Onsite Wastewater
Promoting Health & Protecting Our Resources
2022 MEGA-CONFERENCE

NOWRA NAWT ISORA Missouri Smallflows Organization

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MONDAY, OCTOBER 31, 2022
1:30 PM | NUTRIENT REMOVAL TRACK

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FOSTERING THE ACCEPTANCE, USE, AND MANAGEMENT OF NUTRIENT-REMOVING SEPTIC SYSTEMS IN NEW YORK

Coastal Wastewater Solutions, LLC
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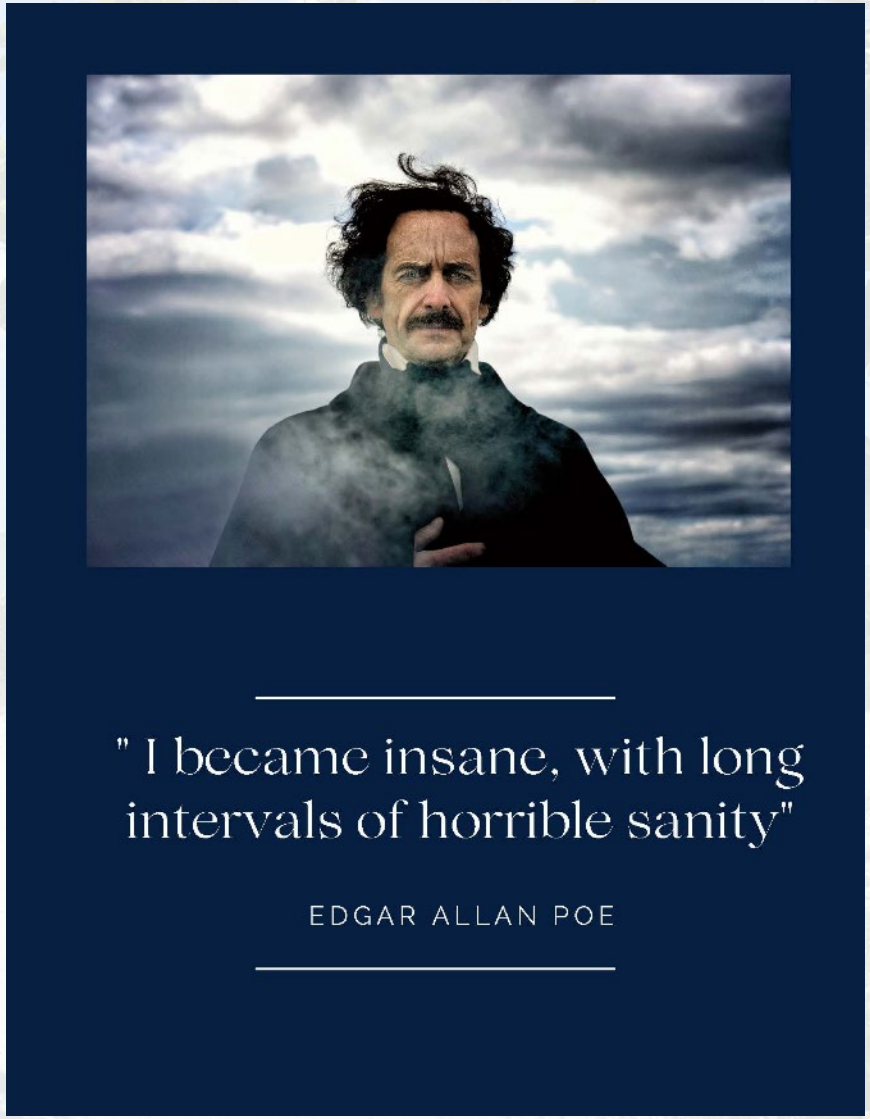
DISCLAIMER:

