment Renovation Project will be complete by the end of 2023, followed by construction bid advertisement in the first quarter of 2024. Recommendation of the bid award to contractor(s) is planned for the second quarter of 2024. Construction is projected to be completed by December 2028.

Phase III – Secondary System Expansion Project

The final step in Buffalo Sewer's CSO LTCP Wet Weather Capacity Project is to expand the secondary biological treatment system to handle more flow through the treatment facility during wet weather events. By processing more flow through the Bird Island WWTF, Buffalo Sewer accomplishes the goal set out by the LTCP, which is to treat sustained peak flows up to 400 mgd through the secondary system while maintaining primary treatment capacity at 160 mgd. In addition, there are miscellaneous other upgrades to critical processes and infrastructure planned throughout the plant, further enhancing the efficiency and reliability of the Bird Island WWTF for generations to come. Phase III is anticipated to reach substantial completion in October 2029 with final completion in May 2031.

Together, the three phases of the Wet Weather Capacity Project represent an investment in local waterways by Buffalo Sewer to reduce CSOs in the City of Buffalo and surrounding communities, providing greater water quality throughout Buffalo for generations to come.

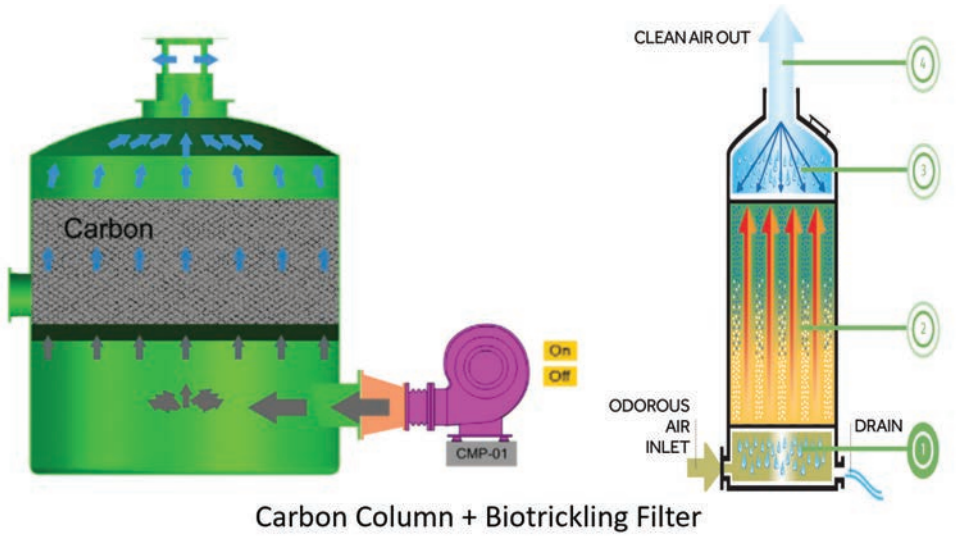

Figure 15. The hybrid odor control system consists of a carbon column and biotrickling filter. *BioAir Solutions*

Figure 16. Future rendering of the new high-rate disinfection system from the public riverwalk view. *Greeley and Hansen*

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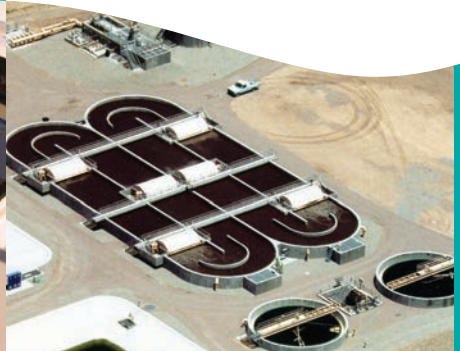

CLR Process Components

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

An Island in the Storm

By Rosaleen B. Nogle

December 23, 2022. Left: Door seals were no match for the blowing snow. Middle: Louvered door with snow forced through by winds. Right: Snow inside building and over electrical panels came through a broken window. *Alex Emmerson, BSA*

Western New York experienced a blizzard of epic proportions in late December 2022. According to the National Weather Service, 37 consecutive hours of blizzard conditions paralyzed the Buffalo Metro area with nearly 4 feet of snow, wind gusts exceeding 70 miles per hour and wind chills dipping below -20°F. The high winds caused widespread power outages, while zero visibility brought snow removal activities to a halt. Thousands of vehicles were abandoned on the roads by the storm's end, and nearly four dozen people lost their lives (National Weather Service, 2023).

