Summer 2017, Vol. 47, No. 2

New York Water Environment Association, Inc.

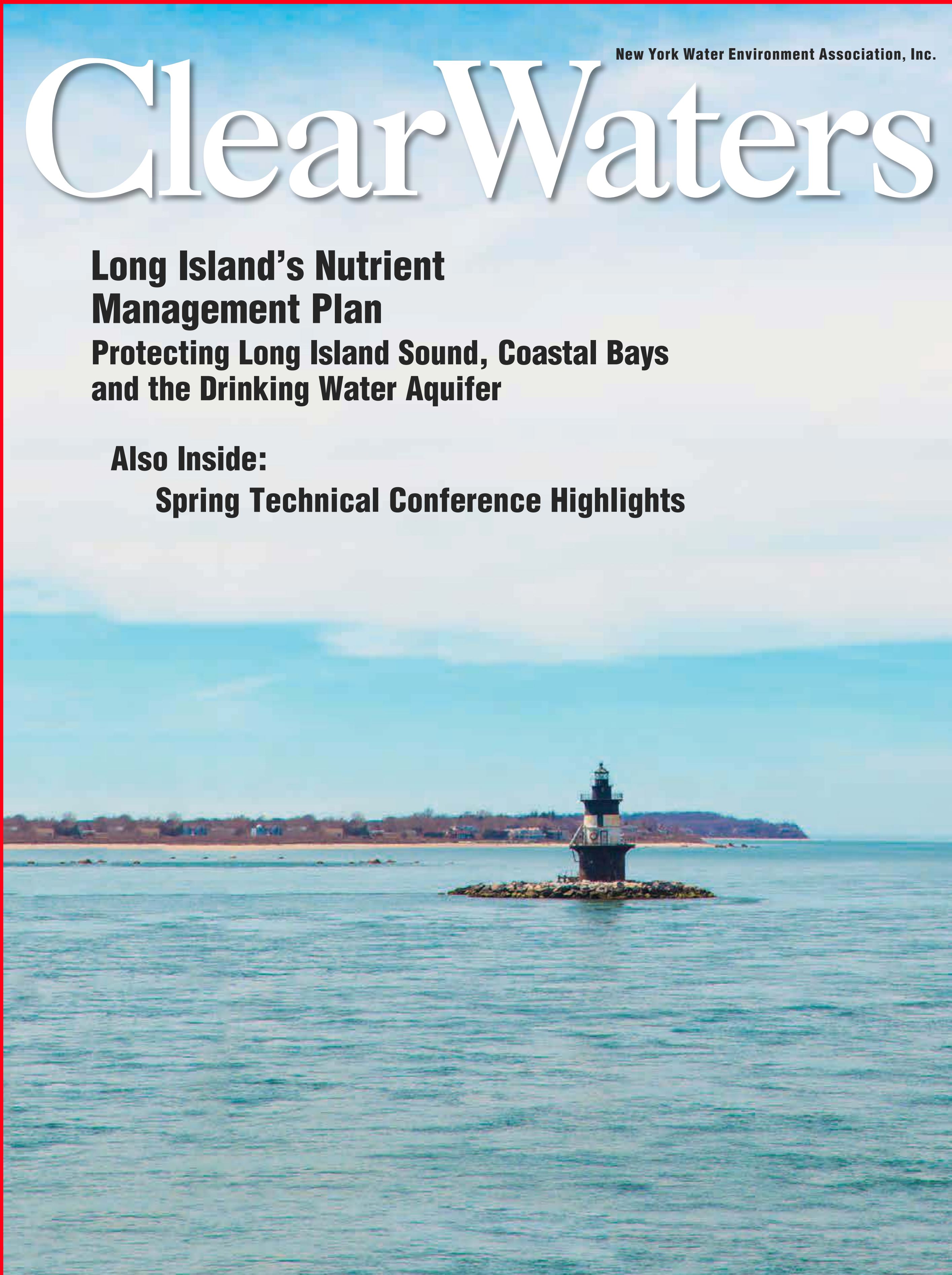
Clear Waters

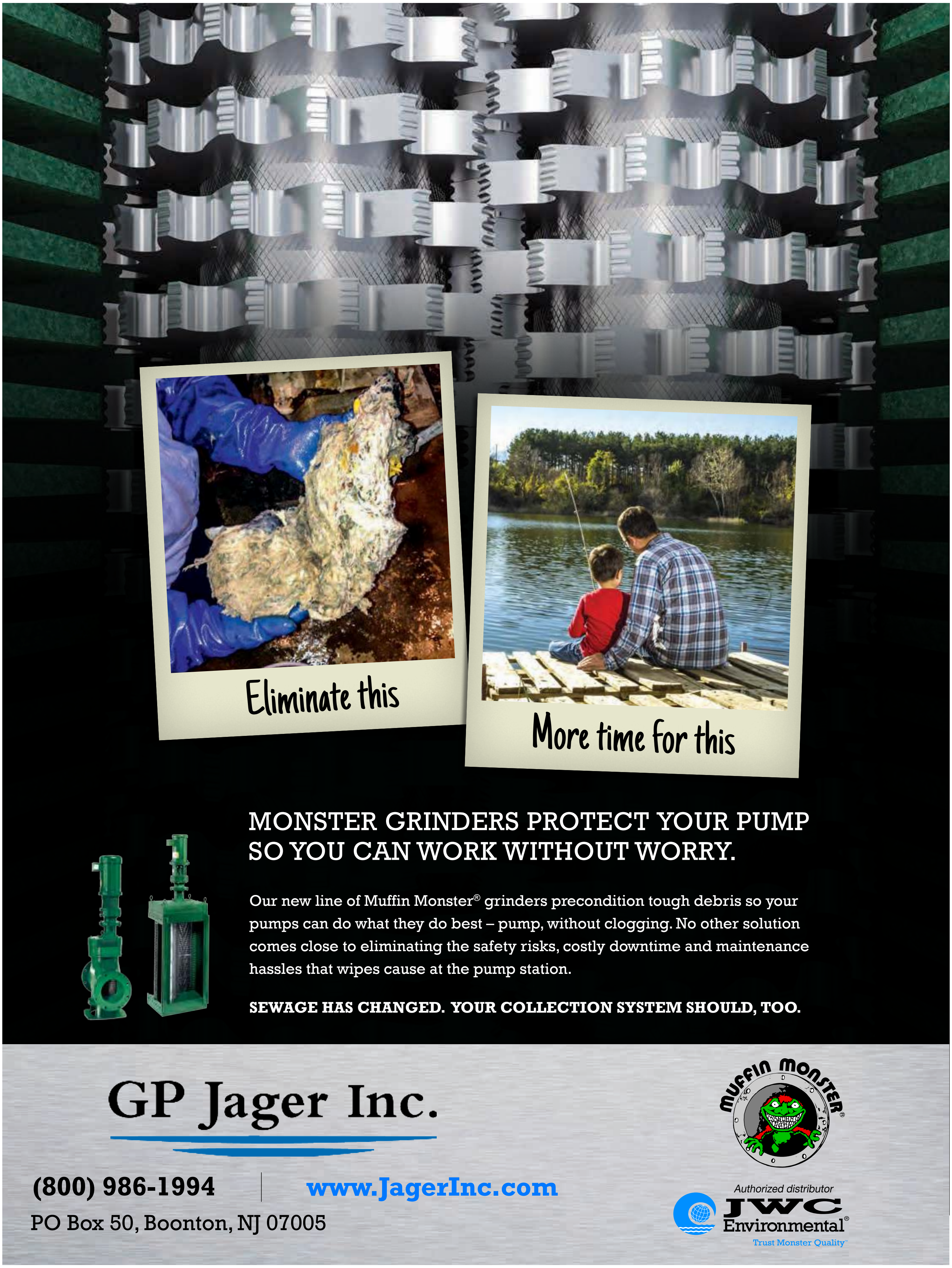
Long Island's Nutrient Management Plan

Protecting Long Island Sound, Coastal Bays and the Drinking Water Aquifer

Also Inside:

Spring Technical Conference Highlights

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Cover: Orient Point Light Station. Situated at the easternmost point on the North Fork of Long Island, the Orient Point Light Station marks the end of Oyster Point Reef. Also known as "the coffee pot", the structure was built in 1899 as a navigation guide through Plum Gut, which runs between the reef and Plum Island. The light station is 64 feet tall and sits five degrees out of plumb.
Photo: istockphoto.com, by littleny. Text sources: U.S. Coast Guard (https://www.uscg.mil/d1/antlis/files/lights/opl.asp; NewYork Lighthouses.com (http://www.longislandlighthouses.com/orientpt.htm); Spikehorn (http://www.spikehorndesert.com/other#/lighthouse/)

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President's Message | Summer 2017

Welcome to the summer edition of *Clear Waters*. It was a wet and cold spring for most of New York. With any luck, the summer will bring better weather, fun activities with friends and family, and (hopefully!) some time off from work.

2017 Spring Technical Conference

In June we completed a very successful Spring Technical Conference and Exhibition in Rochester. The conference officially started with a wonderful opening session that embodied the conference theme of 'Celebrating the Past While Moving Forward'. Genesee Valley Chapter Chair Michelle McEntire and I gave preliminary statements, followed by Deputy Monroe County Executive Thomas VanStrydonck. His witty remarks had the audience laughing and put everyone in a great mood. Deputy County Executive VanStrydonck presented NYWEA with a proclamation issued by County Executive Cheryl Dinolfo declaring June "Water's Worth It" month, reinforcing the importance of clean water for our communities.

Paul D'Amato, Region 8 Director of the NYSDEC, presented an outline of the state's announced funding priorities for clean water projects. He also offered an interesting accounting of NYSDEC's involvement in major projects in the Greater Rochester Area, including the environmental legacy of the Eastman Kodak facilities. Dolores Kruchten, President of Eastman Business Park, nicely complemented Director D'Amato's remarks in her presentation as she laid out the impressive history of the business park with some striking photos and videos. Ms. Kruchten shared amazing facts about the physical size, impressive infrastructure, and critical importance of the park to the region and Kodak's place in the world. The business park has certainly had a remarkable past, and is well positioned for the future as a vibrant community of diverse businesses.

The final presentation of the morning was on the Genesee Brewery's strong resurgence, by brewery manager Mark Minunni. Mr. Minunni highlighted Genesee Brewery's triple bottom-line approach, where everyone is accountable for people, planet and profit; as a result, the company is realizing significant success. Brewery upgrades have made the business run more efficiently, and positioned Genesee Brewery for long-term growth and sustainability. The modernization reduces energy consumption, conserves water, and decreases waste. I want to thank Water Ambassador Mike Garland and the Genesee Valley Chapter for an excellent job assembling a great opening session.

The Program Committee, led by chair Lisa Derrigan and vice chair Jeff Butler, developed a well-received technical program of 11 sessions offered over the three days. The sessions were full of interesting presentations that offered many opportunities for continuing education credits. Although inclement weather prohibited entry into Monroe County's Combined Sewer Overflow Abatement Program tunnel, NYWEA members were able to tour the impressive operations and control center at the Frank E. Van Lare Wastewater Treatment Facility.

David Barnes of the Conference Management Committee, along with local experts from the Genesee Valley Chapter, organized entertaining social events every evening of the conference. A great time was had by all at the Rochester Red Wings baseball game Monday night. Cold and rainy weather did not dampen the fun at Tuesday night's dinner at the Genesee Brew House, where everyone rolled with the weather and enjoyed themselves in the museum and tasting room. Unfortunately our golf outing was shortened by rain and lightning.

One of the best parts of any Spring Conference is the Operations Challenge. This year we had eight teams compete at the conference, including visiting teams from New Jersey and Virginia MAs. The competition was fierce and in the end the Jamaica Sludge Hustlers came out on top. Congratulations to all the teams! NYWEA is excited to send the Jamaica Sludge Hustlers, Brown Tide, and Genesee Valley Water Recyclers to compete at WEFTEC in Chicago this fall.

Thank you to everyone who helped make the 2017 Spring Conference and Exhibition in Rochester a huge success and fun time. A special thanks to the volunteers from the Genesee Valley Chapter for their creative ideas, enthusiasm, and willingness to help.

Long Island Nitrogen Action Plan

This issue of *Clear Waters* is dedicated to Long Island's water quality initiatives with a focus on controlling nutrients. The Publications Committee has done an excellent job once again getting industry leaders to prepare interesting and informative articles. Our goal is to help you understand what is involved in the Long Island Nitrogen Action Plan (LINAP), which includes NYCDEP's $1 billion investment in nitrogen removal.

In a letter dated December 23, 2015, the USEPA proposed a nitrogen reduction strategy to the five states in the Long Island Sound watershed. This strategy would complement the states' earlier progress in the implementation of the Total Maximum Daily Load to Achieve Water Quality Standards for Dissolved Oxygen (DO) in Long Island Sound (2000 TMDL). While the goal of the 2000 TMDL was focused on DO concentrations in the open waters of the Sound, USEPA's proposed strategy "expands the focus to include other nutrient-related adverse impacts to water quality, such as loss of eelgrass, that affect many of Long Island Sound's embayments and near shore coastal waters."

The 2015-16 New York budget included $5 million for the NYSDEC and the Long Island Regional Planning Council – in partnership with local governments and other interested organizations – to develop the LINAP. This plan will address the rising nitrogen levels in groundwater, in order to protect the sole source aquifer that provides drinking water to over 2.8 million people living on Long Island. Nitrogen from fertilizers and on-site residential waste treatment facilities, including septic systems and cesspools, affects many embayments and significant ocean-front waters that offer spectacular beaches, boating, fishing and shellfishing.

'Clear Waters' is Going Digital!

We are excited to announce that *Clear Waters* is now available on a mobile app that will allow our members to read the magazine on their smart phones and tablets. For more information on how to log in, see the ad on page 26. We hope you enjoy reading *Clear Waters* on your mobile device, and use the search capability to research the topics that are featured.

Paul J. McGarvey, PE, NYWEA President

It's All in How We Communicate!

Communicating to the general public the good work that our members do is a challenge. We have recently taken steps to address this issue with the 12-page messaging document and companion video rolled out at the 89th Annual Meeting, as well as the creation of the Public Awareness Task Force. Our call to action is continuous and there's still much work to be done on many fronts. The work performed in the water industry is complicated, and the language we use to describe our work is often filled with jargon and acronyms that don't necessarily make it easy for the public to understand.

I recently learned from Jean Malafronte, one of our members who attended a U.S. Water Alliance meeting, that when the general public was asked what "green" infrastructure means, a certain portion of the population associated this term with a "liberal" agenda, and had a negative connotation associated with the word. Of course, we know that is not the meaning/intent of green infrastructure. However, it does make you think a little deeper about the terminology we use to describe the work our members perform. The recommendation at the conference was to use "nature-based solutions" instead of "green," and that does has a ring to it. In the same vein, the word "infrastructure" also means different things to different people, depending on where you live and your background. The meaning that comes to mind can range from fiber optics to roads and bridges, and is not always associated with water infrastructure. (This has always been frustrating to me!) I guess this goes back to the adage, Out of Sight – Out of Mind. Part of our job is to make sure water makes its way into people's minds when infrastructure is brought up, particularly by elected officials whose decisions will be so impactful. Our challenge is to bring what is out of sight into clear focus for everyone. Thanks for sharing this information, Jean!

Let's look at the reframing of the terminology "wastewater treatment." We see Water Resource Recovery used more often now, and the term Water Purification District has recently been approved by the Albany County Legislature to replace "sewer district". I just learned about a utility in Oregon that rebranded to Clean Water Services. These are all very creative ways to reflect better what our members do. Ultimately, we want the public to be informed about and appreciate what happens to water after it is used. We all play a part in making sure a positive message is reflected.

In speaking about positive reflections, I'm so very pleased to announce that the NYWEA Board of Directors approved a budget in June that included updating the website. We are thrilled to be working on this project and look forward to its unveiling in time for the celebration of NYWEA's 90th Annual Meeting! We want the website to be educational, informative, and a useful tool for all of you. We'd like it to be easy to maneuver, easy on the eyes and have high functionality. Stay tuned!

As I write about branding and communication, the Long Island Chapter leaders recently developed a brochure to share with residents, elected officials, libraries and all stakeholders, which includes specific information on water quality issues affecting people living on Long Island. It is our hope that this brochure, as well as dedicating this issue of *Clear Waters* to Long Island Water Quality Issues, will increase awareness and appreciation of our precious water resource.

Here's wishing you all an enjoyable summer!

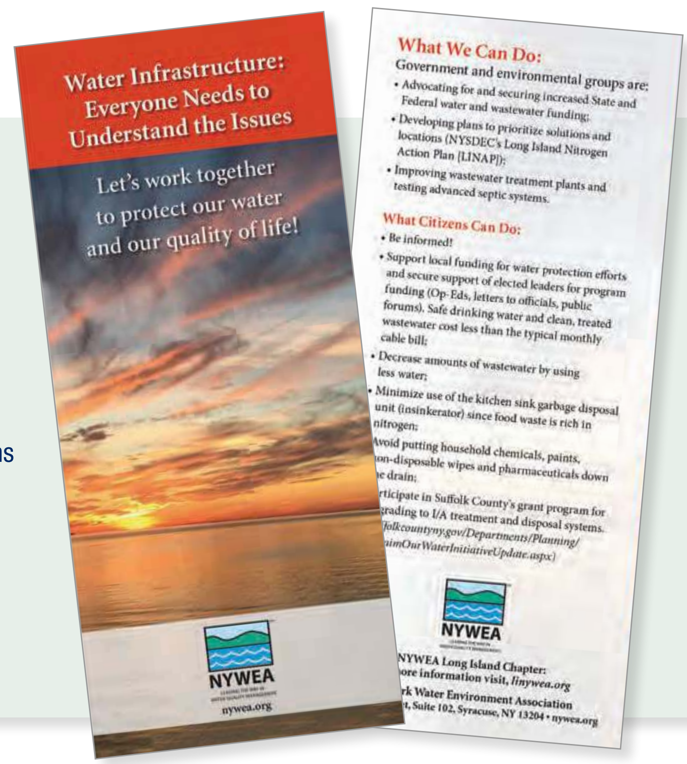
Patricia Cerro-Reehil
pcr@nywea.org

"Long Island is unique because we live directly on top of our only source of water for drinking, bathing and irrigation. As an island, we enjoy beautiful waterways and wetlands."

Informational topics in the brochure include:

- Here's What is Happening
- Effects of Nitrogen and Other Pollutants
- Current Funders of Wastewater Treatment
- Other Pollutants
- Solutions: Expand Sewer Systems and Advanced Septic Systems
- Benefits of Action
- Financing
- What We Can Do
- What Citizens Can Do

FACT: Over 1 million people (74 percent) in Suffolk County have septic systems or cesspools.



Hyatt Regency, Rochester, NY

Highlights of Spring Technical Conference & Exhibition

"Celebrating the Past While Moving Forward"

NYWEA President, Paul McGarvey, addresses members during the Opening Session.

Michelle McEntire gives a welcome address on behalf of the Genesee Valley Chapter.

Mike Manning

Kyriacos Pierides

Past President Joseph Fiegl

Cosimo Pagano

Tim Taber

Ge (Jeff) Pu

Mike Garland

David Silverman

Steve Sanders

Mary Doran

Ken Smith

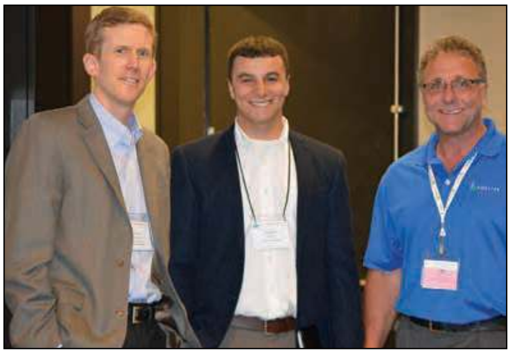
Jeff Le Blanc

Robbie Gaiek, left, and Libby Ford

Bruce Munn, left, talks with Ken Krupa from Kruger.

Randy Ott, GP Jager, talks with attendee.

Aftek Inc.'s Kathy Russell, left, and Rich Horan at their exhibit booth



L-r: Jesse Semanchik, Taylor Bottar and Mark Koester

Jim Cunningham, left, and John Esler

Daniel Ziemianski and Mary Lawhon from Erdman Anthony

L-r: Bob Albright, Mike Garland and Paul McGarvey

Gary Black, left, talks sports with Fred Falleson.

Michelle Virts, left and John Palermo

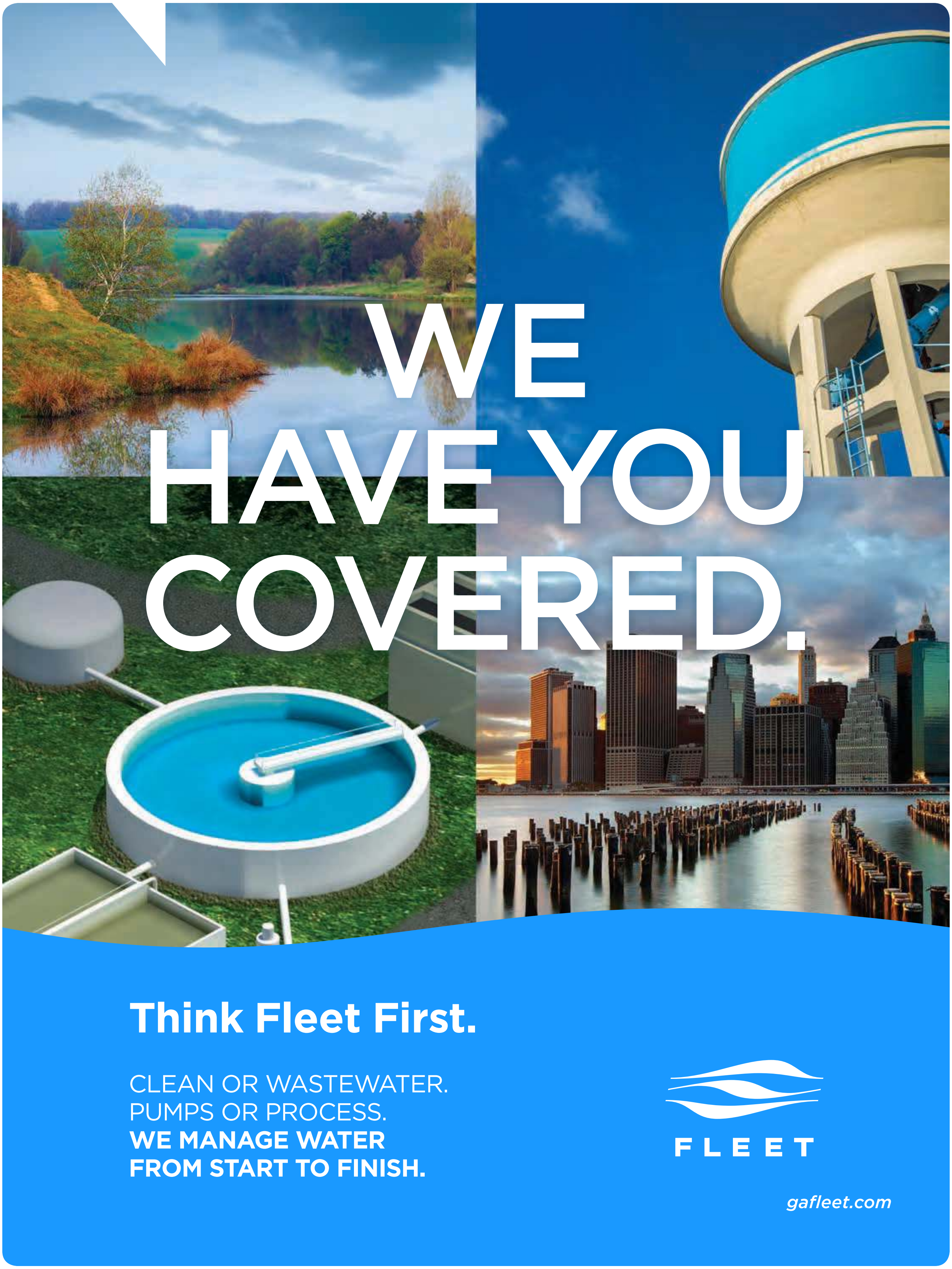
L-r: Barton and Loguidice's Mike Andrews, Lesen Haracz, Erin Ryan pose with Mike Hershelman, City of Rochester.