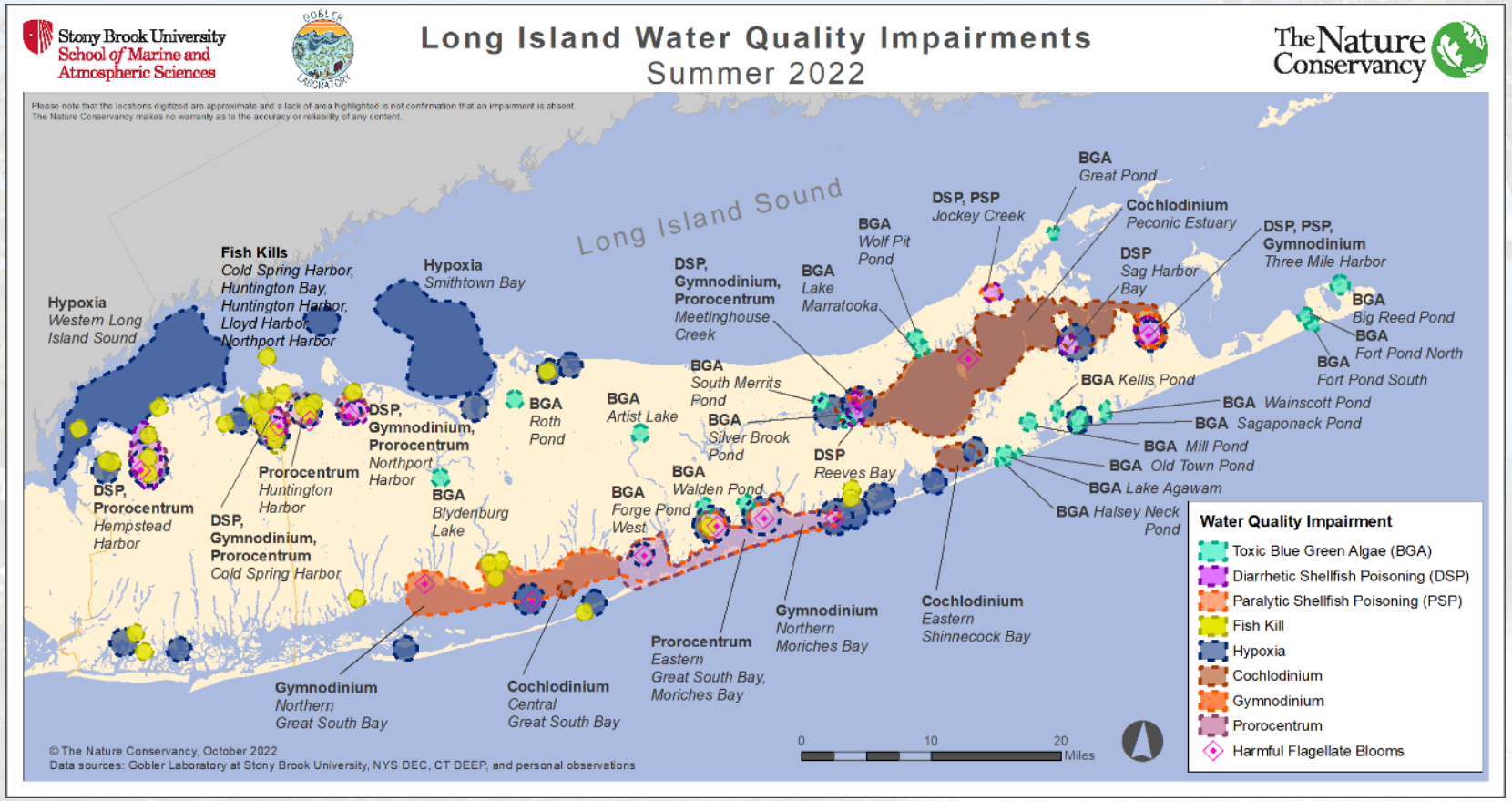
THE OPINIONS REPRESENTED IN THIS PRESENTATION BELONG SOLEY TO THE AUTHOR AND HIS DOGS & DO NOT REFLECT THE OPINIONS OF NOWRA, OR ANY OTHER COMPANY OR ORGANIZATION