Even in the worst of weather conditions, municipalities still need to protect public health and the environment by maintaining stormwater and sanitary sewage drainage and wastewater treatment. The Buffalo Sewer Authority is responsible for managing stormwater and wastewater for the City of Buffalo and 11 nearby suburbs. So how did Buffalo Sewer cope with this once-in-a-generation storm event?

In this article, I will review the geography of Buffalo and its sewer system and treatment facility. I will provide a step-by-step timeline of the storm's impact, from the initial forecasts through the end of the storm. Finally, I will discuss how Buffalo Sewer continued operation through this snow hurricane and the lessons we learned that will better prepare us for the next storm.

Geography of Buffalo

The City of Buffalo is located at the western end of New York state. Buffalo became a city after it was chosen as the terminus of the Erie Canal in 1825. Located at the northeastern tip of Lake Erie, the city became home to a series of canals and slips that allowed ships to dock and transfer goods from the lake-going ships to the smaller canal pack vessels.

Buffalo's flat geography (only 158 feet between the highest and lowest points in the entire city) allowed these canals to be laid without locks. To the southeast of Buffalo, however, the land rises rapidly into hills and then mountains; much of this land within Erie County drains to Lake Erie through Buffalo. The flow of these waters through Buffalo can cause the rapid rise of the creeks and rivers within the city. Usually this does not result in flooding except when their flow is impeded by ice or other blockages that force the waters out of their banks and into lowland neighborhoods in Buffalo and the adjacent suburbs.

Seiche Risk

Besides ice jams, seiches are a major cause of flow impediment to the Buffalo River. A seiche is the rapid change in water levels due to strong winds or atmospheric pressure changes within a contained water body such as a lake. Lake Erie is particularly prone to this phenomenon due to its relatively shallow depth, width and long length, which corresponds to the predominant wind direction. When high-speed winds cross the lake, a differential of 10 feet or more in lake height can develop between Toledo, Ohio, at the southwestern tip and Buffalo at the northeastern tip.

In Buffalo, the impact of these seiche events is intensified by the flatness of the Buffalo River. This river cuts the most southern quarter of the city off from the rest of the city but is fundamentally an artificial canal that replaced the much more ephemeral, meandering and shallow historic waterway, "Big Buffalo Creek." Replacing this creek with the modern "river" has resulted in a canal with little to no natural current and makes it particularly vulnerable to the sudden change in water levels in the connecting lake. As a result, the water level can rise quickly and run backward across the width of the city.

As climate change begins to manifest throughout the Great Lakes basin, average precipitation is rising in the upper watersheds, which is leading to rising average levels throughout the system. In addition, while heat and sea level rise are the most well-known and frequently cited impacts of climate change, ultimately it is the energy within the atmosphere that is increasing. On Lake Erie, this means that the winds blowing across the lake are increasing in strength and frequency. Combined with the higher lake level and warmer temperatures (ensuring the lake remains open water longer into the winter), climate change is manifesting itself in Buffalo primarily as seiche events.

Buffalo's Sewer System

The first sewers were laid in Buffalo before indoor plumbing was com-

mon. Their primary purpose was to drain the wetlands along the Buffalo River in the Downtown and Hydraulics neighborhoods. During dry spells, these areas were often damp, but when rains or snowmelt came or the wind blew along Lake Erie, these early settlements were inundated not just with water, but the contents of cesspits, industrial waste products, and rubbish that had been thrown into the gutters or left in backyards and open spaces. The sewers were constructed to ensure that all of this waste and the floodwaters that were hindering development would be diverted to below the ground and to the nearest waterways.

The oldest sewers were laid in Buffalo in the 1830s by private property owners. These first sewers were little more than brick-lined trenches covered by boards, which degraded within a decade or so. Some of the sewers constructed to replace them in the 1840s remain in active use. As the city expanded rapidly throughout the latter half of the 19th century, so did the sewer system and by 1900, the vast majority of the pipes still in use today had been laid. But it would be another 36 years and require both an act of Congress and the New York Legislature before the first shovel of dirt could be dug for the Bird Island Treatment Facility. These sewers were therefore designed to discharge directly to the waterways.