(Left) L-r: Bill Grandner, Lauren Spink and Paul McGarvey

continued on page 42

(Left) Town of Williamson's John Manahan (left) and Village of Williamson's Joe English (right) receive the Sustainability Award from President Paul McGarvey.

(Right) L-r: Rob Ganley, Mike Garland and Bill Davis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PUMPS OR PROCESS.
WE MANAGE WATER
FROM START TO FINISH.
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Water Views | Summer 2017

Long Island Nitrogen Action Plan

Excess nitrogen is a major problem for Long Island's waters. Nitrogen as nitrates threatens the quality of the aquifer that is the sole source of Long Island's drinking water. In surface water, it causes toxic algal blooms, which contribute to fish kills and degraded marine habitats. Excess nitrogen also damages the coastal marshes that provide a natural protective buffer during storms.

The Long Island Nitrogen Action Plan (LINAP) will establish a strategy on how best to reduce nitrogen pollution through technical, management and regulatory actions. An article by Kenneth Kosinski and Maria Isaacson on page 10 provides a detailed overview of the issues and the efforts underway.

The draft LINAP scope of work was prepared with significant stakeholder input, including five public meetings in 2015 and 2016. The scope describes the LINAP goals, planning structure, tentative schedule and tasks. More details about the LINAP scope of work are presented in the article by Elizabeth Cole on page 16.

Studies that support the LINAP effort are underway. Subwatershed modeling will estimate the amount and sources of nitrogen entering a given waterbody. Hydrodynamic modeling is being used to ascertain the residence times of surface waters, which is important when determining how much nitrogen should be allowed to enter a waterbody. Work is also being done to establish waterbody-specific ecological endpoints, to provide quantifiable goals.

Local involvement and ownership are fundamental to the success of LINAP. Suffolk County is piloting alternative/innovative on-site wastewater treatment systems (A/I OSWS) designed for nitrogen removal. Nassau County is focusing significant resources on improving nitrogen removal at existing water resource recovery facilities, and evaluating alternative outfall locations to reduce adverse impacts on sensitive bays. Read more about these and other efforts in this issue of *Clear Waters*.

NYSDEC and its partners are committed to undertaking aggressive actions to reduce nitrogen pollution while the LINAP effort goes forward. Moreover, information sharing is – and will continue to be – an integral part of LINAP. These efforts include regularly updated web pages and a monthly newsletter highlighting partner updates, public meetings and funding opportunities.

New York has already committed many hundreds of millions of dollars to reduce nitrogen pollution on Long Island. Moving forward with our LINAP partners, and using information gathered from workgroups, modeling, studies and stakeholder input, we will develop and implement more specific actions so that Long Island has the clean water it deserves.

To learn more about LINAP, visit *on.ny.gov/LINAP*. To receive updates, enter your email in the blue "DEC Delivers" box on that page.

– James Tierney, Deputy Commissioner for Water Resources
NYS Department of Environmental Conservation

Focus on Safety | Summer 2017

Preparedness from Outside the Box

In 2012, Hurricane Sandy put emergency preparedness front and center in many people's minds. It also put preparedness on the 'To Do' list of many companies and utilities. In previous columns, I preached about personal preparedness: taking a class; getting your family's contingency plan in place; filtering water; high water; workplace plans; asset management; and all sorts of methods to 'Be Ready'. Remember your Scout training and be prepared!

Let me just say that if you were prepared three years ago, you might not be so prepared now. Preparedness requires the patience of repetition. A flurry of activity in the aftermath of a big headline-making storm lays out preparedness plans for the short term, but those preparations need continued attention in the long term. Has anyone left your organization in the past five years? Then it is likely you have a couple of large holes in your plans. Have you practiced your preparedness plans with new staff, with either tabletop or computer-generated scenarios?

One tool that would make a good addition to a utility's emergency response planning is the All Hazard Consequence Management Plan; a specific version exists for the Water Sector. It takes a different 'spin' on the emergency hazard. Rather than looking specifically at any one cause – such as flood or hurricane – it looks holistically at the potential ways a utility may: lose power, communications, or SCADA; have a reduced workforce; or incur economic or contamination incidents. Then the utilities are taken through preparedness initiatives to increase their resiliency to these challenges and the related recovery/response actions.

A similar process could be used for home preparedness. Instead of thinking separately about each type of home emergency, try thinking 'all-hazard'. For instance, what is the plan if: you need to evacuate the home; if everyone is ill with the flu; if the power goes out for any reason; if you can't use the well; or if the gas station is out of fuel? This is the preparedness side. On the other side are the recovery and response actions. For example, maybe the well went dry. So you stocked up with a couple of days' supply of bottled water, you are grilling all meals and the family is taking showers at Grandma's house. These short-term responses will allow time for you to initiate recovery actions: get the driller scheduled; check the piping; install the low-flow facilities; educate the family on water conservation; and get back to normal as soon as possible.

Using the home-based analogy may make the transition to the work-based All Hazard Consequences model smoother. Home-based issues are familiar to most workers, which will engage the group in thinking of workplace preparedness. It may seem like twisted thinking to some folks, but any conversation that makes both the organization and the homefront more prepared to successfully face adversity is a win.

– Eileen M. Reynolds, Certified Safety Professional
Owner, Coracle Safety Management

Tackling the Nitrogen Problem: The Long Island Nitrogen Action Plan

by Kenneth Kosinski and Maria Isaacson

Poor water quality, especially from nitrogen pollution, has now reached a near crisis point in many coastal areas of Long Island. The issues have been well-publicized on Long Island by wastewater professionals and academics like Walt Dawydiak from the Suffolk County Health Department and Dr. Chris Gobler with the SUNY School of Marine and Atmospheric Sciences. For those unfamiliar with their work, these water quality issues are due largely to the over 400,000 aging on-site wastewater disposal systems that do not have the capability to remove nitrogen. Many of those on-site systems, especially in older communities, are simple cesspools placed within coarse and sandy soils. Cesspools and standard septic systems remove little of the nitrogen from wastewater. There are many older high-density communities without sewer systems concentrated along Suffolk County's coast. For example, 61 percent of the population of Suffolk County lives within the Great South Bay's watershed.

Large quantities of nitrogen-enriched effluent flow from these communities into groundwater, which travels to surface waters or infiltrates drinking water aquifers. This contaminated groundwater degrades the only drinking water source on Long Island. Also, the contaminated groundwater flows into adjacent embayments, which are experiencing low dissolved oxygen, algal blooms (harmful and otherwise), and loss of habitat, including sea grasses and wetlands.

Nitrogen Impacts on Marshland

Peer-reviewed science has demonstrated a connection between excess nitrogen pollution and the degradation of the coastal marshland complexes that help protect Long Island's south shore population centers from storm inundation. Salt marshes are highly productive coastal wetlands that provide a wide array of important ecosystem services, including storm surge protection for coastal communities, nutrient removal, carbon sequestration, and habitat for numerous fish, shellfish and wildlife species.

Excess nitrogen pollution poses a serious threat to Nassau and Suffolk counties' coastal marshlands. There has been an accelerated loss of salt marshes in recent decades all around Long Island, but most notably along the south shore of Long Island and within Jamaica Bay.

Suffolk County's Great South Bay, as an example, experienced an estimated 18 to 36 percent loss in tidal wetlands ***(Figure 1)*** from 1974 to 2001 because of various factors, including wetland fills and coastal development *(NYSDEC 2014a)*. This means that marshland loss along the south shore of Long Island is occurring in an ecosystem that has already experienced significant adverse impacts in many areas.

Excessive nitrogen causes marsh grass along tidal creeks and bay coasts to initially become greener and grow taller in a manner similar to the effects of fertilizing a lawn. The tall marsh grasses, however, produce fewer roots and rhizomes – plant attributes that are critical to stabilizing the edges, soils and structure of marshlands. The poorly rooted grasses eventually grow too tall and then fall over, thereby destabilizing the creek-edge and bay-edge marsh, causing it to slump and exposing soils to erosive forces. There is also an increase in microbial decomposition of organic matter within the soils that underlie the marsh biomass, which can cause marshes to subside *(Deegan, Bowen, et al. 2007; Deegan, Johnson, et al. 2012)*.

The destabilization of creek-edge and bay-edge marshes makes these areas much more susceptible to the constant tugging and pulling from waves, accelerating erosion and the ultimate loss of stabilizing vegetation. This process results in the loss of the naturally resilient coastal marshland barrier – a barrier that protects shoreline communities from major storm surges and wave action. Tidal wetlands can protect coastal communities from storm damage by dissipating wave energy and amplitude, reducing the erosive effect of waves by slowing water velocity and stabilizing shorelines through sediment deposition. Some studies estimated that more than half of normal water energy is dissipated within the first three meters of marsh vegetation, such as cord grass, while other studies concluded that wave height is reduced by 80 percent over fairly short distances as waves travel through marsh vegetation *(Anderson, et al. 2013; Jadhav and Chen 2012)*.

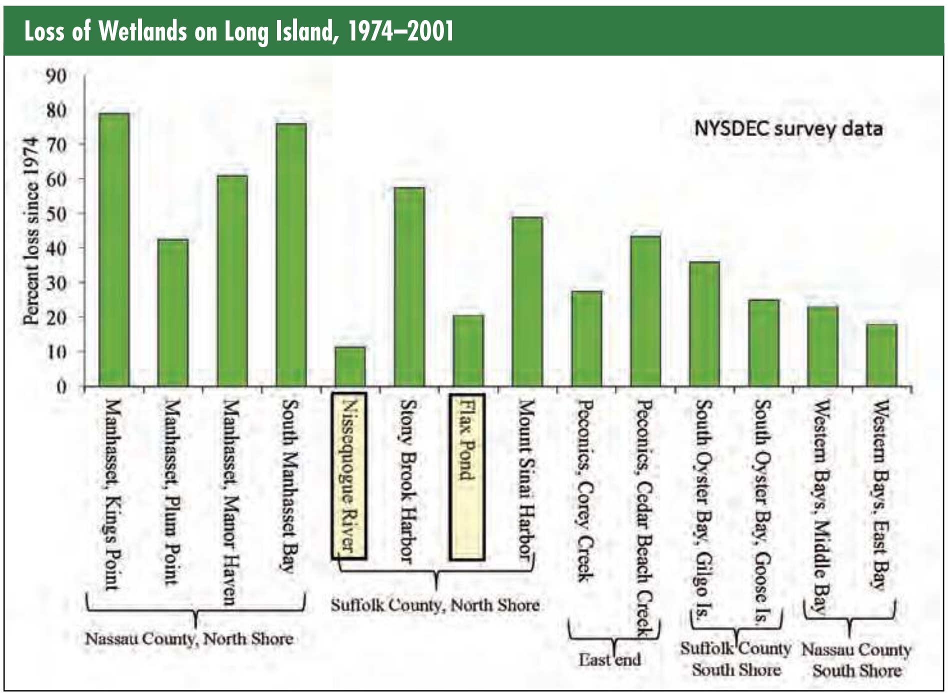

Figure 1. Wetlands along the shores of Long Island have disappeared at an alarming rate. This chart shows the percent of wetlands lost since 1974. In some cases, 80 percent of the wetlands have been lost. A significant cause of the loss is the high amount of nitrogen in the water.

NYSDEC Survey Data

Nitrogen Impacts on Habitat

Poor water quality has severely degraded the ecology of the Great South Bay. Hard clam landings in the Great South Bay once exceeded 500,000 bushels per year in the 1970s (a $62 million-per-year industry employing thousands). In 2016, hard clam landings in Great South Bay were 6,822 bushels, representing 3.8 percent of New York's landings and less than 1 percent of the peak landings in the mid-1970s ***(Figure 2)***.

The loss of critical eel grass habitat has occurred on a similar scale. Historic photography and records indicate that there may have been 200,000 acres in 1930; today, only 21,803 acres remain. Both the Chesapeake and Tampa Bay estuary programs have seen increases in various eel grass species following their efforts to reduce nitrogen loadings, address human impacts and implement restoration efforts *(Greening and Janicki 2006)*.

Nitrogen in Drinking Water Aquifers

Nitrogen and other pollutants remain a constant concern throughout Long Island, as the drinking water for 2.8 million residents is drawn from sensitive groundwater aquifers recharged from the surface. There is a disconcerting trend in the quality of groundwater in Long Island's Upper Glacial and Magothy aquifers. According to Suffolk County, median groundwater nitrogen levels in the Upper Glacial Aquifer have risen 40 percent to 3.58 mg/l, and the Magothy Aquifer has seen a 93 percent increase in nitrogen levels to 1.76 mg/l since 1987 *(Suffolk County 2015)*. While nitrogen levels are generally below the drinking water standard, there are some areas that now exceed the 10 mg/l limit, with this troubling trend accelerating. These aquifers, of course, are recharged through surface water and subsurface wastewater infiltration.

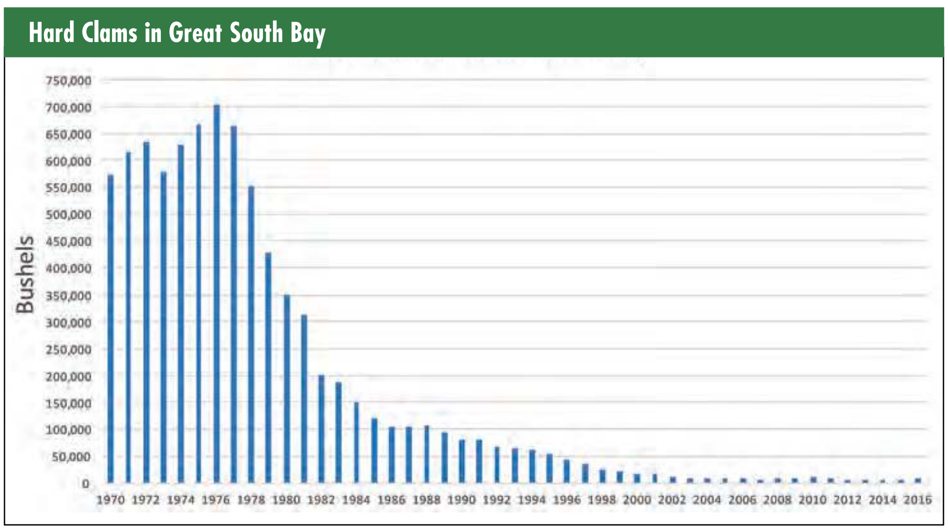

Figure 2. Shellfish landings history in bushels per year(1970-2016). *NYSDEC*

Nitrogen and Algal Blooms

A variety of algal blooms are normal in warmer weather. Excess nitrogen pollution is linked to other types of problematic algae and microscopic organisms, such as "harmful" algal blooms (HABs), "red tides," "rust tides" and "brown tides". These algal blooms have serious adverse impacts on swimming, fishing, shellfishing and boating ***(Figure 3)***.

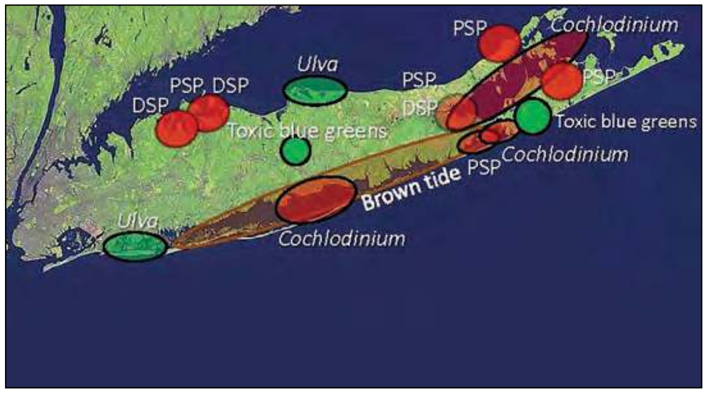

Figure 3. Each shaded area represents the location of a recent harmful algal bloom or multiple blooms. The blooms are fueled by excessive nitrogen and can be harmful to humans, pets and wildlife.

Dr. Christopher Gobler

Addressing the Problems

To address problems like these, in 2015 New York state appropriated $5 million to develop the Long Island Nitrogen Action Plan (LINAP). LINAP will determine how best to reduce nitrogen loading to groundwater and surface water through technical, management, regulatory and policy actions. A broad partnership is working together to develop and implement LINAP, which includes the New York State Department of Environmental Conservation (NYSDEC), the Long Island Regional Planning Council (LIRPC), Suffolk and Nassau counties, local governments, area scientists, numerous environmental organizations, non-governmental organizations and a cadre of consultant services. *(See companion article "LINAP Management Structure and Partnership" for more details.)*

The LINAP development process recognizes that there are many activities targeting mitigation of nitrogen impacts on water quality currently underway. LINAP will not duplicate these ongoing efforts. Rather, it will work in parallel with these efforts with the goal of developing a robust nitrogen loading reduction plan for Long Island.

Major current projects to reduce nitrogen impacts to Long Island's waters include: upgrades to the Bay Park Sewage Treatment Plant; subwatershed planning in Suffolk and Nassau counties; Suffolk County's Septic Incentive Program; an aquifer sustainability study by the U.S. Geological Survey; development of innovative, alternative on-site wastewater treatment systems; and updates to comprehensive management plans for Long Island's estuaries. The most recent New York state budget includes additional funding for several Long Island nitrogen reduction initiatives, including:

continued on page 12

continued from page 11

Tidal marsh on the North Fork of Long Island. *Tara Coady*

- Developing advanced septic system treatment technologies to reduce nitrogen pollution.
- Protecting drinking water at its source.
- Protecting the Long Island South Shore Estuary Reserve and Peconic Bay Estuary.
- Wastewater and sewer improvements in Nassau and Suffolk counties.
- Groundwater monitoring.

Conclusion

Nitrogen contamination is a large problem on Long Island. Nitrogen levels are rising in both surface and groundwater. Environmental and economic impacts are evident. NYSDEC is working with Suffolk and Nassau counties and other partners to determine what needs to be done to stop and reverse the nitrogen problem. The group is collaborating to develop the Long Island Nitrogen Action Plan (LINAP), which is the roadmap to reduce nitrogen in Long Island's water.

Kenneth Kosinski, P.E. is the Director at the Bureau of Water Resource Management, and may be reached at kenneth.kosinski@dec.ny.gov. Maria Isaacson is an Environmental Program Specialist with the Bureau of Watershed Assessment and Management, and may be reached at maria.isaacson@dec.ny.gov. Both Bureaus are in the Division of Water of the New York State Department of Environmental Conservation.

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Long Island Nitrogen Action Plan: Management Structure and Partnership

by Elizabeth Cole

Much of this issue of *Clear Waters* is devoted to the nitrogen pollution in the water around and under Long Island. It took decades for this problem to get to the current level, and it will take many hands to correct it. To that end, a cooperative was established on Long Island to develop the Long Island Nitrogen Action Plan (LINAP).

Many groups on Long Island have been working on water quality issues for years. The LINAP draws in all these invested stakeholders, and functions as an extensive collaboration between: Nassau and Suffolk counties; local governments; estuary programs; protection committees; environmental groups; area scientists; academia; and local, state and federal agencies ***(Figure 1)***. The LINAP does not duplicate the ongoing nitrogen mitigation efforts of its partners; rather, it builds upon and supports these local efforts with the goal of filling in information gaps and developing a robust nitrogen loading reduction plan for the Island. The LINAP makes maximum use of past planning and engineering studies, building on previous work.

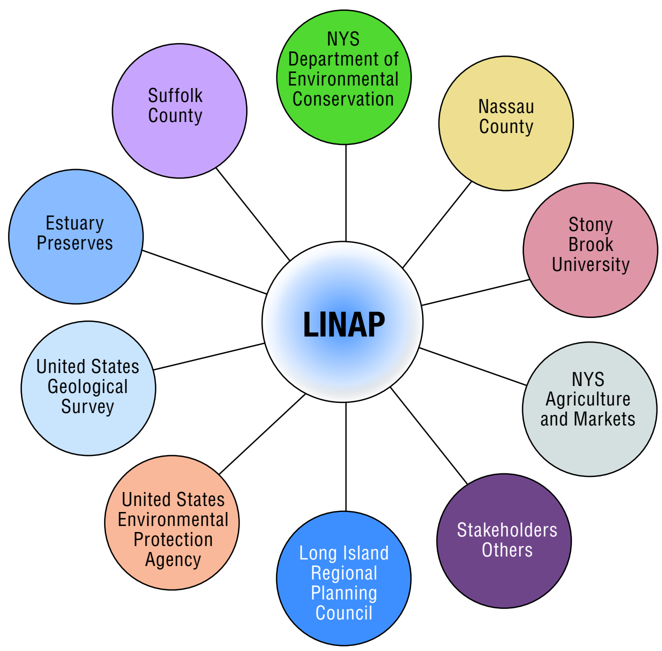

Figure 1. Long Island Nitrogen Action Plan Partners. *Elizabeth Cole*

LINAP Goals and Scope of Work

New York appropriated $5 million in the 2015-2016 state budget to be utilized by the New York State Department of Environmental Conservation (NYSDEC) and the Long Island Regional Planning Council (LIRPC) to develop the LINAP. Additional state funding has been appropriated to work on specific projects.

The primary goals of the LINAP are:

- To identify the sources of nitrogen pollution to surface and groundwater.
- To establish nitrogen reduction endpoints.
- To develop an implementation plan to achieve reductions.

The LINAP is occurring in two phases. The first phase focuses on short term actions (Early Action LINAP), while the second phase will require additional technical and policy attention, over a longer timeframe (Long Term LINAP).