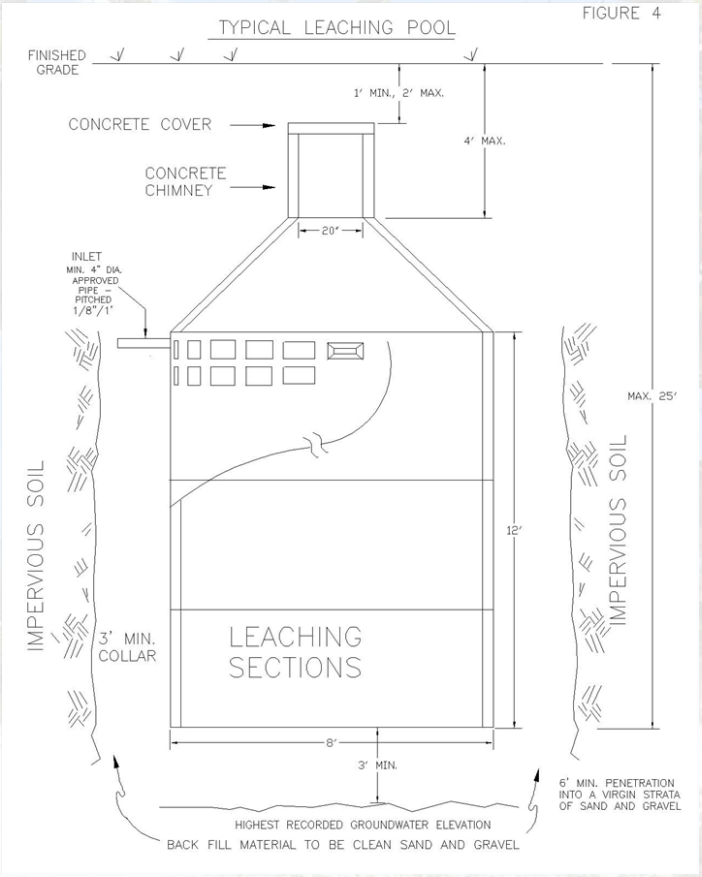
Agenda

1. Nitrogen Reduction on Long Island & the Blueprint for Evolution to Nutrient-Reducing Septic Systems
    - 5-Pronged Approach based on lessons from other states
    - Successes, Struggles, and Lessons Learned
    - Replicating and Applying model to other jurisdictions
2. Phosphorus-Removing Septic Systems in Cayuga County, NY
3. The Science behind a dual nutrient management approach
4. Fostering the Evolution to Nitrogen and Phosphorus Removing Septic Systems in Cayuga County, NY
5. Next Steps
6. Questions