As the treatment facility was being constructed, a series of interceptor sewers were laid to redirect dry weather flows to the Bird Island Treatment Facility. During wet weather, the interceptor sewers were designed to carry up to six times the flow from a design population of 1 million people, a population twice that of the peak experienced in the Second World War era and four times that of today's city. The original outfalls, which created direct outlets to the waterways throughout the city, remained intact and served as relief valves to prevent basement backups or surcharges to the streets during severe wet weather. Over the intervening decades, some of these outfalls have been eliminated or repurposed to carry separate stormwater rather than combined sewage, but 52 outfalls remain in place.

Bird Island Treatment Facility

The Bird Island Treatment Facility, as its name indicates, is on an island located between the Black Rock Canal and the Niagara River. It is accessible only from the water and two bridges. The first is the bascule bridge on the south end of the island. Built in the 1910s, the bascule bridge is located at the bottom of one of the largest changes in elevation in the entirety of the city. The bascule bridge has significant height and weight restrictions that prohibit most commercial vehicles from being able to use it. The second bridge, the international rail bridge, is located on the north end of the island and was constructed in the 1870s. While able to carry larger vehicles, this second bridge has only one lane and requires traffic to alternate between vehicles entering the island and those leaving the island.

The island itself is primarily an artificial construction connecting two smaller historical islands to the north and south of the treatment facility's location. Constructed over the better part of a century — first as a series of sea walls and docks and then filled with municipal refuse, ash and soil — the island expanded as the facility grew. The fill, however, was not very well consolidated.

In the 1930s the primary treatment facility was constructed on the southern end of the island just north of the bascule bridge. With four primary sedimentation tanks, each sized at the time to treat an estimated 60 million gallons per day (mgd) and a raw wastewater pumping capacity of 560 mgd, the state-of-the-art facility provided physical treatment and disinfection to 180 mgd average flow and solids were digested and incinerated on-site. When this facility went on line, downstream communities, which had the highest typhoid rates in the developed world, saw these rates drop to near zero.

Over the next several decades, upgrades were made to double the number of digesters from four to eight, but it was not until the 1970s that major changes to the liquid stream were made. With the implementation of pollution control programs under the Clean Water Act, the facility more than doubled in size to include biological treatment and an expanded solids treatment process. To accommodate these increased processes, a settled wastewater pumping station was also added. While most of both the primary and secondary systems were constructed on piles driven to bedrock, much of the underground tunnel system that connected the buildings were set as poured concrete.

Forecast December 2022

As Christmas 2022 approached, much of western New York's attention was on the upcoming holiday. People were planning their final shopping trips. Many paychecks were dropping Friday ahead of Christmas Sunday. School was supposed to be open through Saturday, but college students were already heading home to their families.

On Monday, Dec. 19, 2022, the first warnings of a coming storm were issued. They were vague, primarily focusing on rain and winds with the potential for an ice storm Friday night as the temperatures dropped below freezing and the winds picked up. The risk of lake-effect snow was limited to Friday night through Saturday night, with the assumption that much of this snow would be concentrated in the Southtowns, outside the city proper and in an area that dealt frequently with 2 feet or more of snow falling in a single storm; this occurrence is far rarer within the city.

By Tuesday, Dec. 20, 2022, this serious — but not uncharacteristic — storm for the area had evolved into a "once in a generation event." Winds gusting to 65 miles per hour or more were expected to move in Friday and bring with them whiteout conditions as lake-effect snow fell. The wind was also expected to create seiche conditions, resulting in lakeshore flooding 3 feet above flood stage along the Lake Erie coastline. Even for those of us dwelling along the Great Lakes, this was a troubling forecast. There were rumblings of canceling some Christmas services or at least making sure that virtual options were well advertised. But still, the focus was on a storm moving in late Friday and much of the impact not being felt until Saturday… and it was still early enough that the report could get better.