Early Action LINAP includes subwatershed analyses, which are currently underway in both Nassau and Suffolk counties. It will incorporate groundwater and surface water modeling to evaluate nitrogen loads from wastewater, fertilizer, stormwater and atmospheric deposition, as well as develop reduction targets for local implementation. 'No Regrets Actions' – or initiatives which can be implemented relatively easily to lower nitrogen loads – are also recommended in Early Action LINAP.

Long Term LINAP will use information from Early Action LINAP and include more rigorous subwatershed analyses and more detailed hydrodynamic modeling. Technical mitigation recommendations will be made for individual watersheds. Long Term LINAP will incorporate fiscal and regulatory measures to facilitate long-term nitrogen load reduction.

Positive stakeholder engagement is a critical goal of the LINAP. Outreach efforts have been on-going, and numerous presentations have been given across Long Island to local civic, industry and environmental groups. Monthly newsletters are distributed to a large pool of stakeholders, which provide updates on progress made by each of the partners involved in the LINAP process. The LINAP web page is updated periodically with technical resources, workgroup updates, relevant presentations, and links to all partners' websites and web pages.

Management Structure

The LINAP is led by a Project Management Team (PMT), composed of staff from NYSDEC, the LIRPC, and Suffolk and Nassau counties. The PMT meets bi-monthly and is responsible for LINAP administration and management. The PMT receives technical input from several workgroups, which draw from a broad array of local, regional and national experts. Workgroups are currently providing input and support on fertilizer management, bioextraction and subwatershed planning. Additional workgroups will be established as needed throughout the planning process.

The *Fertilizer Management Workgroup* is providing input and assistance in evaluating the effectiveness of existing strategies – as well as identifying actions that can be taken – to further reduce nitrogen pollution from fertilizer use in agriculture, golf courses, the landscape industry and by homeowners.

The *Bioextraction Workgroup* was established to assist in formulating a scope of work for a bioextraction efficacy and feasibility study. The group's objectives are to identify information gaps and challenges, as well as estimate the economic viability of farming and harvesting shellfish and seaweed to remove potential sources of nitrogen and other nutrients from water bodies.

Highlights of Partner Activities

Nassau County

Nassau County is conducting a major reconstruction and resiliency upgrade to its Bay Park Sewage Treatment Plant, which was severely damaged by Superstorm Sandy. As part of the upgrade

Figure 2. Bay Park Sewage Treatment Plant. *Nassau County*

effort, a nitrogen removal initiative for the Bay Park plant is being implemented that is aimed at reducing nitrogen output to the western bays. In addition, the County has proposed diverting the Bay Park plant effluent from Reynolds Channel to the Cedar Creek Water Pollution Control Plant's ocean outfall through an unused New York City pipe beneath Sunrise Highway. (See article on page 32.)

Suffolk County

Suffolk County Subwatersheds Wastewater Plan is underway to evaluate parcel-specific nitrogen loads to the groundwater and receiving waters of nearly 200 subwatersheds throughout the County. The effort will develop first-order nitrogen load reduction goals for groundwater and surface waters.

The County is also piloting the use of Innovative and Alternative On-site Wastewater Treatment Systems, which are designed to significantly remove nitrogen from wastewater. The pilot program is designed to test the viability of these systems in local conditions. These systems can potentially provide an environmentally sound alternative to sewers in portions of Suffolk County.

U.S. Geological Survey (USGS)

The USGS is developing a new groundwater flow model for Long Island as part of its ongoing water quality assessments of the nation's principal aquifer systems. One early use of the model is to delineate the groundwater recharge areas (groundwatersheds), travel times and outflow rates to upwards of 1,000 receiving surface waters. These include all those on the state's Priority Waterbodies List. The groundwatershed delineation is being done in cooperation with the NYSDEC. Once the new island-wide model is documented, it will be available for future LINAP nitrogen loading studies.

Estuary Programs

South Shore Estuary Reserve – Nutrients, specifically nitrogen, are a key concern identified in the Long Island South Shore Estuary Reserve Comprehensive Management Plan. The Reserve has provided funding to projects that support the LINAP, including Suffolk County's Subwatersheds Wastewater Plan and the USGS Coordinated Water Resources Monitoring Strategy. These projects will help guide future efforts to improve water quality in the South Shore Estuary Reserve.

Peconic Estuary Program – Nitrogen management is an important part of the Peconic Estuary Program's water quality strategy in the Peconic Bays. Important steps have been taken to reduce point source discharges, including development of a Total Maximum Daily Load (TMDL), establishment of a No-Discharge Zone and upgrades to the major sewage treatment plants. (See article on page 40.)

Center for Clean Water Technology (CCWT) at Stony Brook University

CCWT is tasked with developing and commercializing more cost-effective water quality protection and restoration solutions. Funded by the New York State Environmental Protection Fund (as administered by NYSDEC) and Bloomberg Philanthropies, the Center's initial focus is delivering affordable, high performance technology that can efficiently remove nitrogen and other contaminants from household wastewater, and replace or retrofit existing cesspools and septic systems. The Center is currently piloting a series of Nitrogen Removing Biofilters (see article on page 45). These biofilters are passive, non-proprietary systems that have demonstrated an ability to achieve up to 90 percent nitrogen removal, along with efficient removal of contaminants of emerging concern. In addition to this potentially near-term solution, the Center is pursuing additional research and development efforts aimed at improving the nitrogen removal efficiency and cost of constructed wetlands, permeable reactive barriers, and membrane bioreactor technology.

> The LINAP functions as an extensive collaboration between invested stakeholders and builds on previous work, making maximum use of past planning and engineering studies.

Stony Brook School of Marine and Atmospheric Science (SoMAS)

SoMAS is working with NYSDEC and Nassau County to evaluate parcel-specific nitrogen loads from wastewater, fertilizer, stormwater and atmospheric deposition to the groundwater and receiving waters for subwatersheds throughout Nassau County. Nitrogen load modeling will determine the nitrogen load to 13 subwatersheds. Hydrodynamic modeling is being used to estimate nitrogen loading and flushing rates. The models will determine the priority subwatersheds in the County and inform nitrogen load reduction strategies.

U.S. Environmental Protection Agency (USEPA)

USEPA is proposing a Nitrogen Reduction Strategy to aggressively continue progress on nitrogen reductions, and achieve water quality standards throughout Long Island Sound, its embayments and near-shore coastal waters. This strategy complements and expands the focus of the Long Island Sound Nitrogen TMDL to include other nutrient-related adverse impacts to water quality, such as loss of eelgrass.

County Soil and Water Conservation Districts (SWCD)

In 2015, the Suffolk County SWCD received an Agricultural Nonpoint Source Abatement and Control grant to develop

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Nutrient Management Plans for 15 county farms. In 2016, the New York State Soil and Water Conservation Committee (NYS SWCC) worked with the Suffolk County SWCD to evaluate their Agricultural Environmental Management program and enhance services to local agriculture. The New York State Department of Agriculture and Markets is currently contracting with Suffolk County Agricultural Stewardship Program partners, Cornell Cooperative Extension and Suffolk County SWCD for nutrient management research, planning and implementation from the state's Environmental Protection Fund. The NYS SWCC funded the Nassau County SWCD to implement programs to manage invasive species, restore native ecology, implement green infrastructure, and reforest Nassau County.

Conclusion

Conquering the nitrogen pollution problems will take time; after all, the pollution did not get to its present level overnight. But progress is already being made. Many of the innovative approaches underway are detailed in articles throughout this issue of *Clear Waters*. Many other partners are working hard with complimentary efforts to identify and correct the problems. They are invested in restoring the water with the goal of developing a robust nitrogen loading reduction plan for Long Island. Visit the LINAP web page at: *http://www.dec.ny.gov/lands/103654.html* to see how the story continues to unfold.

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Long Island Sound Water Resource Recovery Facilities Improvement Program, Westchester County, N.Y.

by Thomas J. Lauro, Robert Funicello, G. Michael Coley and James M. Gavin

Over the last nine years, Westchester County has been implementing an improvement program for four of its Long Island Sound water resource recovery facilities (WRRFs): New Rochelle; Mamaroneck; Blind Brook; and Port Chester. This program is the largest capital project in the County's history aimed toward reducing nitrogen discharged to the Sound.

This improvement program encompassed multiple steps over time, in response to the Total Maximum Daily Load (TMDL) to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound *(NYSDEC and CTDEP 2000)*. The goal of this TMDL was to reduce nitrogen discharges by 58.5 percent to the Sound. Following establishment of the TMDL, Westchester County engaged in a process to meet the TMDL goal, which included:

- 2004 Consent Order with New York State Department of Environmental Conservation (NYSDEC).
- 2006 Engineering Plan.
- 2008 Amended Consent Order with NYSDEC.
- Mamaroneck WRRF Nitrogen Removal Project (2009 through 2013).
- New Rochelle WRRF Improvement Project (2008 through 2016).
- Blind Brook WRRF Improvement Project (2009 through 2010).
- 2011 Second Engineering Plan.
- Port Chester WRRF Nitrogen Removal Project (2013 through 2018).

2004 Consent Order

Westchester County's four WRRFs that discharge to Long Island Sound are subject to the TMDL to reduce nitrogen loading to the Sound. In 2004 Westchester County executed an Order on Consent *(NYSDEC 2004)* with the NYSDEC to reduce nitrogen discharges and implement other improvements to the four County-owned WRRFs.

The 2004 Consent Order required preparation of an Engineering Plan that set forth the improvement program at each of the four WRRFs to meet the nitrogen removal goals. In addition, the Engineering Plan would address other improvements required to comply with the revised State Pollutant Discharge Elimination System (SPDES) permits.

2006 Engineering Plan

As a first step in the development of the Engineering Plan, a comprehensive list of possible nitrogen removal alternatives was developed. The comprehensive list of 62 alternatives was then screened to include only those technologies that:

- Can meet Total Nitrogen (TN) discharge of 4 mg/L.
- Have proven operating experience in similar climates and with similar wastewater characteristics as those found in Westchester County.
- Are compatible with the existing WRRF facilities.
- Can stand alone or be used in conjunction with other appropriate technologies.
- Are appropriate for the existing site constraints.

The alternatives that passed this first screening were identified as potential nitrogen removal technologies that could be implemented at each of the four WRRFs. These potential nitrogen removal technologies underwent a more detailed assessment for implementation at each of the four WRRFs. The goal was to develop viable technologies for each WRRF that would reduce TN to 4 mg/L or less, each and every month, at a wastewater temperature down to 10 degrees Celsius (50 degrees Fahrenheit). These studies narrowed the nitrogen removal technology choices to two or three options for each WRRF. In addition, these studies produced recommendations

Table 1. Summary of the Pilot Studies Initiated during Development of the 2006 Engineering Plan.

WRRF	Process	Pilot Study Description	Pros/Cons of Process
Mamaroneck	IFAS	Integrated fixed film activated sludge (IFAS) process using free floating plastic type carrier media	Can use existing aeration tanks and clarifiers with minor retrofits. However, existing tank volume limits treatment capacity. Modular design allows for conversion to MBBR in the future.
		MBBR Fixed film process using free floating plastic type carrier media	Can use a small footprint dissolved air flotation (DAF) clarification technology, which allows clarifiers to be converted to process tanks. Provides the capacity to achieve low levels of nitrogen.
New Rochelle	Biofiltration	Integrated biological fixed film filtration process using spherical media	High rate process minimizes required treatment footprint. Can be phased in using modular design. Provides the capacity to achieve low levels of nitrogen.
	BPC	Breakpoint Chlorination Addition of chlorine and pH control to chemically remove ammonia	Chemical costs significantly outweigh cost of new biological process. Produces disinfection byproducts that are harmful to the environment. Capacity to achieve low levels of nitrogen, but does not remove particulates.

for the other 2004 Consent Order requirements.

To prove the viability of several promising alternatives, pilot plants were run at the Mamaroneck and New Rochelle WRRFs ***(Table 1)***. At Mamaroneck, Integrated Fixed-Film Activated Sludge (IFAS) and Moving Bed Biofilm Reactor (MBBR) processes were piloted. The pilot study report was submitted in January 2006. At New Rochelle, both Biofiltration and Breakpoint Chlorination (BPC) were piloted. The Biofiltration Pilot Plant Study Report was submitted in January 2006 and the BPC Pilot Study Report was submitted in May 2006. The pilot studies successfully met the intended goal of meeting low nitrogen levels at Westchester County WRRFs and the results were used during the WRRF evaluations.

The first draft of the Engineering Plan was completed in September 2006. The draft plan recommended the upgrade of all four WRRFs at an estimated cost of $723 million. After further analysis and discussions with NYSDEC, a revised plan was developed with a cost estimate of $505 million. This revised plan was submitted to NYSDEC as a Draft Report in December 2006, meeting the 2004 Consent Order deadline of December 31, 2006. The Engineering Plan was approved by NYSDEC in April 2007.

2008 Consent Order

Throughout 2007 and 2008, Westchester County and NYSDEC negotiated extensively to revise the 2004 Consent Order based upon the information developed for the approved Engineering Plan. On December 30, 2008, a revised Consent Order *(NYSDEC 2008)* was executed and superseded the 2004 Consent Order. The major differences between the 2004 Consent Order and the 2008 Consent Order were:

- The 2008 Consent Order required nitrogen removal work at just the two larger facilities (New Rochelle and Mamaroneck) of the four Long Island Sound WRRFs. The 2004 Consent Order had required nitrogen removal at all four facilities.
- The 2008 Consent Order required development of a Second Engineering Plan that would address steps to be taken should the nitrogen removal work at New Rochelle and Mamaroneck not achieve the required nitrogen reduction. The deadline for submittal of the Long Island Sound Wastewater Treatment Plant Improvement Program Second Engineering Plan was December 31, 2011.
- The 2008 Consent Order extended the deadline for compliance with the nitrogen limit – a 12-month rolling average (12 MRA) of 1,768 pounds per day – by three years, to August 1, 2017.

The goal of the 2008 Consent Order was to allow more time to evaluate the performance of the improvements at the two larger facilities. The lessons learned would then shape the implementation of the needed improvements at the two smaller facilities in a more cost-effective manner while still meeting the TN discharge limit. Following the 2008 Consent Order, improvement projects were implemented at the Mamaroneck and New Rochelle WRRFs. Although not required by the 2008 Consent Order, Westchester County also undertook the Blind Brook WRRF Improvement Project due to grant availability and recognizing the relatively simple technical requirements.

Mamaroneck WRRF Nitrogen Removal Project (2009-2013)

Design work on the Mamaroneck WRRF Nitrogen Removal Project began in the first quarter of 2009 ***(Table 2)***. The process selected for this facility was IFAS based on the successful pilot testing. Construction of the project was completed on time in July 2013. The total cost of construction to date is $40.6 million; of this cost, about $22.9 million was paid by a grant through the American Resource Recovery and Reinvestment Act of 2009.

Table 2. Summary of the Mamaroneck WRRF Nitrogen Removal Project Tasks and Costs.

Project	Task	Timeframe	Cost
Nitrogen Removal	Equipment Procurement	July 2009	$6.5M
	Construction	December 2009 to July 2013	$34.1M
		Total	**$40.6M**

New Rochelle WRRF Improvement Project (2008-2016)

The New Rochelle WRRF Improvement Project consisted of three separate construction projects ***(Table 3)***:

- New Rochelle WRRF Demolition Contract – Westchester County issued a Notice to Proceed with the New Rochelle WRRF Demolition Contract on December 12, 2008. The demolition contract consisted of removing two multiple hearth incinerators and associated equipment from the sludge operations building prior to building rehabilitation and installation of new equipment. The contract also included dewatering and an internal inspection of two pure oxygen aeration tanks before construction of a third tank. Demolition was completed in March 2010. The total cost of the project was $1.5 million.
- New Rochelle WRRF Composite Performance Implementation and Plant Expansion (Non-BNR) – This project consisted of secondary treatment upgrades for Carbonaceous Biochemical Oxygen Demand and Total Suspended Solids; upgrade of the solids handling, storage and dewatering system; and upgrades required to treat a new SPDES Permit flow limit of 20.6 million gallons per day (mgd) and a new disinfection standard of 0.5 mg/l Total Residual Chlorine.
- New Rochelle WRRF Biological Nutrient Removal Project (BNR) – This project consisted of construction of biofiltration cells to provide nitrification followed by denitrification cells utilizing methanol as an external carbon source.

Table 3. Summary of the New Rochelle WRRF Improvement Project Tasks and Costs.

Project	Task	Timeframe	Cost
Demolition	Demolition of Incinerators	December 2008 to March 2010	$1.5M
Non-BNR	Construction	June 2010 to July 2014	$121.8M
BNR	Equipment Purchase–Biofilter	December 2009	$16.1M
	Equipment Purchase–UV	May 2010	$1.4M
	Construction	July 2011 to July 2014	$94.2M
		Total	**$235 M**

Blind Brook WRRF Improvement Project (2009-2010)

To increase the nitrogen removal efficiency of the Blind Brook WRRF, upgrades converted the secondary process to a tertiary process with the Modified Ludzack-Ettinger (MLE) process. In

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the MLE process the aeration tank uses an anoxic zone at the influent end, with the remaining tank volume remaining aerobic. Nitrification occurs in the aerobic portion and the nitrified mixed liquor is internally recycled to the influent end of the tank where denitrification occurs. The County had previously contracted for a study to determine what benefits might be realized by modifying the secondary system to run the MLE process. Modeling indicated a 28 percent increase in TN removal based on 15 months of data. The model predicted varying nitrogen removals based on wastewater temperature and other factors.

The project was partially funded with a Water Quality Improvement Program (WQIP) grant that provided 90 percent reimbursement of eligible construction costs. Construction had to be completed by September 30, 2010, to meet the grant end date. Construction Notice to Proceed was given May 14, 2010, and construction was completed September 15, 2010. Due to the short construction duration, the County pre-procured the major equipment for the project: Fiberglass Reinforced Plastic (FRP) baffle wall system; Nitrate recycle pumps; and Nitrate analyzer and transmitter. The equipment and construction cost was $622,892 of which $476,512 was reimbursed to the County ***(Table 4)***.

Table 4. Summary of the Blind Brook WRRF Improvement Project Tasks and Costs.

Project	Task	Timeframe	Cost
MLE Process	Major Equipment	Pre-Procured	$161,484
	Construction	May 2010 to September 2010	$461,408
		Total	**$622,892**

Second Engineering Plan (2011)

The 2008 Consent Order required preparation of a Second Engineering Plan to evaluate additional nitrogen reduction alternatives that may be necessary to meet the overall aggregate 12 MRA TN discharge limit of 1,768 pounds per day by August 1, 2017. The 2008 Consent Order included support for the adoption of the System-Wide Eutrophication Model (SWEM) and the associated nitrogen trading exchange rates. The Order also required Westchester County to undertake a Flow Monitoring Program and subsequently to develop a Flow Reduction Strategy. The Second Engineering Plan further developed those concepts as part of an overall additional nitrogen reduction strategy.

The County submitted the Second Engineering Plan to NYSDEC on December 30, 2011. The Plan evaluated further nitrogen treatment capabilities and developed a recommended program. If additional nitrogen removal was deemed necessary beyond the combined removal achieved at the New Rochelle, Mamaroneck and Blind Brook WRRFs, the Second Engineering Plan concluded that improvements at Port Chester WRRF were the most logical next step for a cost-effective treatment solution to meet the nitrogen discharge limit.

Port Chester WRRF Nitrogen Removal Project (2013-2018)

The 2006 Engineering Plan had developed a nitrogen removal project for Port Chester with a projected cost of $106 million. The Second Engineering Plan (2011) identified a lower cost alternative to provide denitrification at a project cost of $66 million. This alternative relies on using the existing Rotating Biological Contactors (RBCs) and new Denitrification (DN) Biological Anoxic Filters (BAF). The key to using this alternative is the performance of the nitrification process in the RBCs. To evaluate the nitrification performance, the Second Engineering Plan recommended a full-scale demonstration pilot testing of one RBC train (Train 8) at Port Chester (Phase I). Once the pilot successfully showed the effectiveness of using the RBCs for nitrification, the County committed to NYSDEC that it would proceed with the design and construction of upgrades to RBC trains 1, 2, 3, 5, 6 and 7 in a phased approach (Phase II). There are seven RBC trains numbered 1 through 3 and 5 through 8. Phase III involves the construction of the DN BAF facility, evaluation of UV disinfection, and adding a new RBC Train 4.

Phase I – Pilot Testing (2013-2016)

One of the RBC trains (Train 8) was retrofitted with new media of varying density and then operated as a pilot facility for 16 months to evaluate the ability of the RBCs to nitrify. The construction cost was $3.2 million. The results of the testing confirmed that the upgraded RBC can provide sufficient nitrification of the wastewater to support a downstream denitrification process. In addition, the pilot test also concluded that at current flows and loads, the existing seven RBC trains combined with a DN BAF facility could remove, on average, a minimum of 475 pounds per day of nitrogen. If a new eighth RBC train were installed, on average up to 600 pounds per day of nitrogen could be removed at design flows and loads.

These key conclusions of the pilot test resulted in a phased construction approach that allowed postponing the construction of the eighth RBC train until it would be needed.

Phase II – Retrofit RBC Trains 1-7 (2016-2018)

The retrofitting of the RBCs was divided into the following sub phases:

- *Phase IIA* – Retrofit RBC Trains 5, 6, and 7 in a similar manner to the Pilot Train 8. The construction contract for Phase IIA was awarded in October 2016 by the County at a cost of $7.2 million. Construction is expected to be complete by December 2017.
- *Phase IIB* – Retrofit RBC Trains 1, 2 and 3 in a similar manner to the Pilot Train 8. Phase IIB is designed and will be bid in September 2017 based on the Phase IIA schedule of completion. The Engineer's Opinion of Probable Cost for this work is approximately $9.1 million. Construction is expected to be complete by December 2018.

Phase III – DN BAF Facility (2015-Ongoing)

Phase III has been the subject of a detailed evaluation over the last year. On October 6, 2016, a report entitled "Evaluation of DN BAF Alternatives at the Port Chester Water Resource Recovery Facility" *(Engineers Consortium LLP 2016)* was submitted to Westchester County. The evaluation also included the study of a UV disinfection process in conjunction with the proposed DN BAF facilities, due to potential regulations for effluent limitations on *Enterococcus* bacteria (or other pathogen indicator) in the plant discharge.

The Report recommended a two-phased approach:

- *Phase IIIA – DN BAF Facility.* Phase IIIA is the construction of a DN BAF Facility consisting of six DN BAF filter cells; an equipment building next to the filter cells housing DN BAF-related equipment; an open channel UV disinfection system; and a new effluent pumping station. The existing Effluent Pumping Station

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will be modified to provide intermediate pumping to convey wastewater flow to the new DN BAF Facility. The project will also include construction of chemical storage and feed facilities to support the nitrogen removal processes. The probable construction cost for the above facilities is approximately $33.6 million.