The Need for Clean-Water Septic Systems on Long Island





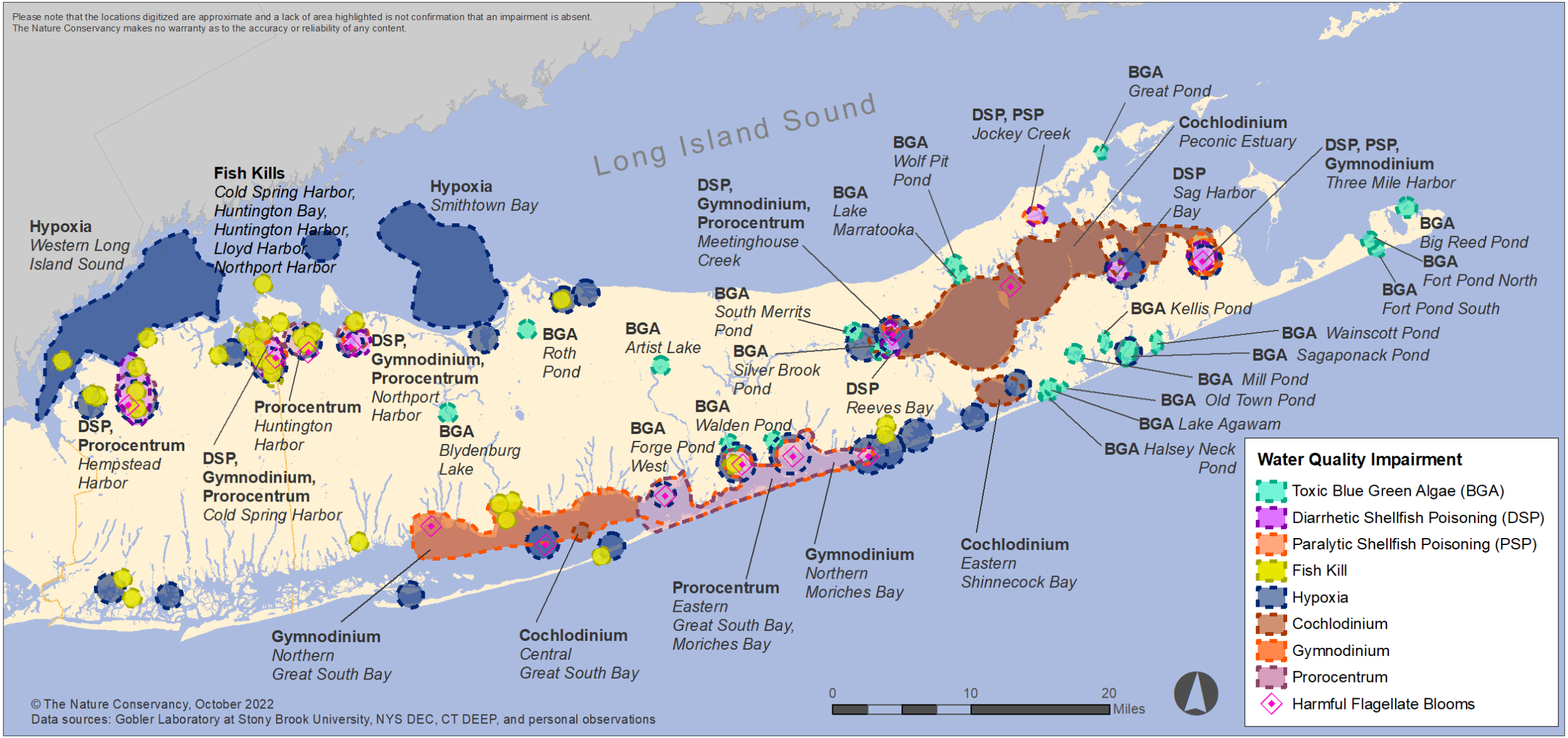
- **Over 425,000 On-Site Systems on LI, Hundreds of thousands of cesspools**
- **74% of Suffolk County is unsewered, 90 % of Nassau's North Shore is Unsewered**
- **HAB's, Shellfishing Impacts, Coastal Resiliency, Public Bathing Beaches**

Stony Brook University
School of Marine and Atmospheric Sciences

GOBLER LABORATORY

Long Island Water Quality Impairments
Summer 2022

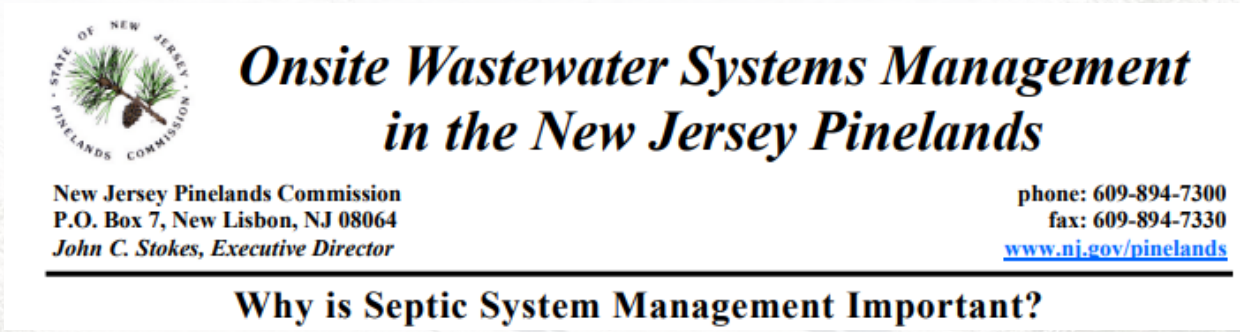
The Nature Conservancy



The Evolution to the use of Nitrogen Reduction Systems in Suffolk County

A Multi-Jurisdiction Tour Set in Motion an Accelerated 5-Pronged Approach to a Clean-Water Septic System Evolution on LI