On Wednesday, Dec. 21, 2022, the weather report had turned still worse, though also more confusing. The wind direction was now forecast as being 90 degrees off the usual direction; instead of moving across Lake Erie as occurs in seiche conditions, the wind was now forecast to be predominantly moving across the state from New York City. Rain was expected to be carried with these warm winds from the southeast. Through the day Friday, the temperatures were expected to drop around 3 p.m. as the wind shifted from the southeast to the southwest. As evening set in, it was expected that lake-effect snows would start blowing through. It was expected that some of this snow would hit the city itself, but again — as had happened in so many storms before — it would probably shift to the Southtowns.

By Thursday, Dec. 22, 2022, the level of danger that this storm would pose — and the lack of public consciousness of the danger — had begun to sink in with the National Weather Service. A warning was issued stating that intense blizzard conditions were expected for about 30 hours straight. But for many people living in a city where the term "blizzard" is bandied about anytime a significant snowstorm occurs, even this warning of nearly hurricane-strength, 70 mile-per-hour peak winds did not have the desired impact. Buffalo Sewer and many other employers nonetheless gave many office workers and other non-on-site critical workers Friday off and most area schools canceled classes. Retail

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stores, however, stayed open, looking forward to welcoming last-minute shoppers in the morning.

The Storm

Thursday evening was rainy and windy, not the most pleasant weather for my bicycle commute home, but not impassable for a 3-mile trip with water repellant gear and lots of lights; I was able to stay late and get some extra work done before heading home. In the morning, the winds had picked up significantly and the rain was blowing sideways. Up until this point the storm seemed to be playing out according to predictions.

At 8 a.m. on Friday Dec. 23, however, the seiche moved in, indicating that the wind had changed early. The wind that was supposed to be blowing from the southeast was now blowing, in part, from the southwest. Two major storms had converged on Buffalo simultaneously. And with the winds coming from both the southwest and the southeast simultaneously, a cyclonic effect was created. No longer were we dealing simply with snow and heavy winds, but those winds were swirling. To complicate matters, with the southwest wind came a sudden temperature drop. The rain that had been drawn in from the southeast became snow and exacerbated the lake-effect impacts.

By 9 a.m., visibility had dropped to a quarter mile or less and the temperature had dropped into the 20s (°F) with windchills in the single digits. In short, the storm that had been predicted to move in during the evening hours had come over 10 hours early. Travel bans had not yet been put in place and shops had been open; people were still out on the roads and trying to get last-minute errands done and now they were stranded.

The once-in-a-generation storm had come in with greater ferocity than predicted and rather than lasting 30 hours, blizzard conditions with hurricane force winds lasted nearly 40 hours. The snow totals as well were far higher than predicted. By the time it ended, almost as much snow had fallen in western New York as occurs in an average winter in a city infamous for its snow. Thirty-seven people were dead, many of whom died in or near their vehicles or trying to walk home from shopping for gifts or groceries.

Operating in a Snow Hurricane

For Buffalo Sewer, this storm posed several challenges to maintaining stormwater and sanitary sewage drainage throughout the City of Buffalo and wastewater treatment for residents of the city and 11 nearby suburbs. In anticipation of these challenges, a group text chain was developed for most of the operational leadership to ensure ongoing communications between those in their homes and those at the facility or at outlying locations. Some immediate actions were identified Thursday to ensure that in the morning staff would be available to address the cascading concerns as the storm developed.