- *Phase IIIB – New RBC Train 4.* In the future, construction of an eighth train in the RBC process (RBC-4) may be needed depending on the performance needed in the RBCs (nitrification process) to achieve the required nitrogen reduction in the DN BAFs

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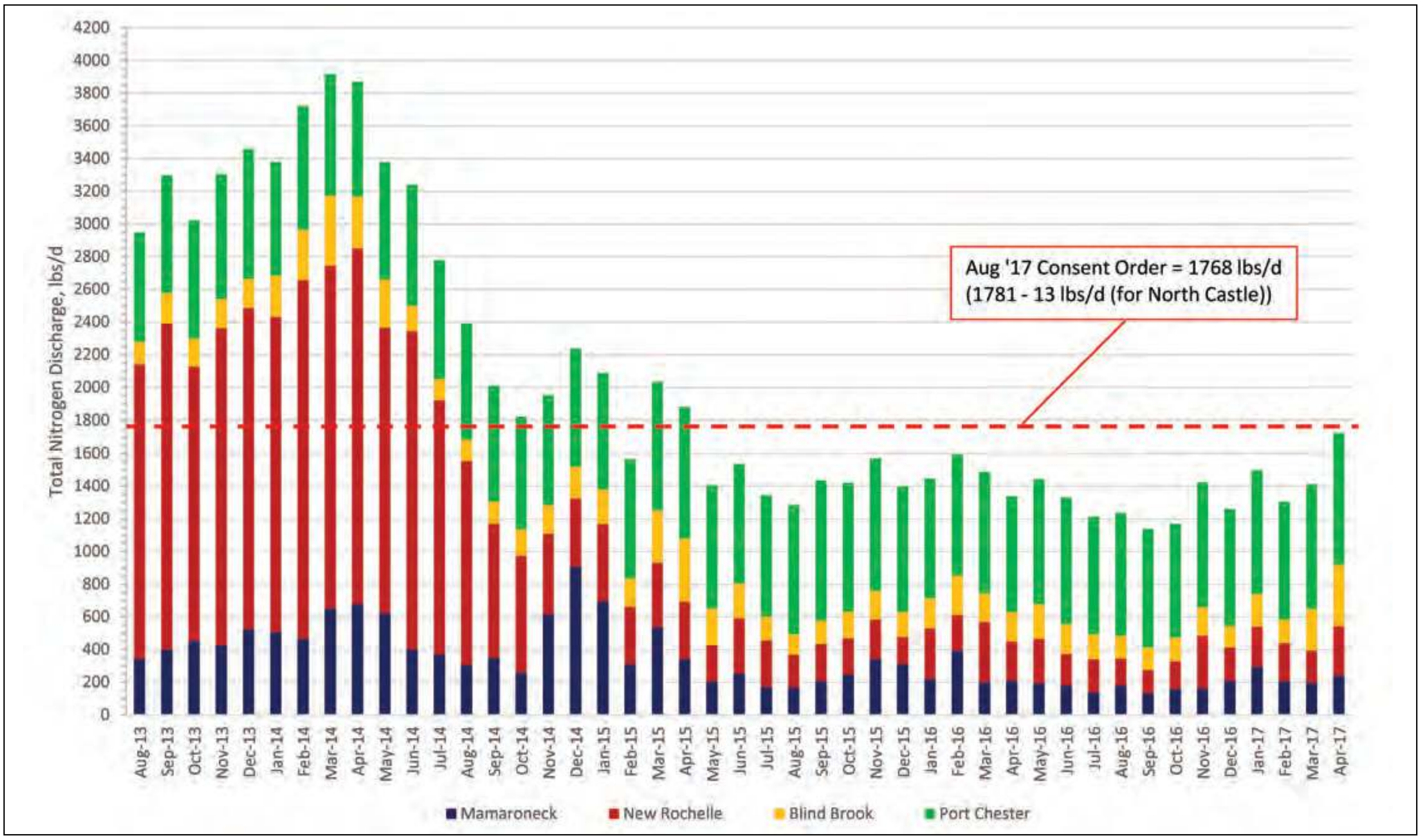

Figure 1. Comparison of 2017 permit limit for Total Nitrogen Discharge to current WRRF performance. *Savin Engineers, P.C.*

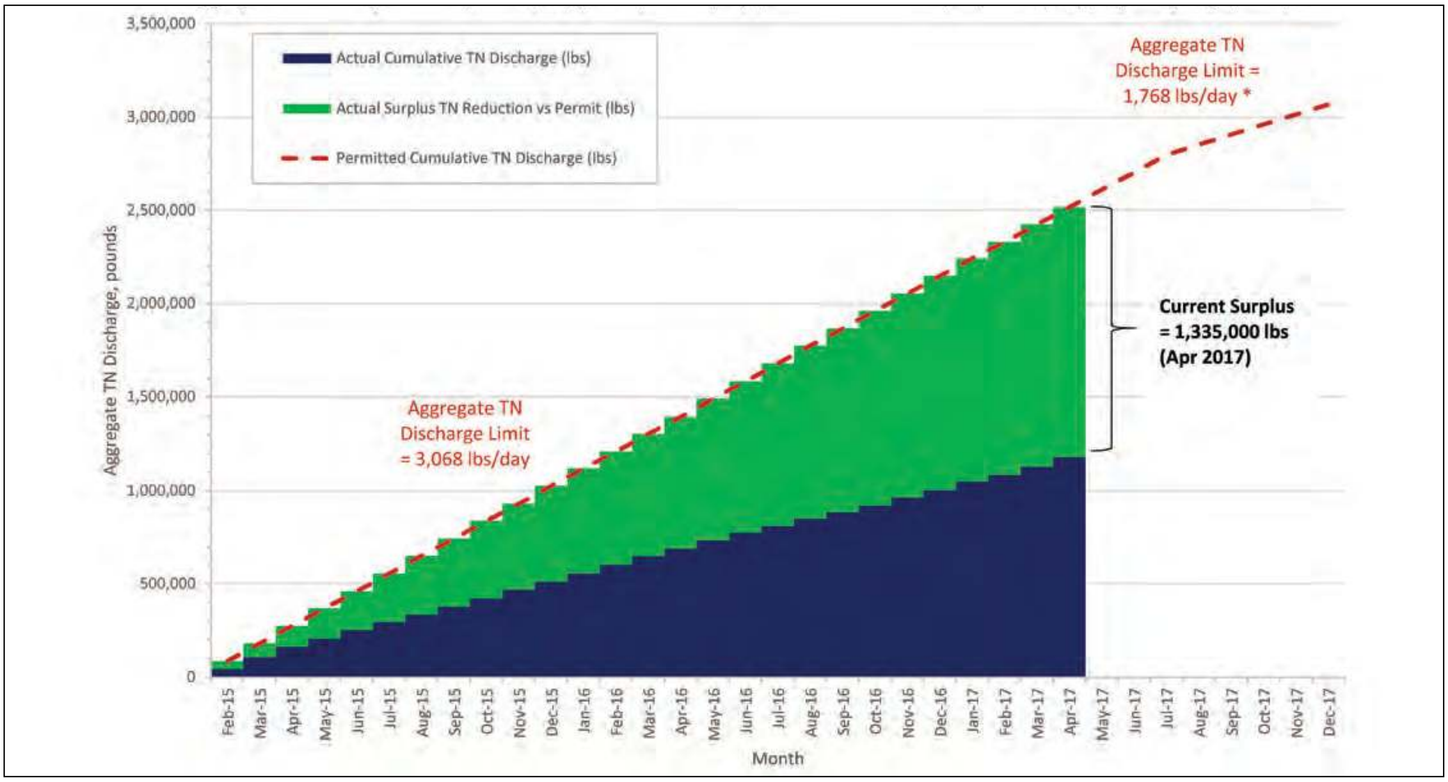

Figure 2. Cumulative Surplus Total Nitrogen (TN) removed vs. permitted discharge. *Savin Engineers, P.C.*

*** Aggregate TN Discharge Limit = 1,781 lbs/day (permit) – 13 lbs/day (New Castle allocation) = 1,768 lbs/day (beginning Aug. 1, 2017)**

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(denitrification process). If needed, RBC-4 would be constructed under a later phase. The probable construction cost for RBC-4 is approximately $6.5 million.

Summary

Westchester County has made a significant investment in effort and funding to fulfill the requirements of the 2008 Consent Order and meet the 12 MRA limit of 1,768 pounds TN discharged per day to the Long Island Sound. To date, construction costs total $276.2 million after loan forgiveness and grant funding, not including the current construction underway at Port Chester WRRF.

Currently, the nitrogen removal facilities at Mamaroneck, New Rochelle, Blind Brook and Port Chester WRRFs are performing well. Since May 2015, 14 months ahead of schedule, the County has met the 12 MRA TN discharge limit of 1,768 pounds per day that takes effect on August 1, 2017 ***(Figure 1)***. This translates into one million pounds of TN that have not discharged to the Sound ***(Figure 2)***.

However, flows to the Long Island Sound WRRFs over the past 20 months have been lower than average, which is contributing to lower nitrogen discharges. A review of historical flow data over a 10-year period indicates that Westchester County may require the removal of an additional 200 to 600 pounds of nitrogen per day.

Westchester County is pursuing the following strategy if more pounds of nitrogen removal are necessary, including:

Nitrogen Trading with New York City – The County is pursuing the potential for nitrogen trading with New York City to meet the effluent limits. It is likely that an Agreement with the City will require modification of the SPDES Permits for both municipalities and would be in effect for a minimum of five years. Trading nitrogen credits would be an interim solution until the County constructs its own facilities.

Municipal Flow Reduction Program – The County continues to advance its Flow Reduction Program with the contributory municipalities to reduce Inflow and Infiltration (I/I). The data shows that there is a strong relationship between flow and effluent nitrogen discharged at the WRRFs.

Port Chester WRRF Nitrogen Removal Project – The County's phased approach to the Port Chester Nitrogen Removal Project allows the County flexibility to add a future new RBC train (RBC-4) to the facility, if needed, to enhance its nitrogen removal capability.

Thomas J. Lauro, P.E. is Commissioner of the Westchester County Department of Environmental Facilities. Also with the Westchester County Department of Environmental Facilities are Robert Funicello, Director of Environmental Programs and G. Michael Coley, P.E., First Deputy Commissioner. James M. Gavin, P.E. is Executive Vice President with Savin Engineers, P.C. For questions concerning this article, please contact Robert Funicello at rff3@westchestergov.com.

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NYC DEP

$1 Billion Nitrogen Reduction Project Improves the Health of the East River and Long Island Sound

by New York City Department of Environmental Protection

Press Release January 5, 2017. Reprinted with permission.

New York City Department of Environmental Protection (NYCDEP) Acting Commissioner Vincent Sapienza announced that following a $1 billion investment in upgrades at four water resource recovery facilities (WRRF), the amount of nitrogen being discharged into the Upper East River has been reduced by more than 60 percent. These significant upgrades will improve the health and ecology of the East River, Long Island Sound and New York Harbor.

"Ensuring the proper collection and treatment of wastewater is essential to protecting public health and our local waterways," said NYCDEP Acting Commissioner Vincent Sapienza. "New York City has invested more than $1 billion and has been a regional leader in nitrogen removal, ensuring that Long Island Sound, the East River and all of New York Harbor are healthy and clean. I'd like to thank all of our partners that are committed to protecting the environment and recognize NYCDEP's scientists, engineers and planners that made these complex upgrades while ensuring New York City's wastewater treatment plants continued to operate around the clock."

In total, New York City produces, and NYCDEP collects and treats, an average of 1.3 billion gallons of wastewater each day. The wastewater travels through the city's 7,500-mile sewer system until it reaches one of 14 WRRFs, where it is treated to federal and state water quality standards in accordance with the Clean Water Act before it is discharged into local waterways.

> Upgrades to four wastewater treatment plants reduced nitrogen discharges by 60 percent, contributing to increasing dissolved oxygen levels and improvement in the ecology of the waterways.

Nitrogen is a naturally occurring element that is found in food and other organic materials and is present in wastewater when it enters the treatment plants. Because nitrogen is not a pathogen and poses no threat to human health, the WRRFs were not originally designed to remove it from the treated water before it is discharged into a receiving waterbody. However, more recent scientific research has found that high levels of nitrogen can degrade the overall ecology of a waterway by promoting excessive algae growth that can reduce levels of dissolved oxygen, especially in warm weather months.

As part of an agreement with the New York State Department of Environmental Conservation (NYSDEC) and the New York State Attorney General, NYCDEP committed to reducing the combined nitrogen discharges from its WRRFs located along the East River by 58.5 percent by January 2017. As of September 2016, nitrogen discharges from New York City WRRFs to the East River have been reduced by approximately 61 percent. The capital investments include:

- $277 million at the Hunts Point Wastewater Treatment Plant.
- $388 million at the Wards Island Wastewater Treatment Plant.
- $209 million at the Tallman Island Wastewater Treatment Plant.
- $161 million at the Bowery Bay Wastewater Treatment Plant.

The introduction of nitrogen removal technology, which converts the organic nitrogen present in wastewater into inert nitrogen gas that is released harmlessly into the atmosphere, required significant upgrades to much of the plants' supporting infrastructure. Some of the work included new or upgraded electrical substations, aeration systems, and sludge pumping systems. In addition, some facilities saw the installation of new sluice gates, mixers, diffusers, froth hoods, blowers, and surface wasting systems. In addition to reducing the amount of nitrogen discharged from the plant, this investment will ensure that the facilities remain in a state of good repair for decades to come.

The western end of Long Island Sound is funneled into a narrow area bounded by lower Westchester, Connecticut, western Nassau, the Bronx and northern Queens and flows into the Upper East River. WRRFs that serve more than a dozen municipalities along the Connecticut and New York coasts are one of the many sources of nitrogen in the Sound. Coastal watersheds that drain directly into the Sound and those that drain into tributaries to the Sound are also major contributors. High levels of nitrogen in the Sound over the last few decades have led to periodic algal blooms that reduce the amount of dissolved oxygen in the water and impair the survival of fish and other marine organisms. Algae colonies can flourish with an ample supply of sunlight and nutrients, such as nitrogen.

On April 5, 2001, the U.S. Environmental Protection Agency approved a nitrogen reduction plan for Long Island Sound which had been established by New York and Connecticut. The plan mandated a 58.5 percent reduction of nitrogen from the 1994 base-line, for dischargers to Long Island Sound, including New York City's Upper East River WRRFs (Hunts Point, Bowery Bay, Wards Island and Tallman Island), the City's Lower East River WRRFs (Newtown Creek and Red Hook), as well as WRRFs serving Long Island, Westchester and Connecticut, through a phased approach over 15 years. NYSDEC imposed nitrogen limits reflecting the approved plan on all the New York WRRFs through the process of renewing required operating permits, also known as the State Pollution Discharge Elimination System.

NYCDEP will continue to work to reduce nitrogen discharges from stormwater runoff and Combined Sewer Overflows. In addition, WRRFs located in Westchester, Connecticut and Long Island that drain to the Sound must meet reduction targets for nitrogen discharges, and these localities are also required to reduce nitrogen discharges in stormwater runoff and Combined Sewer Overflows.

As part of NYCDEP's extensive New York Harbor water quality monitoring program, the reduction in nitrogen discharges into the East River and the effect on water quality will be closely monitored over the next several years. As the plan requires further reductions in nitrogen discharges, it is anticipated that Long Island Sound will take some time to respond to the changes. As the scientific data is quantified, NYCDEP will continue to work with its partners in the region to determine the appropriate steps to continue the restoration of the health and ecology of the Sound.

In addition to the work at the Upper East River plants, NYCDEP has invested $460 million in similar nitrogen removal upgrades at the Jamaica Bay and 26th Ward Treatment Plants, which discharge into Jamaica Bay.

NYCDEP manages New York City's water supply, providing more than one billion gallons of water each day to more than nine million residents, including eight million in New York City. The water is delivered from a watershed that extends more than 125 miles from the city, comprising 19 reservoirs and three controlled lakes. Approximately 7,000 miles of water mains, tunnels and aqueducts bring water to homes and businesses throughout the five boroughs, and 7,500 miles of sewer lines and 96 pump stations take wastewater to 14 in-city treatment plants. NYCDEP has nearly 6,000 employees, including

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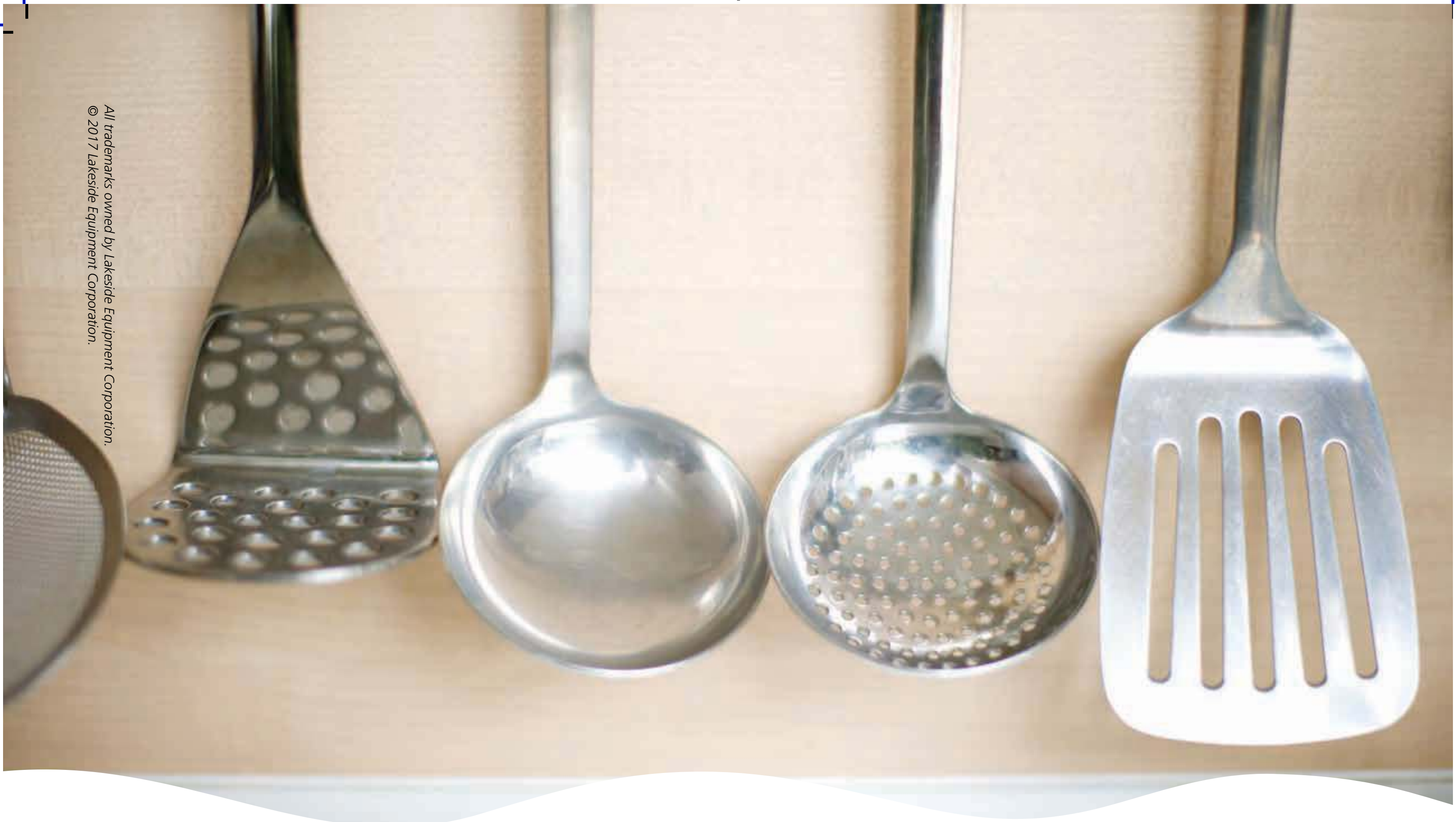
New York City Drainage Areas and Wastewater Treatment Plants

Locations of the New York City drainage areas and treatment plants are shown. *NYC DEP*

One of the upgrades to the Tallman Island Wastewater Treatment Plant in College Point is a new sodium hypochlorite tank and delivery system. *NYC DEP*



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A mixed flow pump station was rehabilitated at the Tallman Island Wastewater Treatment Plant in College Point. *NYC DEP*

Four new blowers were installed in the air process system of the Tallman Island Wastewater Treatment Plant in College Point. *NYC DEP*

almost 1,000 in the upstate watershed. In addition, NYCDEP has a robust capital program, with a planned $14 billion in investments over the next 10 years that will create up to 3,000 construction-related jobs per year. For more information, visit *nyc.gov/dep*, like us on Facebook, or follow us on Twitter.

Photographs were obtained from the NYCDEP Flickr page *(https://www.flickr.com/photos/nycwater/sets/72157678641136726/)*

For more information, contact NYC Department of Environmental Protection, Public Affairs, 59-17 Junction Boulevard, 19th Floor, Flushing, NY 11373, (718) 595-6600.

What People Are Saying…

"The work New York City has done to upgrade sewage treatment plants has helped reduce the amount of nitrogen going into the East River and Long Island Sound. State and local governments need to continue to invest in treatment plants, and communities need to reduce pollution from septic systems and fertilizers, which also degrade water quality in Long Island Sound. We recognize New York City's efforts to reduce nitrogen and expect more of these important water infrastructure projects to keep taking place in the near future."

Judith A. Enck, U.S. Environmental Protection Agency
Former Region 2 Administrator

"This $1 billion capital upgrade to our wastewater facilities will help protect our city's greatest resource – our waterways. With this essential nitrogen reduction project, our city is continuing to be a leader in protecting our environment and our ecological resources. I thank NYCDEP Acting Commissioner Vincent Sapienza for his leadership on this important issue."

City Council Member, Costa Constantinides
Chair of the Council's Environmental Protection Committee

"The flora and the fauna of our harbor and waterways (especially the millions of humans that use and enjoy our waters) can rejoice because NYCDEP is meeting its goals to reduce nutrient pollution. Continuing to invest in our infrastructure – green and grey – will support the dream of a fishable, swimmable New York Harbor, the ultimate goal of the Clean Water Act."

Roland Lewis, President and CEO
Metropolitan Waterfront Alliance

"New York City's residents, fish and wildlife will all reap the benefits from the clean water investments announced by the NYC Department of Environmental Protection. The vitality of our waterways depends on realizing nutrient reduction, stormwater management, and other commitments to clean water by the City and its state and federal partners."

Robert Pirani, Director of the New York-New Jersey
Harbor & Estuary Program at the Hudson River Foundation

"Nitrogen overload from inadequate wastewater treatment has been wreaking havoc on ecosystems such as Long Island Sound and the East River, causing algal blooms and major wildlife die-off events. We are pleased to see New York City's Department of Environmental Protection taking the lead with a significant investment to upgrade its facilities, protecting our fragile waterways from further damage and creating the conditions for them to bounce back."