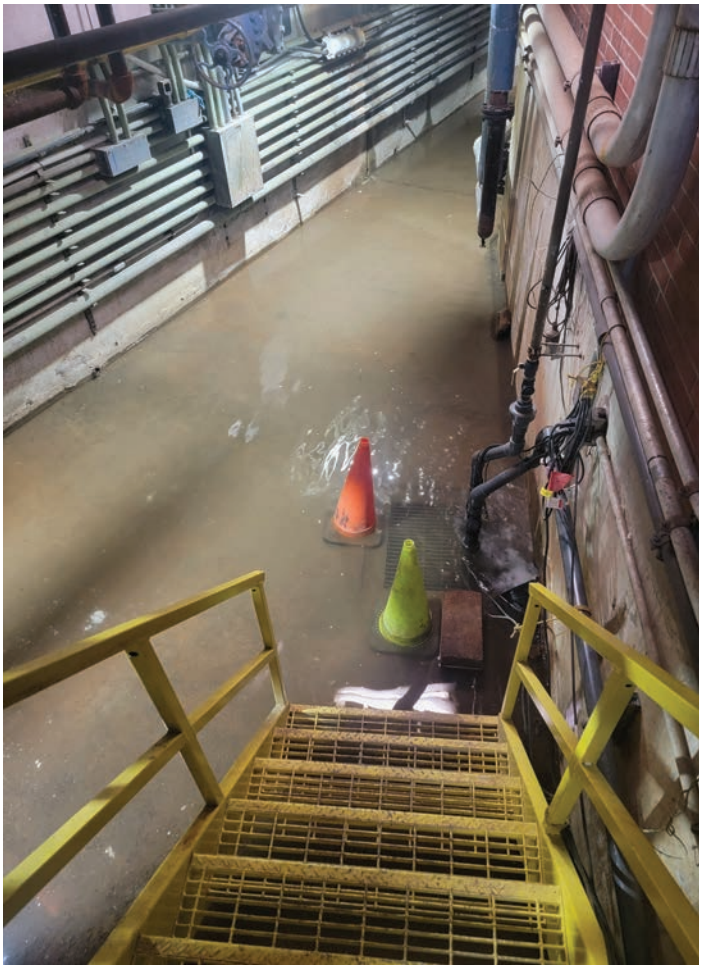
Among the concerns identified was the seiche, which was expected and was in fact significant in its impact. Lake Erie crested 10.67 feet above low-water datum (LWD) at noon Friday, the fourth highest recorded level. There is not much that can be done operationally to address this issue. Structural changes are required to prevent lake waters from backing up through combined sewer overflows and causing basement and street flooding. It did, however, serve to prove out backflow technology that was being installed to prevent future such occurrences.

Street flooding in low points such as viaducts can, however, be addressed to some level by cleaning and re-cleaning the grates to ensure that the water can at least get into the system. With the amount of rain and the winds, this type of flooding was a greater concern for operational staff. Crews were sent out early Friday morning to address street flooding calls. Unfortunately, this meant that these staff members were stranded for much of Friday and Saturday as they became stuck out in the storm. Fortunately, they were able to get themselves to temporary safety and were eventually brought back to Bird Island and sent home Sunday, Dec. 25, 2022.

On the facility side, many of the staff had taken off for the holiday weekend. Other staff had been staged to come in later in the day when the storm was expected to turn bad. As the storm turned worse earlier than anticipated, the staff on-site were unable to leave; they ended up maintaining operations for 36 to 72 hours of unrelieved work.

During this time, flooding, heating, equipment damage, and power loss were identified as the greatest issues of concern. Power to the facility was maintained, but with the winds blowing with hurricane forces for 40 hours in a swirling motion, windows were broken, and door seals and louvered vents were tested and found wanting. Keeping equipment from freezing became a concern as well, though one that thankfully never fully materialized.

The issue that did present itself was flooding in the raw wastewater pumping station. Constructed in the 1930s with only minimal upgrades since, the station itself is on piles, but the access tunnel adjacent is not. Both structures have the potential for groundwater infiltration, particularly when the river rises as would occur during a seiche event. In addition, the pumps themselves were working at full capacity as water from rain and melted snow surcharged the system. Water began to overwhelm existing sump pumps and threatened to reach the raw wastewater motors. The quick actions of operators and the incidental presence of a portable pump staved off this disaster, but it was a near miss.



Water coming up through sump pump, Dec. 23, 2022. *Alex Emmerson, BSA*

Flooding in the wastewater pumping station, Dec. 23, 2022.
Alex Emmerson, BSA

Digester tank with storm-damaged equipment, Dec. 29, 2022.
Alex Emmerson, BSA

As the weekend turned into Monday and then Tuesday, the sodium hypochlorite levels drifted lower and lower. A delivery had come in Thursday, but with maximum treatment capacity maintained for several days straight, supplies were dwindling. The need to get a delivery truck through was becoming dire, but the roads throughout the city were still mostly impassable. People who had become stuck in their vehicles were still being recovered. Plows could not move the enormous snow drifts; the snow had to be scooped and carried away in dump trucks. Working with the City of Buffalo Department of Public Works, a path was identified and a snow clearing escort was provided to ensure that this critical supply could be brought in before we ran out.

Post-Storm Impacts and Lessons Learned

Over the next several weeks, equipment that had been broken or twisted by the winds were identified and repaired. Throughout the city, curb boxes had been displaced or broken by plows and some receiver grates had been scooped up together with the snow. As these issues were identified, the broken or missing infrastructure was replaced. But on the whole, the sewer infrastructure weathered this storm well.

We did, however, have several lessons learned on the staffing side.

First, it is important to pre-plan communications. While the text chain was created ahead of the storm, it was done on the spur-of-the-moment. It was later found that some team members, who could have provided timely and meaningful insights, were not included. If a procedure had been in place in advance, with the luxury of time to think it through, these team members could have been included.

Second, supplies such as shelf-stabilized food and bedding should be kept on hand. Sufficient resources should be provided for employees who are unable to leave the site for more than 16 hours during situations such as this storm.

Third, staffing throughout a storm event should be considered to ensure that if a second or third shift cannot come in, there are sufficient staff to maintain operations. If special trades such as lab personnel or electricians will be needed, they should also be arranged in advance, even if that means resorting to outside contracts.

Lastly, staff that are on hand during an event should be aware of what to expect and under what conditions they may be required to stay past the end of their shifts. While Buffalo Sewer's union contracts do not have mandatory overtime provisions, when the weather prohibits the movement of even first responders, our staff need to remain on-site to ensure their safety and to avoid putting others at risk.

A year later we continue to mourn the loss of the dozens of our city's residents who died in the storm. We also have taken this storm as a serious reminder of our duty to ensure that future storms do not result in a failure of our critical service or imperil the health, safety or lives of our employees. As climate change continues to manifest itself in more severe storms throughout New York state, across the United States and around the world, the need to be prepared for the next big one becomes all the more urgent for us at Buffalo Sewer and for the water sector as a whole.

Rosaleen B. Nogle, PE, BCEE, BC. WRE, is the principal sanitary engineer with Buffalo Sewer Authority and may be reached at rnogle@buffalosewer.org. Photos credit to Alex Emmerson, treatment facility superintendent with Buffalo Sewer Authority.

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TENORM or How to Double Your Construction Costs and Schedule Overnight

By Rosaleen B. Nogle

Banner on site fencing. *Casterland Fanfan*

Project Background

As part of Buffalo Sewer's 2014 Approved Long-Term Control Plan, the Hamburg Drain Optimizations were included as projects to be completed by the end of Year 4 or March 18, 2018. These optimizations, to be located within the Combined Sewer Overflow 17 sewershed, were to manage overflows to the Hamburg Drain.

The Hamburg Drain is a sewer that was laid in the footprint of the former Main and Hamburg canal after it was abandoned. The Main and Hamburg canal in turn was laid in the Little Buffalo Creek's former bed. As a former creek bed, the Hamburg Drain is subject to intense infiltration and is directly hydraulically linked to the Buffalo River, which is itself a deep shipping canal laid in the ephemeral Big Buffalo Creek's former bed.

The goal of Hamburg Drain Optimizations was to decrease the required size — and potentially eliminate — the 5-million-gallon Hamburg Drain Storage facility, which was to be constructed in later years. Exactly what these optimizations were to consist of was unclear. Typically, the term "optimizations" was used to reference a weir raising or orifice adjustment, neither of which was a practical option in this case.

To make matters more difficult, as design was set to start on these optimization projects in 2015, the level of the Buffalo River was inordinately high; the Hamburg Drain was downstream of weirs and hydraulically linked to the river, not to the Bird Island Wastewater Treatment Facility.

After significant delays throughout the design process, it was determined that two Real-Time Control Projects — the Broadway at Oak Smart Sewer Project and the Mill Race Smart Sewer Project — would be constructed to meet the intent of the "Hamburg Drain Optimizations" projects. These two Smart Sewer projects would be located along two different sewers upstream of the Hamburg Drain. The Mill Race Smart Sewer would be constructed along a further upstream extent of the former Little Buffalo Creek from the Hamburg Drain, while the Broadway at Oak Smart Sewer would be constructed within an oversized combined sewer that was built in the 1960s to divert flows from and around the New York State Route 33 Kensington Expressway.