Marcia Bystryn
President of the New York League of Conservation Voters

"I congratulate NYCDEP for achieving this important clean water milestone for the East River, Long Island Sound, and New York Harbor. This achievement reflects years of collaborative effort by my office, the State DEC, and New York City DEP to reduce the nitrogen pollution discharged by the City's wastewater treatment plants. We look forward to continuing this collaboration and sustaining progress in improving the health and cleanliness of waters that surround the New York City area."

New York State Attorney General Eric T. Schneiderman

Nassau County's Nitrogen Reduction Initiatives

by Brian Schneider

The County of Nassau (the County), with 1.36 million residents, is faced with many challenges with respect to drinking and surface water quality. One of the primary challenges comes from living directly on top of our drinking water supply, which has direct connection to our embayments, coastal marshes, wetlands and ocean. Every activity that we as humans perform could – and has had – a direct and mostly deleterious impact on our sole source aquifer system. Pollution from industry, stormwater runoff, septic systems and many other point and nonpoint sources has finally garnered the attention of residents, environmentalists, regulators and politicians alike. Poor water quality, especially from nitrogen pollution, seems to have reached a near crisis state. Science has shown that there is a direct connection between excess nitrogen pollution and the degradation of coastal marsh areas that act as a buffer against storm inundation, which ultimately impacts the County and the region's coastal resiliency.

The Bay Park Sewage Treatment Plant Upgrades

Beginning in the 1950s, the County recognized the importance of reducing the effects of nitrogen pollution on the groundwater system by constructing centralized sanitary sewer systems and treatment facilities serving roughly 90 percent of the County's population ***(Figure 1)***. While these sanitary systems greatly reduced the nitrogen loads to the groundwater system, the outfall of one of the main sewage treatment plants, the Bay Park Sewage Treatment Plant (BPSTP) in East Rockaway, discharges nearly 50 million gallons per day of treated sewage effluent into Reynolds Channel within the western bay of the County. The elevated levels of nitrogen in

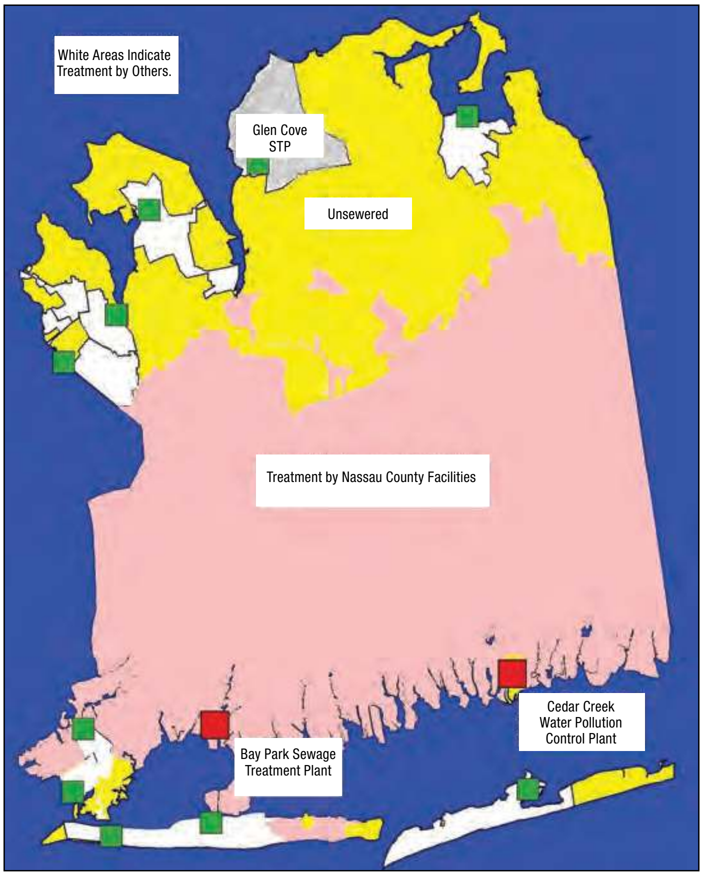

Figure 1. Map of Nassau County showing sewered and unsewered areas.
Nassau County

Aerial view of Long Beach and Reynolds Channel, Nassau County, New York. *istockphoto.com*

Aeration basins are one component of a nitrogen removal strategy at the Bay Park Sewage Treatment Plant. *istockphoto.com*

the discharge violates state and federal water quality standards, and has been linked to a widespread degradation of marsh grasses and their sub-structures. Excess nitrogen also contributes to blooms of macro-algae *(Ulva)* which leads to oxygen depletion, fishery impact and diminished recreational opportunities.

Because of the crippling damages to the BPSTP caused by Superstorm Sandy in October 2012, the plant has been undergoing a series of major upgrades and resiliency projects totaling $820 million. Some of the upgrades include nitrogen reduction initiatives, with the goal to reduce nitrogen inputs into the western bays by as much as 50 percent. One of the nitrogen removal projects is a side-stream treatment project that reduces effluent nitrogen by 15 percent at a cost of $20.6 million. In this process, the centrate is treated and approximately 50 percent of the influent ammonia is converted to nitrite. Nitrite and ammonia are then consumed through anaerobic ammonia oxidation to produce nitrogen gas and nitrate. A seasonal Biological Nitrogen Reduction (BNR) project will reduce nitrogen in effluent from 35 mg/l to 20 mg/l during the four summer months at a cost of $18.9 million. In this process, effluent total nitrogen would be reduced by installing baffles and submersible mixers with caustic addition and feed systems added to aeration basins. These projects will be under construction during 2017 and 2018.

Re-Directing the BPSTP Outfall

With violations in water quality standards and effluent limits for nitrogen and ammonia in BPSTP effluent, the construction of a new ocean outfall for the effluent of the BPSTP was found to be the best alternative to meeting water quality standards at an anticipated cost of over $550 million. Following Superstorm Sandy, discussions revolving around a new ocean outfall intensified between the County and regulators. Additionally, the consolidation of flows from other existing municipal sewage treatment plants and communities located on Long Beach Island into the BPSTP could eliminate nitrogen discharges from sewage treatment plants into the western bays. However, finding funding to move forward with a new ocean outfall presented immovable obstacles for the County.

The focus shifted in late 2016 to the idea of employing an unused county-owned aqueduct, which exists beneath the roadbed of Sunrise Highway, to transport treated effluent from the BPSTP to the existing ocean outfall of the Cedar Creek Water Pollution Control Facility in Wantagh ***(Figure 2)***. Preliminary calculations on flows, pipe size and estimated costs led to an engineering study in March 2017 on the feasibility of commissioning this unused 72-inch steel force main to transport treated effluent between BPSTP and the Cedar Creek outfall. A draft final report currently under review has recommended that the pipe can be repurposed for the transmission of treated effluent utilizing traditional relining techniques.

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Figure 2. Proposed alignment of pipe connection between Bay Park Sewage Treatment Plant and the Cedar Creek Ocean outfall. *Arcadis/Hazen & Sawyer*

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Figure 3. An inspector walks through the pipe in Seaford, Manhole No. 19, during inspection of the 72-inch steel force main of the Sunrise Highway Aqueduct System in 1977. *Nassau County Department of Public Works*

Septic sand and gravel drainage system. Septic systems are common in the northern portion of Nassau County. *istockphoto.com*

To support these draft findings, the County has issued an RFP for a project to design not only the relining of the aqueduct but also all the necessary components to pump treated effluent from BPSTP to the Cedar Creek outfall. Preliminary cost estimates to pump and transport effluent between BPSTP and the Cedar Creek outfall are about $300 million – a considerable savings compared to a new outfall.

The 72-inch steel force main was a central component of the Sunrise Highway Aqueduct System (aka the Ridgewood Water Supply System) which consisted of a series of surface water impoundments, infiltration galleries, open jointed pipes, conduits and groundwater well fields constructed to supply residents of New York City with as much as 60 million gallons per day of drinking water between 1862 and 1958. As the City of New York brought upstate reservoirs online to supply water to its residents, Nassau County purchased the water supply system infrastructure in 1986 with hopes of possibly utilizing components of the system for a wide variety of uses such as water supply, fire water storage, stream flow augmentation, sewer mains or as a sleeve for utility conduits ***(Figure 3)***.

Unsewered Areas of the County

Although most of the population of the County is served by sanitary sewers, there are unsewered areas still using on-site septic and cesspool systems of varying age and effectiveness. Previous studies have shown a correlation between failing on-site septic systems and the concentration of septic systems by population to potential groundwater pollution and/or surface water runoff contamination from these systems. The County therefore has recently completed a Sanitary Sewer Feasibility Study for the Hempstead Harbor communities on the east side of the harbor, as well as other locations on the Port Washington peninsula. The objective of the study was to review and determine if new sanitary sewers can either be transmitted through piping to the existing Glen Cove sanitary sewer system or to the Cedar Creek sanitary sewer system through the Village of Roslyn sewage pumping station. The goal of the study was to protect the sole-source aquifer as well as the surface waters and to allow for use of existing beaches for recreational use. The six specific areas that were considered are: Crescent Beach (Glen Cove); Village of Sea Cliff; Glenwood Landing; Glen Head; Roslyn Harbor/Greenvale; and Port Washington.

The report summarized the estimated construction costs for all of the areas included in the feasibility study ***(Table 1)***. These costs are prohibitively expensive for the connection of just over 5,600 properties. As such, alternatives to conventional sanitary sewers will need to be considered in these areas, similar to the innovative alternative septic systems which are presently being evaluated in Suffolk County.

Table 1. Estimated Construction Costs from the Sanitary Sewer Feasibility Study for Hempstead Harbor Communities and the Port Washington Peninsula.

Areas	Estimated Construction Cost	Total Cost All Areas
Crescent Beach Village of Sea Cliff Glenwood Landing	$37,500,000	$670,000,000
Glen Head Roslyn Harbor/Greenvale	$613,000,000	
Port Washington	$18,000,000	

Crescent Beach Bacterial Source Tracking

Following completion of the feasibility study, the County initiated a focused sampling of surface (stream) and groundwater to identify the source of bacterial contamination to the stream that discharges near Crescent Beach, which has been closed for bathing since 2009. Focused sampling will be done of dry and wet weather flows, combined with groundwater monitoring well samples. Remedial action will be based on the results of the sampling program and the specific sources of contamination. The results of the field work and sampling are expected to be completed by early July. A future phase of work could modify or confirm where sewering should take place and what alternative sewers/systems would be needed.

Summary

For many years, the County of Nassau has been investigating and taking corrective actions to reduce contamination of groundwater and surface water from nitrogen sources. Recently, the County has implemented initiatives to further reduce the loading of nitrogen

Groundwater sampling will be one component of the focused monitoring program to identify the source of bacterial contamination to the stream that discharges near Crescent Beach. *istockphoto.com*

into the western bays of Nassau County, specifically coming from the effluent discharge of the BPSTP. A $820 million reconstruction effort at the facility will see many improvements, including a side-stream treatment project that will reduce effluent nitrogen by 15 percent in 2018. A seasonal BNR project will further reduce effluent nitrogen during the summer months from 35 mg/l to 20 mg/l.

In March 2017, the County explored the feasibility of utilizing an existing 72-inch steel force main to transport treated effluent from the BPSTP to the outfall of the Cedar Creek Water Pollution Control Facility, thereby eliminating the need for a new ocean outfall and saving over $200 million. Additional nitrogen reduction could occur in the western bays with the consolidation of existing municipal sewage treatment facilities.

The County recently completed a Sanitary Sewer Feasibility Study for the Hempstead Harbor communities on the east side of the harbor as well as other locations in Port Washington. The study has documented estimated construction costs of $670 million to connect about 5,600 properties in the study area. Due to the high cost, the County will need to evaluate alternatives to conventional sewers in these areas.

Presently underway is a site-specific study in the Crescent Beach area to find the source of bacterial contamination that has caused beach closures. Once the source of the contamination is identified, plans for remediation of the problem will be developed.

Brian Schneider, CPESC, is the Assistant to the Deputy Commissioner of Public Works for Administration for Nassau County and may be reached at bschneider@nassaucountyny.gov.

Sound Solutions in Water Resource Recovery: Village of Northport

by Stephen Hadjiyane and Donna Bee

The Long Island Sound is home to a vibrant community of plants and animals, and serves as a major source of food and recreation for more than 8 million people within its watershed. The effluents from Water Resource Recovery Facilities (WRRFs) contribute to ongoing water quality issues, including an unhealthy increase in nitrogen and a significant drop in dissolved oxygen (DO) levels – a condition known as hypoxia.

Hypoxia may occur in bodies of water when an excessive discharge of nitrogen into the water causes eutrophication, or more simply put, an increase in floating planktonic algae. The algae settle to the bottom of the water body as they die and then begin to decay. The decaying process depletes the remaining oxygen. DO levels below 5 mg/L have been observed to stress aquatic life and can even cause fish kills or lead to the development of "dead zones" – large hypoxic areas that are unable to sustain aquatic life.

The Long Island Sound Study (LISS), a bi-state partnership, was formed in 1985 and authorized by the U.S. Environmental Protection Agency to assess the water quality of the Sound and to implement programs that monitor water quality, reduce nitrogen loads, restore habitats, and engage and educate the public. The cooperative developed a Comprehensive Conservation and Management Plan to protect and restore Long Island Sound and prevent extreme hypoxic conditions from occurring.

The Village of Northport, New York WRRF

The Village of Northport is located about 50 miles east of Manhattan, New York, on the North Shore of Long Island at the southeast side of Northport Harbor. The community is home to approximately 7,500 residents and a number of small shops and restaurants in a pedestrian-friendly downtown. But it is best known for its secluded deep water harbor, beautiful waterfront parks, and numerous beaches that draw in visitors from across the region.

Unfortunately, these beaches have been subject to closures over the years due to poor water quality in the harbor. In 2004, the LISS challenged the Village of Northport to protect and enhance the harbor because of its important ecological and recreational value.

View of Northport Harbor, the receiving water for the Village of Northport's WRRF effluent. Waters from Northport Harbor flow into the Long Island Sound. *Gannett Fleming*

The Village's Upgrade Plan

To achieve compliance with nitrogen permit limits, the Village of Northport adopted an aggressive infrastructure upgrade plan at its WRRF. To achieve a reduction in off-shore hypoxia and maintain dissolved oxygen levels in the harbor, The Village plan set a goal of reducing WRRF nitrogen loading by 80 percent, with the expectation that this would be achieved within 15 years.

The Village plan established the following schedule for nitrogen reduction:

Permit Milestone	Percent of Full Reduction Achieved	Effluent Total Nitrogen Limit (lb/d)	Effluent Total Nitrogen Concentration at Permit Flow (0.450 MGD) (mg/L)
2004	40%	35	9.3
2009	75%	21	5.6
2014	100%	10	2.7

Note: MGD = million gallons per day

Since 1970, the WRRF has been transformed from a simple extended aeration process to one of Long Island's most advanced biological nitrogen removal (BNR) wastewater treatment plants. Significant infrastructure improvements that were implemented to help achieve the goals established in the Village plan included:

- Conversion to Modified Ludzack-Ettinger (MLE) process.
- Deep-bed sand denitrification and filtration system and associated methanol supply system that provides for the growth of bacteria to consume unwanted nitrogen.
- Magnesium hydroxide pH control system to ensure reliable denitrification during colder winter months.
- Replacement of the existing comminutor (grinder) with a screen and compactor system to reduce re-ragging problems traditionally experienced at the plant.
- Six-section motor control center with normal and emergency busses and variable frequency drives for process equipment.
- Process management and control system upgrades that enable improved plant operations.

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The Village of Northport made significant upgrades to its water resource recovery facility. *Tony Lopez Photo*

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The Village plan allowed for a phased approach to plant upgrades in consideration of available funding, which also enabled incorporation of the latest BNR technologies that became available as advancements in nitrogen removal were developed over time.

Year	Milestones
1970	• Extended aeration process • Chlorine disinfection
2004	Permit Limit Limit = 35 lbs/day (Phase I Upgrades) • Equalization tank • Extended aeration converted to MLE process • Ultraviolet disinfection
2009	Permit Limit = 21 lbs/day • Dissolved oxygen control system
2014	Permit Limit = 10 lbs/day (Phase II Upgrades) • pH control system • Denitrification filters • Influent screening system

Wastewater Flows

The plant's maximum monthly average permitted flow is 0.450 MGD. In 2005, the WRRF experienced flows above 0.400 MGD due to severe inflow/infiltration (I/I). To address this problem, the Village implemented a 10-year I/I reduction plan that included sewer and manhole lining and investigating cross-connections to sanitary sewers. These corrective measures have resulted in a steady decline in flows (***Figure 1***).

Process Improvements

Many treatment plants in the New York metropolitan area utilize the MLE process with great success. It is considered one of the best available technologies to remove nitrogen, reliably achieving nitrogen levels ranging from 6 mg/L to 8 mg/L. The Water Environmental Research Foundation (WERF) Nutrient Limit of Technology is 3.0 mg/L total nitrogen. This value assumes approximately 1.0 mg/L is the dissolved organic nitrogen (DON) fraction.

Phase I (2004) upgrades included converting the Village of Northport WRRF to an MLE process with UV disinfection. Phase II (2014) upgrades included installation of denitrification filters and a pH control system (cold weather optimization system) to further reduce nitrogen to levels below 4 mg/L. The Village wastewater nitrogen speciation shows DON ranging from 1.0-1.5 mg/L. The DON refractory portion resists biodegradation.

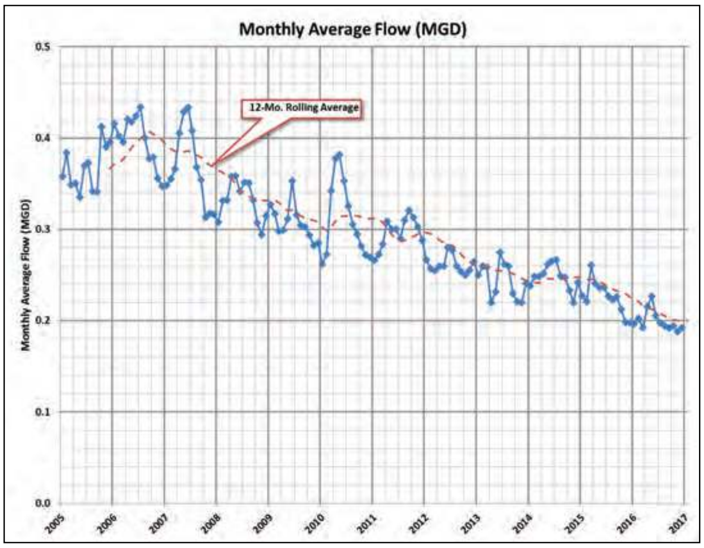

Figure 1. Monthly and rolling average flow (MGD) from 2005 through 2017. Incorporated Village of Northport WWTP, Northport N.Y.
Gannett Fleming

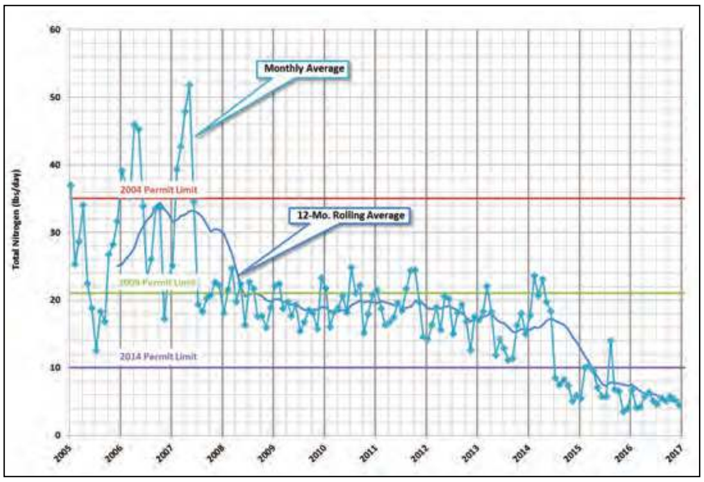

Figure 2. Effluent nitrogen loading (lbs/day) monthly and rolling averages, 2005 to 2017, with permit limits from 2004, 2009 and 2014. Incorporated Village of Northport WWTP, Northport, N.Y.
Gannett Fleming

The improvements resulted in a decrease in nitrogen discharge to the harbor from a high of more than 38 lbs/day in 2004 to less than 5.5 lbs/day in 2016 – well within the 2014 permit limits of 10 lbs/day ***(Figure 2)***.

The denitrification facility is the heart of the upgrade project.
Tony Lopez Photo

The denitrification system blends seamlessly with the existing infrastructure.
Tony Lopez Photo

Chemical metering pumps precisely regulate the amount of methanol infused into the denitrification system. *Tony Lopez Photo*

The aeration tank and anoxic zone baffles are an integral part of the MLE process. *Gannett Fleming*

True Partnership and Achievement

Using innovative yet practical approaches, the 15-year journey is a model of true partnership that included the Village, the engineer, operators, contractors and NYSDEC. The primary objective of the project – to achieve compliance with the LISS 2014 permit limits – was accomplished by July 2014.

- Nitrogen loading to the Northport Harbor has been reduced to less than 5.5 lbs/day from a high of 38 lbs/day.
- Beaches reopened for public use.
- Decrease in off-shore hypoxia conditions and increase in dissolved oxygen levels.

Stephen Hadjiyane is a vice president at Gannett Fleming, a global infrastructure and engineering firm, and he specializes in design of nitrogen removal treatment systems. He is past chair on the Long Island Chapter of the NYWEA and can be reached at shadjiyane@gfnet.com. Donna Bee is the plant superintendent at The Village of Northport WRRF. She holds a Grade 2A operator license and has more than nine years of experience in plant operations. Bee is the Operator Representative to the NYWEA Board of Directors, as well as a director on the Long Island Chapter Board. She can be reached at nptstp@optonline.net.

How to Save an Estuary: Wastewater Reuse at the Riverhead Sewer District's Water Resource Recovery Facility

by Christopher A. Weiss and Timothy M. Nordberg

Why would H2M architects + engineers (H2M) and the Town of Riverhead improve upon a perfectly functioning wastewater treatment plant and pave the way for new concepts like "wastewater reuse"? When the wastewater facility is situated on a sole source potable water aquifer and a nationally significant ecological estuary. It also helps when you are lucky enough to have an environmentally forward-thinking municipality that embraces innovation for the overall benefit of the region. Reusing wastewater on Long Island is an idea that has been overlooked for too long. Creating the first municipal reuse facility in New York was the perfect solution to address this unique combination of circumstances.

Post-construction aerial view of the Riverhead Water Resource Recovery Facility and Indian Island Golf Course. *H2M architects + engineers*

Project Challenges and Solutions

The existing 1.3 million-gallon-per-day (MGD) Town of Riverhead Advanced Wastewater Treatment Facility (AWTF) in Suffolk County, was last upgraded in 2000. The AWTF regularly met its total nitrogen discharge limit of 15 mg/l to the Peconic River. In 2001, recommendations from the Peconic Estuary study *(Peconic Estuary Program 2001)* included reducing nitrogen loading by all sources to strengthen and maintain the estuary for the future. This recommendation coincided with the sewer district's consideration that a portion of their effluent could be reused as irrigation water on the neighboring Indian Island Golf Course to reduce the nitrogen loading to the Peconic River.