Broadway at Oak Smart Sewer Project

The New York State Route 33 Kensington Expressway, colloquially known as "The 33," is an expressway constructed to allow suburban and airport traffic to reach downtown Buffalo in a faster and more efficient way. A significant portion of this highway was installed below the ground surface through the Frederick Law Olmsted-designed Humboldt Parkway. Not only did this sunken expressway cut in half the thriving neighborhood that was once united by this tree-lined parkway, it also required redirecting existing sewer flows around the highway.

One of the new sewers that was installed for this purpose was the 9-foot-diameter reinforced concrete pipe sewer that extends from The 33 south along Michigan Avenue to Broadway and then continues for two blocks in the westbound lanes of Broadway before continuing south along Oak Street to then convey dry weather flows to the Southern Interceptor sewer and to overflow to the Hamburg Drain. It is within this structure that the Broadway at Oak Smart Sewer would be constructed.

In 2019, design work on a gate structure in the block east of Oak Street began with a preliminary cost estimate of $3.1 million. Before bidding could begin, permitting was required from the New York State Department of Transportation (DOT). This permitting was delayed significantly, first by the COVID pandemic and then the resignation of the Principal Sanitary Engineer in June 2020. As this position remained vacant for over a year afterward, communication between Buffalo Sewer and DOT was delayed and the permit process took over a year to complete.

By late spring of 2021, the final design had been completed with an engineer's estimate of $2.25 million. DOT permitting was not finalized until the end of the summer of 2021. When bids opened Sept. 28, 2021, as post-COVID lockdown hyperinflation was taking hold, the low bid was for $3.4 million.

After extensive contract document processing and shop drawing review, the project was $300,000.00 over the original budget and 50% over the engineer's estimate. But April 4, 2022, four years after the Hamburg Drain Optimizations project was originally scheduled to have been completed, construction on the 7.2-million-gallon-per-year Broadway at Oak Smart Sewer storage project finally began.

Barricades were erected, the road was cut, and ground was broken April 8, 2022. Teal and bright green lines were found in what was thought to be a concrete road base. A stop-work order was immediately issued and the DOT design drawings for the sewer and The 33 were more closely scrutinized. The drawings were found to contain an option that if the contractor were to substitute slag for concrete, the state was to have received a credit on the cost savings.

Teal and bright green lines found in what was thought to be a concrete road base that turned out to be slag TENORM. *Casterland Fanfan*

What Are Slag and TENORM?

To understand why work was stopped and why the drawings were searched for references to "slag," it is helpful to understand what slag is and the issues that can result in using it as a construction material.

When ore is smelted to produce iron or another metal, there are impurities that are present in the ore that need to be separated from the selected material. While the choice material is used in the finished metal, the impurities are collected together and disposed of as slag. These impurities in the ore can include radioactive isotopes, which when part of the host ore composed primarily of the choice material are at very low levels. When they are consolidated into slag, however, the radioactivity may rise to regulated levels.

Slag with these qualities is referred to as "Technologically Enhanced Naturally Occurring Radioactive Material" or TENORM. Generally, the levels of radiation present in TENORM are non-hazardous, as long as they remain buried and no one comes into direct contact with them. But once it is disturbed, it becomes radioactive hazardous waste and requires special handling and disposal in conformance with Part 380 of New York state's Environmental Laws.

The issue of TENORM first rose to prominence in Western New York in Niagara Falls. Local manufacturers had offered slag for free to contractors from the 1940s through the 1960s in what was seen as a waste- and cost-saving measure. The contractors in turn had used the material on both public and private projects throughout Niagara Falls. It seemed like a good idea at the time, but in the decades to come roads, driveways, and even building foundations started setting off Geiger counters, and were identified as emitting radiation at regulated levels through aerial surveys.

Until the Broadway at Oak Smart Sewer project, the issue of TENORM and slag was generally considered by the local engineering and contracting community to be a problem concentrated in and largely restricted to Niagara Falls. With the discovery of the bright green and teal lines in the road base on Broadway, however, concerns regarding a more widespread issue were raised and a crew was dispatched to the site with a Geiger counter, which immediately started chirping.

So Now What?

Given that radioactivity was now confirmed at above background levels, though still at relatively low levels, a specialty consultant and testing firm was called in to advise on the storage, determination of constituents and disposition of the material. Samples were collected and sent for laboratory analysis that would take over a month to complete. In the interim, the road base, including the TENORM, could be collected on-site in a covered location and stored until a final disposal location could be found. While radioactive, the level of radiation observed was not an immediate threat to the health or safety of the public or workers, but direct contact was nonetheless to be avoided.

The process of segregating and storing the material resulted in a one-month construction delay on an already aggressive schedule that was to have been completed before Thanksgiving of 2022. With the local asphalt manufacturers closing down for the winter immediately after Thanksgiving each year, and a winter shutdown through the Christmas Blizzard, this delay ultimately entailed pushing back paving until spring, resulting in significant additional handling and storage costs totaling $180,000.00.

Once the material was analyzed, the costs skyrocketed even further as the nearest disposal site that could accept the material was in Ohio; specialty contractors had to be used to carry the TENORM-containing slag the daylong trip to get there. This resulted in an additional $620,000.00 change order and further delays in work.

Project Completion

Finally, Sept. 28, 2023, almost a year behind schedule and at a final cost of $4,224,349.96, the Broadway at Oak Smart Sewer project contract was completed. Happily, the site has already begun to store flows and work to prevent overflows. In the second half of 2023, even as the site is still being calibrated, the project has already stored over 7.2 million gallons, the designed capacity for an entire year.

While significantly over budget and behind schedule, due in large part to TENORM, this project remains a success story as well as a lesson learned in site investigations moving forward.

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Operator Quiz Winter 2023 – Test Your Knowledge on Safety

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. Which of the following would be the safest action to take in the event of a major chlorine container leak?

A. Call the fire department
B. Roll the container so that liquid escapes rather than gas.
C. Submerge the container in a basin or stream
D. Notify local police or sheriff

2. Safety-toe protective footwear, including steel-toe shoes or boots, normally have a compression rating of _____ft-lb.

A. 300
B. 75
C. 10
D. 100

3. Recommended personal hygiene practices to minimize the risk of being infected by wastewater pathogens include...

A. Washing your hands before the beginning of your shift
B. Only rubbing your eyes while working if you are wearing impervious gloves
C. Changing out of your work clothes and showering before leaving work
D. Reading the material safety data sheets for all chemicals used at the plant

4. All chlorine cylinders are required to contain at least one fusible metal safety device designed to melt at between ___ to___ degrees F.

A. 100-120
B. 158-165
C. 200-212
D. None of the above

5. Which of the following provides safety information for potentially hazardous or toxic materials?

A. SDS
B. CFR
C. OSHA
D. PESH

6. A supervisor may be held responsible, in part or completely, for an accident if they...

A. Require that work be performed in haste
B. Disregard an unsafe environment in the workplace
C. Fail to consider any number of safety hazards
D. All the above

7. Before entering a confined space that could contain a hazardous atmosphere you need a _____.

A. Completed confined space entry permit
B. Proper retrieval device
C. Permission from immediate supervisor
D. Canister respirator, gloves and hard hat

8. What is a safe level of oxygen in a confined space?

A. 18%–20%
B. 20.5%–25.5%
C. 23%–28%
D. 19.5%–23.5%

9. A Safety Officer's duties should include...

A. Evaluating every accident
B. Keep and apply statistical accident reports
C. Offer recommendations to improve safety
D. All the above

10. Safety Data Sheets must contain the following information:

A. Concentration, manufacturer name and address, and possible uses
B. Chemical name, emergency procedures for spills, and necessary personal protective equipment
C. Chemical name, manufacturer name, purchaser name, and disposal procedures
D. Purchaser name, possible health effects, and storage requirements

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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.

Answers: **1.** (A) Call the Fire Department **2.** (B) 75 ft **3.** (C) Changing out of your work clothes and showering before leaving work **4.** (B) 158-165 **5.** (A) SDS **6.** (D) All the above **7.** (A) Completed confined space entry permit **8.** (D) 19.5%-23.5% **9.** (D) All the above **10.** (B) Chemical name, emergency procedures for spills, and necessary personal protective equipment

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