What seemed like a straightforward application idea was found to be all but simple. New York did not have state standards in place for wastewater reuse for irrigation discharge. So, H2M and Riverhead had to conduct a research study to determine what the standards would be, prove the standards could be met, and get the standards approved by the regulating agency – all before the project could move to the full-scale design phase. The research study collated all the reuse water standards from states across the country already applying reuse water, and selected the strictest of each parameter to be monitored in the discharge. Then, a pilot plant was designed and constructed on the AWTF property. A portion of the existing plant's tertiary effluent was passed through the pilot plant for additional treatment to meet these stringent reuse water standards. To test the water from the reuse pilot plant, a replica golf course hole was constructed on the AWTF property using the same soils, grasses, and landscaping as the Indian Island Golf Course. Testing was conducted on the water from the sprinklers as well as on the replica golf course landscaping, soil strata and air.

Successful application of readily available treatment equipment on typical tertiary AWTF effluent to meet the newly formed reuse water standards has set the path for other projects in New York to follow. However, just as the reuse standards derived by this project were being approved by the regulating agency, the New York State Department of Environmental Conservation (NYSDEC), in line with the U.S. Environmental Protection Agency's (USEPA) estuary recommendations, modified the facility's State Pollutant Discharge Elimination System (SPDES) permit to a lower effluent nitrogen concentration, from 15 mg/l to 3.2 mg/l.

To meet the lower effluent nitrogen limit, the entire treatment facility would be upgraded. The wastewater reuse project, initially planned as an extension to the existing wastewater treatment facility, was now re-designed to be an integral part of a full facility upgrade. The new Riverhead Water Resource Recovery Facility (WRRF) project blossomed to cost $24 million, which included a 1.5 MGD membrane bioreactor and reclamation system with a fully integrated wastewater reuse process train and golf course irrigation supply system. Ultrafiltration membrane technology, used in the main process treatment train, was selected based on its ability to produce crystal clear effluent on a consistent basis prior to final disinfection. This eliminated discharge clarity impacts on the Peconic River, resulting in plant effluent that is always reuse-ready. That was the heart and soul of this project.

Water Resource Recovery Facility Design

The new facility was designed with the environment in mind. Existing structures, including concrete tanks and operations buildings, were repurposed. Energy efficiency measures were selected, such as variable frequency driven motors, in-tank probes for real-time process monitoring and motion sensors for lighting. These efficiency measures reduced the overall carbon footprint for the construction and future operation. Permit limitations in place during dewatering operations ensured that no pollution would occur in the tributary creek adjacent to the site, which ultimately flows into the Peconic River. Trenchless directional drilling techniques were used to install the 1,000 feet of force main piping under the golf course, from the facility to the irrigation control building. This approach eliminated the costly rehabilitation of fairways, tees and greens.

To provide consistent results from a complex plant capable of meeting the limits of today's technology, H2M used techniques to provide the "simpl-exity" needed to simplify the complex nature of the operations. Using wireless connectivity between the facility and the golf course, as well as fiber optic cables between process control panels on the site, a site-wide SCADA loop was created for total local controls, with remote access built in for viewing the pro-

Aerial view of the pilot study and replica golf hole on the Town of Riverhead Advanced Wastewater Treatment Facility property. *H2M architects + engineers*

Reuse water supply piping to the golf course irrigation system, including a high strength ultraviolet disinfection vessel. *H2M architects + engineers*

cess from anywhere. More reliable sensors also allow for real-time process control abilities, further promoting energy efficiency and control over the treatment operations.

New York State's First Municipal Reuse Facility

The Town of Riverhead WRRF is the first municipal reuse facility in New York state and was completed in time for the 2016 golf irrigation season. The project was completed within budget, which included New York state and Suffolk County grants of $2 million and $8 million, respectively. The new facility was upgraded with biological reactors matched with ultrafiltration for solids/liquid separation and ultraviolet disinfection to meet the limits of today's technology. These processes were chosen to both consistently meet the Total Maximum Daily Load for Total Nitrogen levels for discharge to the Peconic River, and to stay within the footprint of the pre-existing plant. The limitations of the new SPDES permit will reduce the overall annual nitrogen discharge by over 50 percent from the previous limitations.

The Town of Riverhead WRRF will reuse up to 100,000 gallons of in-plant washwater and makeup water each day for internal treatment facility equipment. Potable water traditionally has been purchased from the local supplier for this purpose. The benefits of

The Town/County/State approved notifications posted on the Indian Island Golf Course. *H2M architects + engineers*

the internally recycled water include reduced groundwater demand for the local potable water treatment plant and additional control over water pressure with the addition of a single booster pump.

The Town of Riverhead WRRF also provides up to 450,000 gallons per day of reuse water for normal sprinkler irrigation to the adjacent Indian Island Golf Course, free of charge. This irrigation water no longer needs to be drawn from golf course groundwater wells and is sufficient to provide all the water they need on a typical summer watering cycle. Reuse water containing minimal nitrogen will replace the iron-rich well water that interfered with the mechanical operations of the irrigation valves and sprinkler heads. It will also provide additional nutrients to the fairways, tees and greens that reduces the need for traditional fertilizer application. By reducing the draw on the groundwater aquifer, the groundwater level that exists will continue to protect against the intrusion of the surrounding salt water bodies. A truly outstanding result of the project was the community acceptance by the residents, the golf course patrons and the grounds crew, pushing past the fear of wastewater reuse and joining the chorus of … "It's about time."

The upgraded facility, with its Water Resource Recovery components online, will enhance these benefits to the overall well-being of this coastal community by both diverting an additional one-third of the permitted total nitrogen discharge during irrigation seasons away from the plant's Peconic River outfall and by saving up to 100 million gallons a year of groundwater pumped from the aquifer.

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NYWEA Executive Director Patricia Cerro-Reehil, center, stands with Water Ambassadors (l-r:) Kirk Rowland, Richard Lyons, Bob Wither (Vice President), Bob Butterworth, Tom Lauro, Joe Fiegl and Tony DellaValle at the George Eastman House in Rochester, N.Y.

Lauren Livermore, left, talks with Siewert Equipment's Kevin Conway.

Ann Kupferschmid with *"ecoli happens"* mug!

L-r: John Amend, Dave Barnes and Mike Garland

John Sansalone looks on as Operations Challenge is staged.

Bob Wither is the Trivia Questions emcee.

NJWEA President, Tom Grenci, left, and Jack Lagrosa, Executive Director

The members of the Bowery Bay Coyotes ready for the competition! (L-r:) Chris Reyes, Anthony Quadrino, Dragan Pilovic and Yue Yeu Guo. (Eugene Buckley, Alternate, not pictured.)

The Mixed Liquors (l-r:) Mike Panebianco, Michael Burkett, Casey Clark, Jeremy Perry (Alternate). James Plochocki (Coach) not pictured. Inset: Peter Bartlett.

The Genesee Valley Water Recyclers placed third and will go on to Chicago. The team is made up of Timothy Keegan, Jr. (Captain), Justin Slentz, Robert Holland, Lucas Kasperowicz and Michelle Hess (Alternate). They are posing with proud members of the Genesee Chapter.

Overall winners! The Jamaica Sludge Hustlers (l-r:) Yu-Tung Chan, Captain Ray Antenucci, Robert Ferland and Anthony Petrone with President McGarvey. (Joe Atkins, Alternate, not pictured.)

The Brown Tide Team is made up of (l-r:) Rob Jentz, James Behr, Nick Barresi (Alternate), Alec Breen and Captain Jake Miller. The team placed second and will also go on to Chicago.

The Virgina Blue Ridge Brawlers' team is comprised of (l-r:) Wayne Brown, Kevin Thomasson, Lacy Burnette, Stephen Lofaro and Randy Williams (Alternate and Coach).

Jersey Devils (l-r:) John Kahnke, Jim Collins, Kevin Barstow, Adam Scheick, Tim Fisher (Coach); center, rear, Tom Grenci, seated, Jack Lagrosa.

Lower Hudson Chapter's Watershed Warriors (l-r:) Kenneth Taylor, Bruce Decker, Adam Reaves, Matt Burd, Eric Albano. Not pictured: Daniel Byrne (Alternate)and Erik Coddington (Coach).

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Nitrogen-removing Biofilters for On-site Wastewater Treatment on Long Island: Current and Prospects

by Stuart Waugh, Roy Price, Xinwei Mao, Kylie Langlois, Samantha Roberts, Molly Graffam, Patricia Clyde, Jackie Collier, Christopher Gobler, Harold Walker and Jennifer Garvey

Long Island, New York, has one of the greatest concentrations of on-site wastewater disposal systems in the nation, with more than 500,000 cesspools and septic systems in Nassau and Suffolk Counties alone. Nitrogen and other contaminants emanating from these systems discharge to groundwater and flow into sensitive coastal environments. The result? Harmful algal blooms that have caused massive declines in fisheries as well as threats to public health; widespread loss of wetlands that have weakened the island's natural resiliency against coastal storms; and contamination of the region's sole source drinking water supplies *(NYSDEC 2009, 2010, 2011 and 2012; Gobler and Sunda, 2012; Gobler et al, 2012; Hattenrath et al, 2010; Hattenrath et al, 2015; Tomarken et al, 2016)*.

A large-scale upgrade of existing wastewater management infrastructure is needed to restore regional water quality, but traditional sewering – connecting developed parcels to existing water resource recovery facilities – is considered economically unviable for many Long Island communities. Instead, the region is poised to become an epicenter for cutting-edge decentralized wastewater treatment, relying on a toolbox of advanced individual on-site treatment technologies and neighborhood-scale wastewater collection and treatment systems.

In response to this environmental and economic crisis, New York state recently established the Center for Clean Water Technology (CCWT) at Stony Brook University. The initial focus of the CCWT is to support the development and commercialization of more cost-effective on-site wastewater treatment technologies. Currently, the effluent total nitrogen performance requirement for advanced on-site wastewater treatment systems in Suffolk County is 19 mg/l. However, the CCWT's goal is to support the development of systems that meet a "10/10/30" target, which means systems that cost no more than $10,000 to install, achieve nitrogen outputs of 10 mg/l or less, and last 30 years or more.

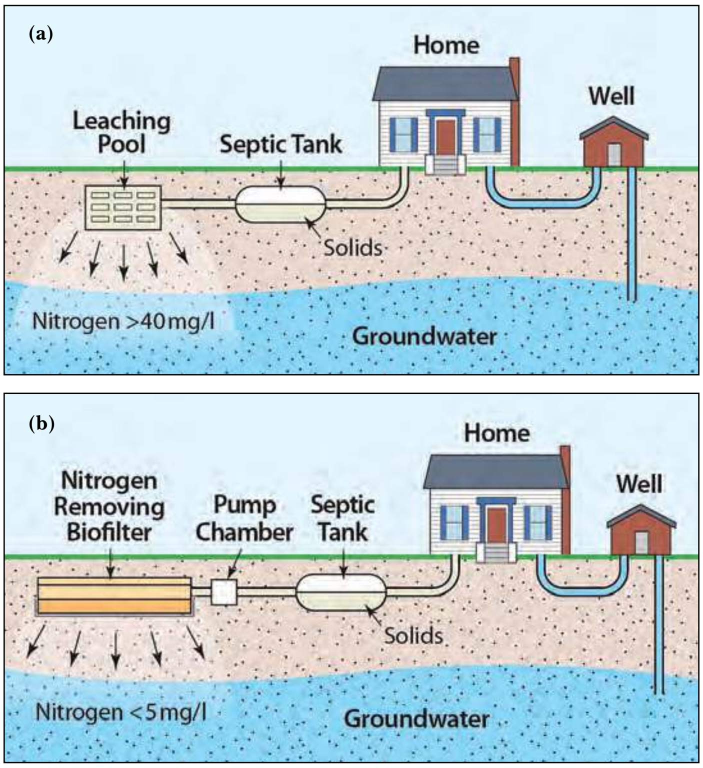

Figure 1. Conceptual infrastructure schematics (a) of a conventional septic system on Long Island, infrastructure that is not designed to remove nitrogen from wastewater; and (b) of an unlined/unsaturated Nitrogen Removing Biofilter.

One approach that has been the subject of extensive study by the CCWT is a non-proprietary, field-built system known as a Nitrogen Removing Biofilter (NRB). NRBs are a form of passive wastewater treatment, which means they contain few moving parts (a single, low-pressure dosing pump) and operate largely by gravity, making them low in energy usage, low in maintenance and, thus, low in cost.

Similar in footprint and basic functionality to a traditional leach field, the common form of dispersal for septic tank effluent across the nation ***(Figure 1a***), NRBs are comprised of a sand-based "nitrification layer" overlaying a "denitrification layer" of sand mixed with lignocellulose, or wood chip, media. The NRB unit is installed following a standard septic tank/pump chamber combination and is dosed intermittently by a low-pressure distribution system ***(Figure 1b)***.

In full-scale pilot installations investigated by the CCWT, NRBs have demonstrated an ability to consistently achieve effluent total nitrogen concentrations on the order of 10 mg/l or less, and greater than 90 percent attenuation of pathogens, pharmaceuticals and personal care products ***(Figures 2*** and ***3)*** *(Anderson and Hirst, 2015; Heufelder 2015)*. The incorporation of locally sourced sand and wood media aims to position the NRB as an economically viable alternative for high-efficiency on-site wastewater treatment, which research suggests will perform for multiple decades *(Robertson and Cherry, 1995)*. Further, the shallow profile of NRBs (less than four feet) makes them a suitable option in regions with shallow water tables, which are prevalent across Long Island and are increasingly common in all coastal areas as sea levels continue to rise.

The Science of NRBs: Form and Function

The removal of nitrogen from wastewater in an NRB is designed to occur in two distinct steps utilizing microbial processes:

1) A "nitrification step" in which ammonia and reduced organic nitrogen in septic tank effluent are converted to nitrate in an unsaturated, oxygen-rich sand layer.
2) A "denitrification step" in which nitrate is converted to dinitrogen gas in an unsaturated to saturated, oxygen-limited layer of sand and lignocellulose (wood chips).

Although these are the dominant processes occurring in the respective layers, the microbial ecology of these systems is complex ***(Figure 4)***. For example, CCWT research has detected the presence of microorganisms that carry out not only nitrification but also denitrification, anaerobic ammonium oxidation (ANAMMOX), and other nitrogen transformation pathways in

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PPCPS (Pharmaceuticals and Personal Care Products)

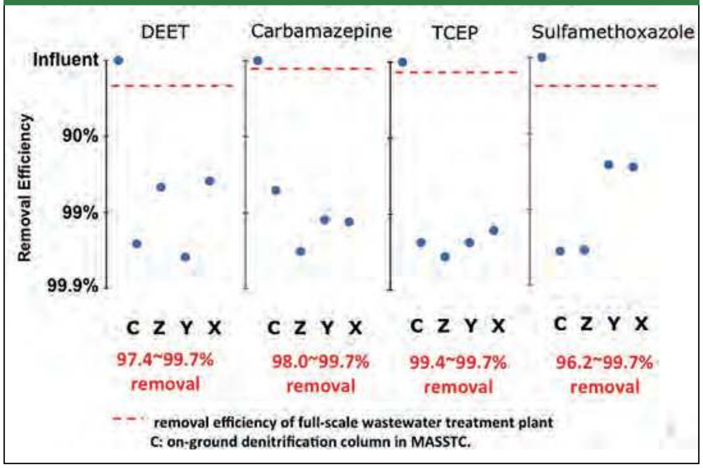


Figure 2. Removal efficiency of organic contaminants in NRBs at the MASSTC. System "X" has a fully saturated denitrification layer; Systems "Y" and "Z" have unsaturated denitrification layers. System "C" represents an aboveground denitrification study in a column fed with nitrified percolate.

Microbial Analysis – *E. coli* (pathogens)

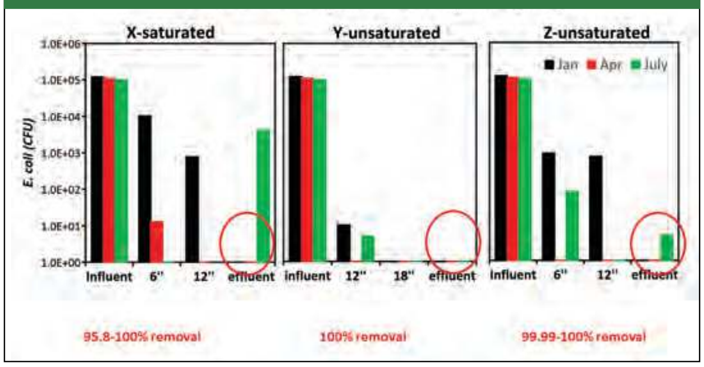


Figure 3. Removal efficiency of *E.coli* (pathogens) in NRBs at the MASSTC. System "X" has a fully saturated denitrification layer; Systems "Y" and "Z" have unsaturated denitrification layers. The values 6 inches, 12 inches and 18 inches indicate depth within the NRB unit.

Functional Groups of Nitrogen-Transferring Bacteria

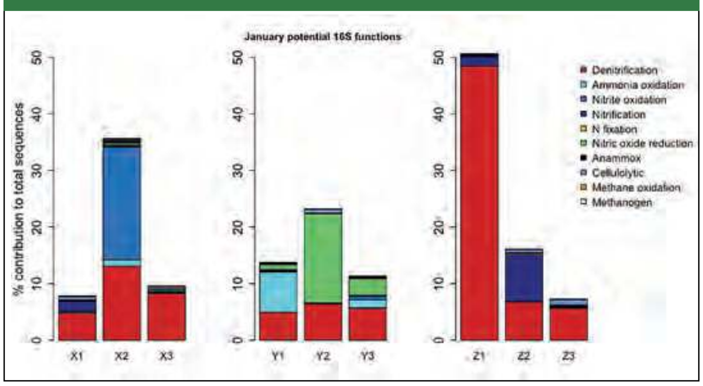


Figure 4. After classification of operational taxonomic units (OTUs, analogous to species based on 97 percent identical 16S ribosomal RNA [rRNA] gene sequences) to the genus level, the 100 most abundant genera and three low abundance nitrogen transforming genera were assigned potential functions based on a literature review *(see legend)*. The relative abundance of each functional group is graphed above: "1" represents the nitrification pan lysimeter; "2" represents the interface pan lysimeter; and "3" represents the effluent of each system ("X", "Y", and "Z", from left to right). Using these sequences, we can identify types of bacteria that are present, and based on that identification we can infer what their potential functions are in transforming nitrogen from one form to another, and ultimately in removing nitrogen.

the unsaturated or "nitrifying" layer *(Langlois and Collier, 2016)*.

The layered concept that is fundamental to promoting nitrogen removal in a two-step process also supports various design configurations, several of which have been developed to maximize cost-effectiveness, accommodate varying site constraints and respond to concerns expressed by regulators. For example, since August 2016 the CCWT has been piloting the following three designs at the Massachusetts Alternative Septic System Testing Center (MASSTC), as part of an ongoing research collaboration with the Barnstable County Department of Health and Environment:

1) Lined NRB with a saturated denitrification zone.
2) NRB with wood chip chamber.
3) Unlined, unsaturated NRB.

The materials used in these pilot tests (sand and wood chips) are native to Long Island. The test performance results for each of the three designs are shown in ***Figure 5***. Schematics of the three designs are presented in ***Figures 6***, ***7*** and ***8***.

Pilot Testing Results

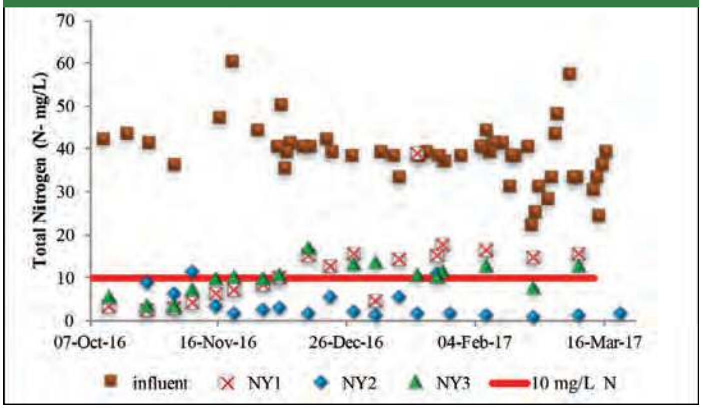


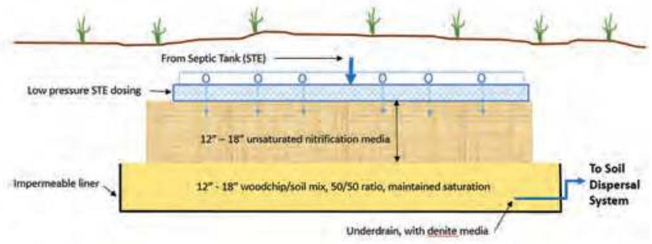
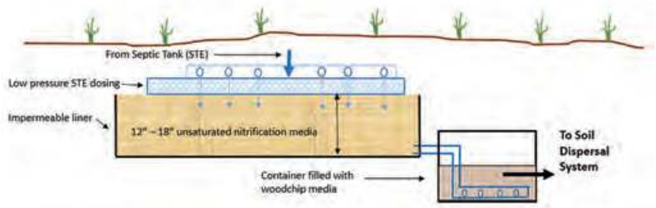
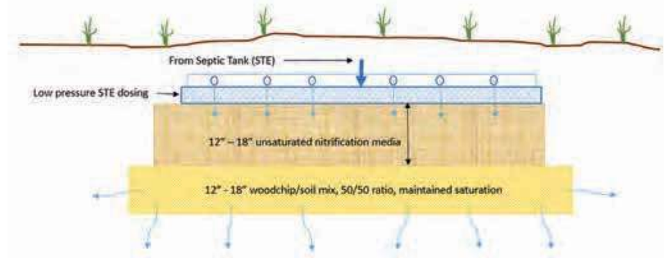
Figure 5. Comparison of total nitrogen (TN) removal by three pilot systems installed at the MASSTC in Barnstable, MA in August 2016. NY1 = TN in effluent from lined/saturated NRB; NY2 = TN in effluent from NRB with wood chip chamber; and NY3 = TN in effluent from unlined/unsaturated NRB.

Next Steps: Pilot Installations and Design Optimization through Research

While data from numerous installations are needed to assess system performance in varied conditions, preliminary results from pilot installations of NRBs in Florida and Massachusetts are encouraging. A series of NRB installations is planned by the CCWT at residences in Suffolk County, New York, beginning in the summer of 2017 as part of a program in collaboration with the Suffolk County Department of Health Services. These systems will be monitored monthly for at least two years, providing a rich set of performance data for regulators and systems designers.

Ongoing research by the CCWT will investigate nitrogen transformation rates and the microbial ecology in NRB systems, as well as different material types and combinations. This research will inform continued design optimization with the goal of minimizing system footprint, construction costs and maintenance requirements, while maximizing nitrogen removal efficiency and longevity.

Because NRBs are a non-proprietary technology, the goal of this work is the development of a guidance document for adoption by regulatory agencies, making NRB systems available to any licensed

Schematic	Design Specifications	Design Rationale	Test Performance Results
Figure 6. Lined NRB with saturated denitrification zone installed at MASSTC in August 2016. 	Six- to eight-inch soil cover, followed by a 12- to 18-inch nitrifying sand layer overlaying a 12- to 18-inch denitrifying layer of 50:50 sand and wood chip matrix **(Figure 6)**. The denitrifying layer is lined, requiring a leaching pool (new or existing) or small leach field for final disposal of the treated effluent.	The system liner ensures saturation of the denitrification layer, which extends the longevity of the wood media as a carbon source for denitrification.	This system initially achieved nitrogen removal at levels below the CCWT's target of 10 mg/l of nitrogen, but in colder weather its nitrogen removal efficiency was diminished **(Figure 5)**. Through continued monitoring the CCWT will examine if performance improves with warmer weather.
Figure 7. NRB with wood chip chamber installed at MASSTC in August 2016. 	A 12- to 18-inch sand layer **(Figure 7)** funnels nitrified effluent via gravity to a tank filled with wood chips. The treated effluent requires dispersal to a leaching pool (new or existing) or small leach field.	This configuration allows for replacement of the wood chips as a denitrification media. Additionally, the containment of the treatment unit is desirable in certain scenarios when managing separation distances from shallow ground water.	To date, the system has consistently achieved nitrogen outputs of under 10 mg/l, and reached levels as low as 5 mg/l **(Figure 5)**.
Figure 8. Unlined NRB design with unsaturated denitrification zone installed at MASSTC in August 2016. 	Similar in dimensions and materials to the lined, saturated NRB, this configuration has six to eight inches of soil cover, followed by a 12- to 18-inch nitrifying sand layer overlaying a 12- to 18-inch denitrifying layer of 50:50 sand and wood chip matrix **(Figure 8)**. The denitrification layer is not lined, allowing treated effluent to flow directly into the soil beneath the system.	This configuration is the simplest and least expensive to construct. Additionally, it has the smallest footprint as no additional mechanism is needed for final disposal of the treated effluent. However, the longevity of the wood chip media as a carbon source for denitrification may be less due to exposure to oxygen. The literature suggests an unsaturated wood chip bioreactor can perform for several decades, but investigating this concern remains a priority focus of CCWT research.	This system initially achieved nitrogen removal at levels below the CCWT's target of 10 mg/L of nitrogen. Performance slightly exceeded 10 mg/l in colder weather, but returned to below 10 mg/l as the weather warmed **(Figure 5)**.

designer or installer within each participating regulatory jurisdiction, enabling the wide-scale implementation of the approach.

The New York State Center for Clean Water Technology at Stony Brook University is funded by the New York State Environmental Protection Fund, as administered by the New York State Department of Environmental Conservation (www.stonybrook.edu/cleanwater).

The authors, staff of the CCWT, are: Research Team Dr. Stuart Waugh and Dr. Roy Price; Faculty Collaborators Dr. Xinwei Mao and Dr. Jackie Collier; Ph.D. students Kylie Langlois, Samantha Roberts, Molly Graffam, and Patricia Clyde; Co-Directors Dr. Christopher Gobler and Dr. Harold Walker; and Associate Director Jennifer Garvey. Inquiries about this article may be directed to hilary.wolfskill@stonybrook.edu.

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Making Water Quality Protection Affordable – Suffolk County's Septic Improvement Program

by Dorian Dale, Justin Jobin and Sarah Lansdale

Water is the single most significant natural resource for which Suffolk County, New York, bears responsibility. In 2014, Suffolk County Executive Steve Bellone identified water quality as his administration's highest priority. The Suffolk County Septic Improvement Program is another step in the County Executive's efforts to Reclaim Our Water. This program builds upon:

- Two rounds of septic pilot programs, which resulted in the evaluation of 14 different technologies at 43 year-round county residences.
- The adoption of Article 19, the first significant addition to the sanitary code in since 1973.
- The release of the Comprehensive Water Resources Management Plan *(Suffolk County 2015)*.

Nitrogen pollution from cesspools and septic systems has been identified as the single largest cause of degraded water quality contributing to beach closures, restrictions on shellfishing, toxic algal blooms, and massive fish kills *(Kinney and Valiela 2011; Deegan, et al. 2012; NYSDEC 2014)*. A conventional on-site septic system was never intended to remove nitrogen. The average residential septic system discharges approximately 40 pounds of nitrogen per year. For homeowners living close to surface waters in Suffolk County, nitrogen can rapidly reach surface waters where it contributes to degradation of our marshes, bays, and beaches. Even inland, nitrogen from septic systems will eventually reach the groundwater and surface waters.

Tens of thousands of parcels are currently served by nitrogen-releasing cesspools and septic systems, but many will likely never connect to a sewer system which has become, in most cases, prohibitively expensive. Remediating degraded water quality will depend on replacement of 360,000 existing non-performing systems with Innovative and Alternative On-site Wastewater Treatment Systems (I/A OWTS).

Over the past several years, Suffolk County has assertively set the stage for the transition to the use of these new systems. To make the cost of nitrogen-removing I/A OWTS more affordable for homeowners, Suffolk County has devised the Septic Improvement Program, which combines a grant and low-interest financing program, as the next component of the Reclaim Our Water initiative.

I/A OWTS Demonstration Program

In April of 2014, Suffolk County issued the first Request for Expression of Interest (RFEI) for a Demonstration Program of I/A OWTS. This Demonstration Program was a resounding success, as a total of 19 systems were donated from four manufacturers representing six different technologies. Interested homeowners were selected by a County-wide lottery, and the systems were installed between June 2015 and March 2016. As a result, four technologies received provisional approval by April 2017 ***(Table 1)***.

Table 1. Technologies Piloted in Phase 1 of the Suffolk County I/A Septic System Demonstration Program.

Technology	Status
Hydro-Action® AN Series	Provisionally approved September 2016
Norweco Singulair® TNT®	Provisionally approved October 2016
Orenco AdvanTex® AX-RT	Provisionally approved March 2017
Norweco HydroKinetic®	Provisionally approved April 2017
Orenco AdvanTex® AX20	Still in Pilot Phase
BUSSE MF MBR	Still in Pilot Phase

Based upon the success of the first phase, Suffolk County issued an RFEI for a Phase 2 Demonstration Program, in which a total of 24 systems were donated from six manufacturers representing eight different technologies. In July 2016, twenty homeowners were selected via lottery. Four of the Phase 2 systems were installed in the winter of 2017 and the remaining systems are projected to be installed by mid-2017 ***(Table 2)***. Phase 2 systems may receive provisional approval in 2017.

Table 2. Technologies Piloted in Phase 2 of the Suffolk County I/A Septic System Demonstration Program.

Technology	Status
PremierTech Aqua – Eco-Flo® Coco Filter	2 of 2 Systems installed
Amphidrome®	1 of 2 Systems installed
Pugo Systems	1 of 4 Systems installed
FujiClean USA™	4 Systems to be installed
Waterloo BioFilter	2 Systems to be installed
BioMicrobics microFAST®	2 Systems to be installed
BioMicrobics BioBARRIER®	2 Systems to be installed
BioMicrobics SeptiTech® STAAR™	2 Systems to be installed
GeoMat™ Pressurized Shallow Drainfield	2 Systems to be installed
Infiltrator® ATL Geotexile Sand Filter	2 Systems to be installed

These demonstration projects afford I/A OWTS manufacturers the opportunity to showcase and demonstrate single family residential on-site wastewater treatment system technologies in Suffolk County, to evaluate the viability of these systems in local conditions and potentially expedite their provisional approval. Additionally, these projects are implemented at no cost to either the County or participating homeowners.

How Do I/A OWTS Benefit the Homeowner?

In addition to providing environmental benefits by reducing the nitrogen load to groundwater and surface waters, homeowners receive benefits from these state-of-the-art technologies:

1. I/A OWTS can provide homeowners with a more cost-effective solution on lots that have significant site constraints such as

continued on page 50

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high groundwater, poor soils, small restrictive lot size and coastal proximity.

2. Conventional Systems have a life expectancy of approximately 20 years. However, I/A OWTS may last much longer – if maintained properly – as they provide a high-quality clean effluent that generally does not lead to clogging of the leach field, as occurs with conventional systems. In addition, I/A OWTS consist of separate components, all of which are replaceable individually.

Septic Improvement Program Overview

The Suffolk County Septic Improvement Program (SC-SIP) is available to qualified owners of residential property. Costs associated with installing I/A OWTS are estimated at $17,850, which includes technology, drain field, design and installation. To offset a portion of the cost for homeowners, grants up to $11,000 will be provided through the SC-SIP. Homeowners may also be eligible to participate in a loan program administered by a third-party lender to finance the remaining cost of the system, up to $10,000, at 3 percent interest over 15 years.

Septic Improvement Program Eligibility Criteria

The SC-SIP grant funding includes up to $10,000 for the purchase and installation of an I/A OWTS, and up to $1,000 for a pressurized shallow drain field and requisite engineering and design services. All other costs, such as irrigation repairs, electrical improvements and any other improvements necessary for the installation, are to be paid by the property owner/applicant. Post-installation landscaping and irrigation restoration is the responsibility of the property owner.

A pressurized shallow drain field (PSD) is an alternative to the use of a conventional concrete leaching pool system for dispersal of treated effluent. The system utilizes a series of pipes placed in the upper 18 inches of the soil horizon for maximum treatment by natural soil processes. This even application of the effluent just below the ground surface, where biological activity is greatest, allows for additional nutrient removal to take place during the dispersal process. Plant and grass roots are also able utilize these nutrients, reducing the need for fertilizers. In addition to providing a higher level of treatment, shallow placement maximizes vertical separation distance from the drain field to the water table, making PSDs ideal for high groundwater situations.

Grant funding awards will be prioritized by the parcel location, in the following order:

(1) Parcels located within the *Priority Critical Areas*.
(2) Parcels located within *Critical Areas*.
(3) Parcels located outside *Critical Areas*.

Priority Critical Areas are defined as high- and medium-density residential parcels, either within the zero to two-year groundwater travel time to surface waters (as defined in the Suffolk County Comprehensive Water Resources Management Plan [2015]) or within 1,000 feet of enclosed water bodies in Suffolk County.

Critical Areas are defined as high- and medium-density residential parcels located within the two to 25-year groundwater travel time to surface waters, as defined in the Suffolk County Comprehensive Water Resources Management Plan.

To participate in the SC-SIP, the homeowner's parcel must be located within one of the targeted, high-priority areas of Suffolk County, and the homeowner must meet all of these eligibility criteria:

- The residence must be single-family, owner occupied year-round, and must be the owner's primary residence.
- The residence must be served by a septic system or cesspool that is not connected to a public sewer or located in any sewer district.
- The property must not be a rental property.
- New construction is not eligible; however, construction projects on existing residences may be eligible.
- The residence must not include an in-home business, other than a personal home office that does not require additional kitchen use or customer access.
- The homeowner may not be a current employee of Suffolk County, an elected official or an office holder of any political party, including official political party committee members.
- There must be available a valid Certificate of Occupancy (CO) or Certificate of Zoning Compliance for the residence.
- Income verification, in the form of a copy of the homeowner(s) most recently filed federal income tax return, is required. Grant assistance through the SC-SIP is based upon the following household income criteria:
    - Adjusted Gross Income (AGI) of less than or equal to $300,000 per year will be eligible for 100 percent of the grant ($10,000).
    - AGI between $300,000 and $500,000 per year will be eligible for 50 percent of the grant ($5,000).
    - AGI of $500,000 or more will not be eligible for a grant.

Applicants whose properties are determined suitable for the installation of a PSD may request additional funding to add a PSD to their I/A OWTS. An enhanced PSD grant of up to $1,000 ($500 for those household incomes between $300,000 to $500,000) is available pending the homeowner's eligibility.

This program has been substantially supported by Governor Andrew Cuomo and the New York State Department of Environmental Conservation, which provided funding for staff and the startup of the Suffolk County Septic Improvement Program.

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NYWEA
LEADING THE WAY IN WATER QUALITY MANAGEMENT

1,4-Dioxane in Groundwater: An Emerging Concern on Long Island

by Harold W. Walker

The Center for Clean Water Technology (CCWT) at Stony Brook University is launching a state-sponsored, multi-year program to proactively address Contaminants of Emerging Concern in drinking water, with an initial focus on 1,4-dioxane in groundwater. The program will consist of three interrelated tracks/objectives:

(1) grants to support pilot testing of technologies in partnership with water suppliers.

(2) research to support pilot technology evaluation.

(3) research and development of novel or refined methods for removing targeted contaminants from drinking water.

Currently, there is no federal Maximum Contaminant Level (MCL) for 1,4-dioxane in drinking water, but the chemical is on the fourth United States Environmental Protection Agency (USEPA) Contaminant Candidate List (CCL4). 1,4-dioxane is a probable human carcinogen and has been detected in groundwater across the United States. Many solvents, such as tricholorethylene (TCE), contain 1,4-dioxane as a stabilizer. 1,4-dioxane is also used in several commercial products.

As part of the Third Unregulated Contaminant Monitoring Rule (UCMR3) water suppliers across the United States were required to monitor for 1,4-dioxane. Nationwide, nearly 7 percent of public water suppliers detected concentrations of 1,4-dioxane greater than the 10-6 cancer risk guideline of 0.35 µg/L. On Long Island, 39 water suppliers serving 75 percent of the population detected concentrations of 1,4-dioxane above 0.35 µg/L.

Due to the physical and chemical properties of 1,4-dioxane, few treatment technologies currently exist to remove it from drinking water; however, advanced oxidation process (AOPs) show promise. AOPs represent a class of technology that utilizes the process of oxidation and the formation of hydroxyl radicals to destroy organic contaminants. Hydroxyl radicals are powerful oxidants that are highly reactive with a broad range of contaminants in drinking water. Several AOPs are under development using ozone (O_3), hydrogen peroxide (H_2O_2), ultraviolet (UV) light, titanium dioxide, and/or ultrasound.

The combination of UV with H_2O_2 has been pilot tested by the Suffolk County Water Authority (SCWA) and is now being developed by SCWA for a larger scale demonstration. Based on their pilot-scale work, UV-H_2O_2 shows significant promise as an effective treatment technology for the removal of 1,4-dioxane from drinking water.

The CCWT will be working with water suppliers like SCWA to carry out a comprehensive assessment of AOPs such as UV-H_2O_2 and other technologies for treating 1,4-dioxane. These efforts will facilitate the wide-spread adoption of effective technology to deal with this drinking water threat.

What is 1,4-dioxane?

- It is used in many products, including paint strippers, dyes, greases, varnishes and waxes. 1,4-dioxane is also found as an impurity in antifreeze and aircraft deicing fluids and in some consumer products (deodorants, shampoos and cosmetics).
- Synonyms include dioxane, dioxan, p-dioxane, diethylene dioxide, diethylene oxide, diethylene ether and glycol ethylene ether.
- Short-lived in the atmosphere, it may leach readily from soil to groundwater, migrates rapidly in groundwater and is relatively resistant to biodegradation in the subsurface.
- Common treatment technologies include advanced oxidation processes and bioremediation.

Source: USEPA. 2014. Technical Fact Sheet 1,4-Dioxane. *https://www.epa.gov/sites/production/files/2014-03/documents/ffrro_factsheet_contaminant_14-dioxane_january2014_final.pdf*

Dr. Harold W. Walker, P.E. serves as the co-Director of the New York State Center for Clean Water Technology, and is Professor and Founding Chair of the Department of Civil Engineering at Stony Brook University. He may be reached at harold.walker@stonybrook.edu.

Nitrate in Domestic Water Supplies: Potential Adverse Health Effects

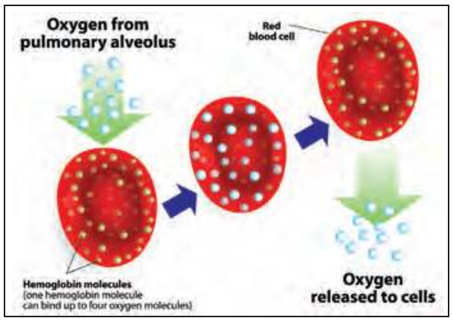
by Doug Daley

Problem Definition

Nitrates in drinking water are a public health concern because of the possibility of inducing methemoglobinemia (aka, "blue-baby syndrome") in infants under six months of age. The extent of the problem of induced methemoglobinemia is unknown, as it is not a reportable disease. Aquifer nitrate concentrations tend to be greater in areas of agricultural land use than in areas of other land use areas *(USEPA 2015)*.

Occurrence of Nitrate in Domestic Drinking Water Supplies

The nitrogen cycle is a complex set of biological and chemical processes, which ultimately determine the amount of nitrate found in ground and surface waters. Nitrate is a product of the nitrification of ammonia. An intermediate step in nitrification produces nitrite, which is readily oxidized to nitrate; consequently, nitrite is rarely found in the natural environment.



istockphoto.com

Nitrate concentrations that exceed the U.S. Environmental Protection Agency (USEPA) Maximum Contaminant Level (MCL) of 10 mg/L are more frequently detected in agricultural regions than in other land use areas *(USEPA 2015)*. Nitrate concentrations are positively correlated with agricultural land use, especially nitrogen fertilizer applications, and tend to be greater in areas with well-drained soils *(DeSimone 2009)*. Fertilizer, livestock manure and human sewage can be significant contributors of nitrates in groundwater sources of drinking water *(USGS 2015)*. Well construction and poor waste disposal practices often contribute to individual problems. Spills and misuse of chemicals cause more severe local problems.

In a nationwide assessment of domestic water supply wells, nitrate concentration exceeded the MCL in 7.1 percent of wells in agricultural areas, compared to 3.1 percent in areas of urban land use and 3.7 percent in areas of mixed land use. Studies that specifically targeted agricultural land use areas reported over 23 percent of the sampled wells exceeded the MCL *(DeSimone 2009)*.

Health Concern

Nitrate in drinking water was identified as a health concern in Iowa in 1945, when Dr. H. Comly established a connection between a case of infant methemoglobinemia and high nitrate concentrations in a private water supply *(Comley 1945)*. The concern with nitrate in drinking water is that methemoglobinemia can be induced when nitrate is reduced to nitrite in the reducing environment of the upper gastrointestinal tract. The reaction is mediated by nitrate-reducing bacteria, which cannot survive at pH less than 4, and are usually confined to the intestine. In adults and older children, nitrate is usually absorbed from the stomach before it reaches the intestine; nitrate is rapidly excreted in the urine and does not oxidize hemoglobin *(National Research Council 1978)*. However, in infant children, where the gastric pH usually exceeds 5, nitrate is reduced to nitrite in the stomach and enters the bloodstream. There, nitrite reacts with hemoglobin and forms methemoglobin, which interferes with the blood's ability to transport oxygen, causing functional anemia *(Denshaw-Burke 2016)*. The resulting anoxia produces a bluish coloring of the skin (cyanosis), fatigue, weakness and confusion. Death may occur at extremely high (greater than 70 percent) methemoglobin blood fraction. Methylene blue is the primary emergency treatment *(Denshaw-Burke 2016)*.

Infants under six months of age are at greater risk of methemoglobinemia than older infants. Other individuals which may be at relatively higher risk include infants with diarrhea or respiratory problems, pregnant women and persons with chronically reduced stomach acidity *(National Research Council 1978)*.

Regulations

The USEPA has established the MCL for nitrate in public water supplies to be 10 mg/L as N. The MCL is an enforceable standard that reflects the greatest concentration of a contaminant that is allowed in drinking water. MCLs are based on requirements for public water supply systems, and are recommended for use with individual residential systems.

In addition, the USEPA Health Advisory (HA) for nitrate is an estimate of acceptable drinking water levels for a substance based on available health effects information. The HA is not a legally enforceable Federal standard, but serves as technical guidance to assist federal, state, and local officials. The One-Day HA for nitrate is 100 mg/L, which is intended to protect a 10-kg child consuming one liter of water per day. Likewise, the Ten-Day HA for nitrate is 100 mg/L, which is the concentration that is not expected to cause any adverse noncarcinogenic effects for up to ten days of exposure by a 10-kg child consuming one liter of water per day *(USEPA 2012)*.

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My Water Legacy – NYWEA Connects with the Hayduk Family of Long Island

by Stephen G. Hayduk and Stephen A. Hayduk

Editor's Note: In the spirit of the Water Environment Federation's (WEF's) social media campaign, #MyWaterLegacy, for this issue of Clear Waters we looked for NYWEA members on Long Island who had family connections in the water resources field. We found Stephen G. Hayduk, P.E., and his son Stephen A. Hayduk, I.E., both of whom work in the family business, Hayduk Engineering, LLC.

When I graduated college as a civil engineer, there was a bit of a recession going on and engineering jobs were not easy to come by. I ended up with Eberhard Engineering, a one-man firm that specialized in water and wastewater, including and especially aerated lagoon wastewater treatment plants throughout New England and on Long Island. Although I studied water and wastewater engineering as part of the civil engineering program at the Rochester Institute of Technology (R.I.T.), my original aspiration was to become a structural engineer and to someday design a bridge – a big bridge, like the Verrazano Narrows Bridge! The rest is history. I subsequently worked as a project engineer and project manager at Bowe, Walsh & Associates and Bienstock & Lucchesi, where I rose to the position of Chief Engineer. In 1984, I opened Hayduk Engineering, primarily a water and wastewater engineering operation.

Kevin Wood Photography

Stephen G. Hayduk, P.E.

In 1985, I volunteered to serve on the Suffolk County Vietnam Veterans Memorial Commission; I am a Vietnam War Veteran, having served in the United States Army from 1968 to 1971. Over the next six years I served as executive director and engineer in charge of design and construction of the memorial, a 100-foot-tall monument atop Bald Hill in Farmingville, New York. After completion of the landmark, one fellow engineer on Long Island remarked to me, "Steve, is this your bridge?" Perhaps!

In March 1992, due in large part to Hayduk Engineering's reputation, I was appointed as the Commissioner of the Suffolk County Department of Public Works. Of necessity, I closed my consulting firm for the next five years, during my tenure as Commissioner of that 900-employee department. In that position, I also wore the hat of being the Chairman of the Suffolk County Sewer Agency. I received the Chapter Achievement Award from NYWEA Long Island Chapter in 1994.

Situated on top of Bald Hill, one of the highest points on Long Island, this monument acknowledges the service and sacrifice of all Vietnam Veterans – those who died, those who were wounded, and the men and women who served. *George Hayduk*

I reopened my private practice in 1997 and continue as a consultant today. My firm has designed and overseen the construction of numerous water distribution systems; sanitary sewer systems; sanitary pumping stations; wastewater treatment facilities; stormwater collection, recharge and retention systems; and related projects throughout the northeast, but most significantly on Long Island. The firm also provides civil and site engineering services. The wastewater projects performed by Hayduk Engineering include engineering design of new facilities, hands-on investigations and troubleshooting at existing facilities, and the upgrade/rehabilitation of same.

Like Father, Like Son ...

In 2007, I joined my father at Hayduk Engineering as a draftsman. Later, I obtained my bachelor's degree from R.I.T. Today, I am a Project Engineer responsible for engineering design of many of the firm's wastewater projects. My father and I work very closely together, managing the operation of the business, our other staff members and the workload of the firm. We are both active members of the NYWEA Long Island Chapter and various other professional organizations. I am the current Chair of the Young Professionals Committee for the Long Island Chapter of NYWEA.

Kevin Wood Photography

Stephen A. Hayduk, I.E.

Hayduk Engineering, LLC – A Veteran-Owned Business

In 2015, New York State passed legislation to enact the Service-Disabled Veteran-Owned Business (SDVOB) program, requiring a participation goal of 6 percent on all state-funded contracts. Hayduk Engineering received its certification from the State of New York as a SDVOB in December 2015. Hayduk Engineering is also federally verified as a Service-Disabled Veteran-Owned Small Business (SDVOSB).

Challenges and Rewards of Working in Water Resources on Long Island

We have always found that Long Island is a unique engineering environment. This may be in part due to the nature of the municipalities and the regulatory agencies here, but it is also in large part due to the geology of the island. Stormwater design is done much differently in many of the Long Island municipalities than elsewhere, more empirically as a result of the glacial terminal moraine and the soils deposited here. This is also reflected in wastewater engineering of treatment facilities, especially concerning effluent disposal fields. Also, nutrient control – particularly in Suffolk County – is primarily a nitrogen issue, whereas in other places

Service-Disabled Veteran-Owned Businesses (SDVOBs) in New York

The Division of Service-Disabled Veterans' Business Development ("Division") was created within the Office of General Services in mid-2014. Since its inception:

- 225 SDVOBs were vetted and certified from October 2014 to June 2016.
- Averaging over 112 certifications per year.
- Applications are approved or denied within 39 working days, on average.
- SDVOBs were awarded $23,000,000 in contracts and purchase orders during the inaugural year of the program.

Source: *Division Mid-Year Report, June 2016 (https://ogs.ny.gov/Veterans/Docs/DSDVBD2016Mid-YearReport.pdf)*

throughout the country other concerns, such as phosphorus, are more significant.

The other interesting part about wastewater engineering on Long Island is the fact that there are about 200 existing wastewater treatment plants in Suffolk County alone, ranging in size from a few thousand gallons per day (gpd) to about 40 million gallons per day (mgd), with many different types of treatment processes. Most of the treatment facilities are privately owned and operated, which presents a number of challenges for local consultants, operators and municipalities. This also makes Long Island unique, as many other areas in the country have much larger regional sewer systems and wastewater treatment plants.

Considering a Career in Water Resources?

We would say to a young person considering entering the water resources field that it is a challenging, rewarding and exciting career. The work itself is always interesting, as most projects are unique, and the technologies in the marketplace are constantly evolving. As a professional in the water resources field, the work you do is an integral component of and a direct contribution to the protection and improvement of the environment, whether it is popularly acknowledged or not. Our decades of experience in the field have proven to be both professionally and personally rewarding.

From left to right: Stephen A. Hayduk, Chris Ceresko, and Stephen G. Hayduk of Hayduk Engineering on the NYWEA Long Island Chapter Young Professionals Committee Annual Fishing Trip 2012.

Dick Crescenzo of W.A.S.T.E, Inc.

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Chang and Thorpe Stockholm Junior Water Prize Winners

We are thrilled to learn from the Water Environment Federation (WEF) that Rachel Chang and Ryan Thorpe, both of Manhasset, New York, have won the 2017 U.S. Stockholm Junior Water Prize (SJWP), the nation's most prestigious youth competition for water-related research.

Their project was developed to detect and purify water contaminated by bacteria, Chang and Thorpe won $10,000 and an all-expenses paid trip to Stockholm to represent the United States at the international competition in late August.

Their paper titled, "A Novel Approach to Rapidly and Sensitively Detect and Purify Water Contaminated with *Shigella, E. coli, Salmonella,* and *Cholera*," Chang and Thorpe underscore the fact that in countries lacking sanitary water waterborne diseases cause 3.4 million deaths annually. Chang and Thorpe have developed and engineered a system to efficiently detect and purify bacterial presence in a quick time frame with a lower detection limits than conventional methods. Graphene was utilized to create four specific biosensors through the immobilization of specific enzymes that target analytes released during the respiratory cycles of model organisms for *Salmonella, Shigella, Cholera,* and *E. coli*. The system successfully detected minute levels of bacteria in a rapid time frame and purified the water of pathogens.

Students from 48 states and Puerto Rico competed in the national finals June 16-17 at the University of North Carolina at Charlotte. The Stockholm Junior Water Prize aims to increase students' interest in water issues, research and careers, as well as to raise awareness about global water challenges. The competition is open to projects focused on improving water quality, water resource management, water protection, and drinking water and wastewater treatment.

Ryan Thorpe and Rachel Chang, Manhasset, N.Y., hold the U.S. Stockholm Junior Water Prize.

Study Adapts to New Coastal Flooding Reality

by JoAnne Castagna

A hurricane passes directly over New York City. In just one hour, the harbor rises 13 feet and floods over wharves, causing rivers on each side of the island city to converge.

Anyone living in New York would assume this is Hurricane Sandy that devastated the region just a few years ago. It's actually the Great Hurricane of 1821.

"This is not the first time the region faced a hurricane the size and strength of Sandy, and it goes to show that another Hurricane Sandy could occur in the future," said Bryce Wisemiller, Project Manager, U.S. Army Corps of Engineers, New York District.

He said coastal storms like Sandy aren't new, but what is new are the stakes. Today we have more development and people living on our coast. We also now face an unpredictable climate change and sea level rise which could further compound coastal flooding.

Wisemiller is the project manager on what could possibly be one of the largest U.S. Army Corps of Engineers studies ever undertaken that will look at ways to safeguard communities in the New York and New Jersey Metropolitan region from future hurricanes. The study, entitled the "New York/New Jersey Harbor & Tributaries Focus Area Feasibility Study", is an offshoot of a comprehensive study performed by the Army Corps right after Hurricane Sandy, which identified risks and vulnerabilities along the North Atlantic Coast from Maine to Virginia.

The Army Corps will work with many agencies from New York and New Jersey on this study, including the New York State Department of Environmental Conservation, New Jersey Department of Environmental Protection and the New York City Office of Recovery and Resiliency. This multi-agency team will work with communities to recommend a combination of risk reduction measures to enable adaptation to an unpredictable future. Those on the team express that an adaptable mindset will also be required.

"The geographic scale of this study is vast," said Olivia Cackler, Coastal Section Chief, U.S. Army Corps of Engineers, New York District and Lead Planner for the study. "Typically, our studies focus on a municipality or a watershed; this one encompasses many watersheds and 900 miles of coastline in New York and New Jersey, with the New York and New Jersey Harbor as the focal point."

This will include communities in New York, including the South Shore of Staten Island, Jamaica Bay, Rockaway Peninsula and Western Long Island Sound. Communities in New Jersey will include the Raritan to Sandy Hook shoreline, Arthur Kill, Kill Van Kull, Newark Bay, and the Passaic and Hackensack Rivers. In the harbor area, the study will include the Upper Bay of New York Harbor, the Hudson River, the East River and the Harlem River. More communities may be added as the study progresses.

A full range of risk reduction measures are going to be offered to communities and include structural, nonstructural, and natural and nature-based features.

Cackler said that structural measures are designed to reduce the frequency and intensity of flooding. These measures can include putting up a floodwall, levee, beach fill, dune, or an offshore barrier.

Nonstructural measures focus on reducing the amount of damages without addressing the flooding. This can include such things as elevating or buying out a house, wet or dry flood proofing, evacuations, and zoning changes. Natural and nature-based features try to reproduce natural defense mechanisms. This can include creating marsh islands and wetlands, aquatic restoration and placing sand on beaches.

Communities can assess these measures and alternatives and make decisions based on what they value. Vietri said, "You have communities that value natural and nature-based features a lot more than structural alternatives. They can increase what they see as important and downplay what they value less. To say that everything should be the same is totally not correct."

Cackler agreed that a one-size-fits-all approach doesn't work. "We have a very diverse study area in terms of topography and land use. Using a combination of risk management measures allows us to tailor our approach by using the most appropriate measures for that community."

By having a wide range of alternatives, communities can also compare various levels of protection. Vietri said, "We want them to compare doing a breakwater verses a wetland. Both do two different things. Yet both working together provide even something much more. We want them to not just engage and review the alternatives in the study, but to help advise the Army Corps, and to me this is a pretty significant change in how we resolve these sorts of problems."

Before communities weigh in on what blend of measures they want, the U.S. Army Corps of Engineers performs a cost-benefit ratio. Wisemiller said this ratio must show that the benefits of the project outweigh the costs. The plan with the most net economic and environmental benefits to the nation becomes apparent through this process.

How communities decide may bring tradeoffs. "There are benefits and risks with all combinations of coastal risk management measures," said Wisemiller. "The study will look to evaluate and weigh the different approaches with the full involvement and input from the regional stakeholders and the public."

This study will also factor in possible climate change and sea level rise over the next 50 years.

By having a wide range of alternatives, communities can also compare various levels of protection. Joseph Vietri, who headed the comprehensive study, said, "We want them to compare doing a breakwater verses a wetland. Both do two different things. Yet both working together provide even something much more. We want them to not just engage and review the alternatives in the study, but to help advise the Army Corps, and to me this is a pretty significant change in how we resolve these sortsof problems." Vietri is the Director of Coastal Storm Risk Management National Center of Expertise, North Atlantic Division, U.S. Army Corps of Engineers.

Cackler said, "How we deal with planning uncertainty is with Resilient Adaptation." This allows us to adapt to the changing conditions as we see them in real time.

She continued, "There are three sea level rise scenarios that we have to consider when we look at our risk reduction measures.

"For example, let's say we assume that there is going to be low or moderate rate of sea level rise and we design a seawall to hold up to this. Years go by and we actually see a high rate of sea level rise. If we keep in mind Resilient Adaptation, we can construct the seawall with a larger base so that it would be possible to add to its height

Storm surge in Sheepshead Bay, Brooklyn, N.Y. during Hurricane Sandy.
JoAnne Castagna, Public Affairs

instead of having to build a new, larger seawall."

Vietri believes that for the study to be successful, everyone has the responsibility to look at these changing conditions and to make better decisions. He said that this requires an adaptive mindset and he is happy to say that he is seeing it. For example, he is seeing more agencies get tougher on developers who want to build in flood zones. "I haven't seen this in my 30-year career with the Army Corps," said Vietri.

Wisemiller said that the team will strive to complete the study as quickly as possible, without undercutting the quality or level of rigor in the analysis. He said that studies typically take about three years, but that this study will need more time. The study is expected to result in a report of implementable solutions that will be presented to the U.S. Congress. Moreover, Wisemiller said they are seeking public participation throughout the entire study.

"The goal at the end of the day is not to have a controversial report that doesn't lead to anything productive and useful," he said. "We want something that not only informs the region of the risk that exists now and will exist further into the future, but also to provide solutions that we can implement with them."

Information about the "New York/New Jersey Harbor & Tributaries Focus Area Feasibility Study" and upcoming community meetings about the study may be obtained by emailing *cenan-pa@usace.army.mil.*

JoAnne Castagna, Ed.D. is a Public Affairs Specialist/Writer at the U.S. Army Corps of Engineers, New York District. She can be reached at joanne.castagna@usace.army.mil.

Resources

To advertise or to become a member, contact Rebecca Martin at 315-422-7811 ext. 5 or e-mail her at rebecca@nywea.org.

Visit www.nywea.org for information or see us on Facebook.

Operator Quiz Test No. 116 – Definitions

The following questions* are designed for trainees 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 section of wastewater treatment. Good luck!

1. A term used to describe the difference between the actual value and the set point is known as:
   a. Drift
   b. Broke
   c. Sway
   d. Process variable

2. A physical or chemical quantity that is usually measured and controlled in the operation of a treatment plant is called a:
   a. Process statistic
   b. Process variable
   c. Process limit
   d. Process condition

3. To remove a gas or vapor from a vessel or confined space via displacement or dilution:
   a. Vent
   b. Seal
   c. Aerate
   d. Purge

4. A straight pin that will break when a certain load or stress is exceeded is called a:
   a. Shear pin
   b. Break pin
   c. Fail pin
   d. Wooded pin

5. The continuously variable signal type sent to an analog instrument, 4-20 mA for example, is called:
   a. Digital signal
   b. Analog signal
   c. Variable signal
   d. Steady signal

6. The amount of heat required to raise the temperature of one gram of water one degree Celsius is:
   a. Carb
   b. Calorie
   c. Thermodynamic
   d. Heat transfer

7. A chemical that causes very fine particles to clump together into larger particles is known as a:
   a. Settling agent
   b. Emulsifier
   c. Coagulant
   d. Colloid

8. The spiral-shaped casing that surrounds a pump, blower or turbine impeller and collects the liquid or gas discharged by the impeller is called the:
   a. Conical housing
   b. Snail shell
   c. Volute
   d. Solenoid

9. A digester sampling well that allows sampling of the digester contents without venting digester gas is called a:
   a. Sludge tube
   b. Thief hole
   c. Flame arrestor
   d. Manometer

10. A flat board or plate placed in flowing water to cause more uniform flow velocities is called a:
    a. Baffle
    b. Weir
    c. Wall
    d. Sluice gate

11. A publication of the U.S. government that contains all of the proposed and finalized federal regulations, including safety and environmental regulations is:
    a. EPA
    b. NPR
    c. CFR
    d. DEC

*Questions compiled using Operation of Wastewater Treatment Plants Vol II 7th ed. 2007

Answers on page 62.

For those who have questions concerning operator certification requirements and scheduling, please contact Tanya May Jennings at 315-422-7811 ext. 4, tmj@nywea.org, or visit www.nywea.org/OpCert.

Job Openings

Water/Wastewater Project Engineer – Albany, N.Y.

For more than 50 years Barton & Loguidice, D.P.C. has served the engineering needs of municipal, industrial and institutional clients across the northeast. We are a multi-disciplined firm of professional engineers, environmental scientists, planners and landscape architects with offices in Syracuse, Albany, Rochester, Newburgh, and Watertown, N.Y., Camp Hill, PA and Lanham, MD. B&L specializes in transportation engineering, water supply, wastewater management, solid waste management, land planning and site design, and environmental and facilities engineering. We are looking for bright, motivated candidates to join one of the leading consulting engineering firms in the northeast.

We are currently seeking a full-time Project Water/Wastewater Engineer to join our Albany, N.Y. office.

Duties primarily include engineering related to potable water supply systems and wastewater management systems, as well as some general civil engineering, such as study preparation, design calculations, production of specifications and design drawings, and verification of construction projects for compliance with plans and specifications.

Technical duties include project management and oversight of:

- Design all aspects of water and sewer piping systems and pump stations for both new and rehabilitation projects.
- Develop contract drawings, specifications, and estimates for treatment facilities including both water and wastewater treatment plants.
- Design and detailing of municipal water supply and wastewater management facilities.
- Preparation of engineering design reports.
- Preparation of plans, specifications, and estimates.

Candidates should have a B.S. in Civil/Environmental Engineering with 5-7 year's experience in the analysis and design of municipal water treatment and distribution systems, and municipal wastewater collection and treatment systems, or an equivalent combination of education and experience. Registration as a Professional Engineer (P.E.) in N.Y. is required and experience in the consulting engineering field is desired.

Candidates should be proficient in technical writing, possess solid marketing and communication skills, be able to interact effectively with staff and clients, and have experience in the preparation and presentation of proposals. Candidates will be responsible for managing and/or providing technical assistance to continually advance projects within scope, budget and schedule for all phases of water and wastewater projects.

Compensation is commensurate with qualifications and experience. We offer a generous benefits package, including 3 weeks of vacation, low-cost individual health insurance, and a 401(k) plan with employer match.

Please visit our website, **bartonandloguidice.com/careers.htm** to apply to the "Civil/Water/Wastewater" Engineer position in Albany, N.Y.

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Conveyance Engineer – New York, N.Y.

Candidates must possess 5 to 10 years of experience in the planning and design of water, wastewater, and stormwater pipelines.

Required Experience

The desired candidate will have experience in the following:

- Design of new pipelines and pipeline rehabilitation
  - o Preparation of pipe sizing calculations for conveyance systems
  - o Preparation of drainage area maps
  - o Surface runoff coefficients, invert, slope, velocity and hydraulic grade line evaluation
- Pipeline condition assessment and prioritization
- Sewer system evaluation surveys
- Familiarity with street design and reconstruction requirements
- Utility coordination – determination and resolution of vertical and horizontal utility conflicts
- Technical expertise in the layout and profiles of pipeline design in AutoCAD Civil 3D 2015
- Site survey requirements
- Knowledge of subsurface and geotechnical engineering requirements
- Development and review of technical reports, proposals, contract documents, resources studies, computer modeling and data analysis
- Preparation of contract specifications and drawings
- Office and field engineering support during construction

Position Requirements

- Bachelor's degree in Civil Engineering
- PE required with ability to obtain registration in New York State
- Possess strong verbal communication and technical writing skills
- Effectively and proactively coordinate with various disciplines (Stormwater, Civil, etc.)

Contact: Eileen Feldman at efeldman@hazenandsawyer.com

Project Engineer (Water/Wastewater)

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation.

Privately owned by our people, GHD provides engineering, architecture, environmental and construction services to private and public sector clients across five continents. Focused on creating lasting community benefit, our connected global network of 8,500 people delivers projects with high standards of safety, quality and ethics. Committed to sustainable development, GHD improves the physical, natural and social environments of the many communities in which we operate.

Our office in Cazenovia, New York is seeking a motivated Project Engineer to join the Water and Infrastructure group. As a Project Engineer, you will primarily be responsible for engineering evaluation, design, and construction of water treatment and infrastructure projects for clients throughout New York State and the Northeast. You will be exposed to a range of interesting projects and opportunities in the water business.

Additional responsibilities will include:

- Develop designs of water facilities and infrastructure
- Prepare technical specifications
- Perform hydraulic/hydrologic computations and cost estimates
- Assist with permit application preparation
- Represent the firm in client meetings
- Market the services of the firm to potential and existing clients, including networking with peers and colleagues
- Identify, prepare and participate in presenting proposals to prospective clients
- Provide ongoing consulting services to established clients
- Travel as required to project sites and meetings

The successful candidate will possess the following skills and qualifications:

- Bachelor's degree in Civil or Environmental Engineering (Master's preferred)
- Current PE License in the State of New York, or the ability to obtain it
- 4–8 years of experience in the area of water design and construction
- Prior consulting experience working with municipal clients
- Working knowledge of AutoCAD
- Must be a team player
- Strong interpersonal and communication skills
- Willing and able to travel as needed

GHD is a large, well established organization with a culture that promotes teamwork, integrity and respect. As a valued member of the business, you will have the opportunity to work with industry leaders and to develop your career through the GHD Business School.

As a multicultural organization, we encourage individual achievement and recognize the strength of a diverse workforce. GHD is an equal opportunity employer. We provide equal employment opportunities to all qualified employees and applicants without regard to race, creed, religion, national origin, citizenship, color, sex, sexual orientation, gender identity, age, disability, marital status or veteran status.

If you are interested in pursuing this position, please submit your cover letter and resume via GHD's careers website: **https://ghd.taleo.net/careersection/jobdetail.ftl?job=CAZ00187&lang=en**

This position does not provide visa sponsorship.

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Civil Engineers: to plan, design, direct, oversee and execute civil engineering projects in our water/wastewater and site groups.

Team Leader/Project Manager: Candidate will be responsible for client and project development, client interaction, and client meetings. Licensure is required with a minimum of 10 years of experience.

MRB Group provides a comprehensive range of professional services to municipal, commercial, and not-for-profit clients in the following fields: civil, structural engineering; architecture; site development; GIS and mapping services; and municipal consulting. We have offices in Rochester, Syracuse, Seneca Falls, and Elmira, New York and Austin, Texas.

Visit our website (www.mrbgroup.com) for additional information. Resumes can be sent directly to: resume@mrbgroup.com or mailed to: MRB Group, The Culver Road Armory, 145 Culver Road, Suite 160, Rochester, NY 14620.

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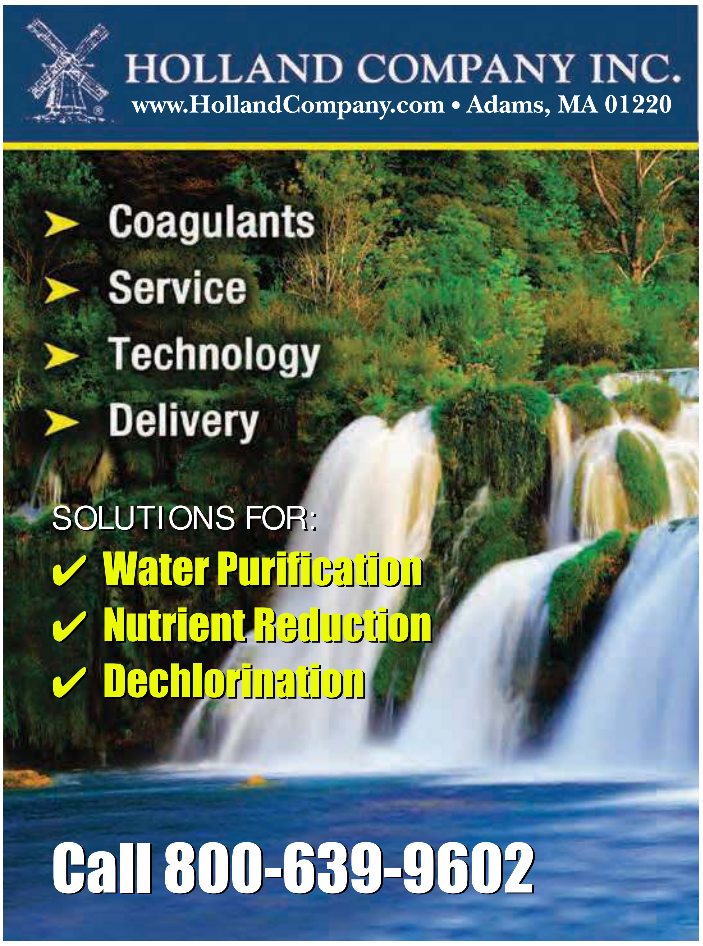

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Answers from page 59: 1 A, 2 B, 3 D, 4 A, 5 B, 6 B, 7 C, 8 C, 9 B, 10 A, 11 C