MASSTC
The Massachusetts Alternative Septic System Test Center



The Evolution to the use of Clean-Water Septic Systems on Long Island

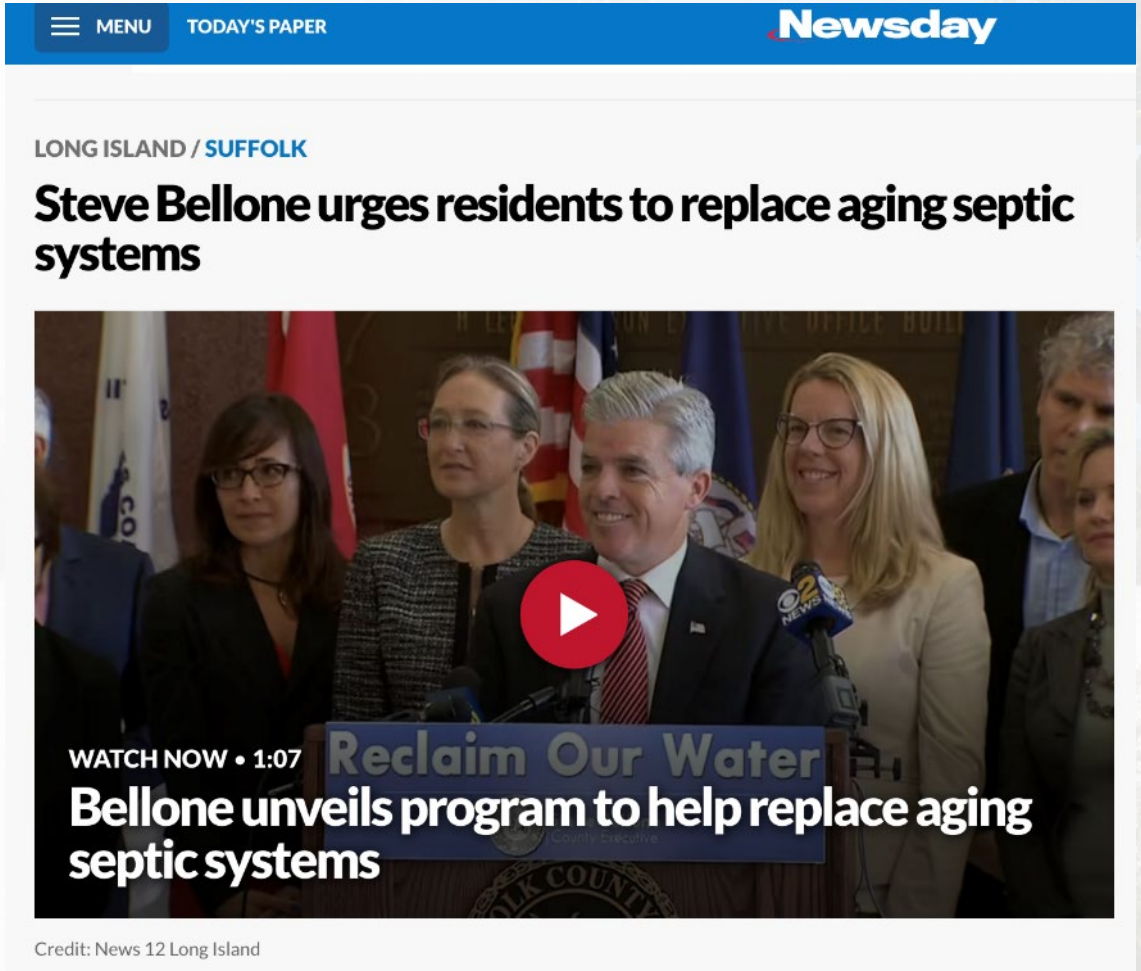
A Multi-Jurisdiction Tour Set in Motion an Accelerated 5-Pronged Approach to a Clean-Water Septic System Evolution on LI

1. Develop Capacity to Evaluate, Approve, Permit, and Regulate Technologies
2. Train, Inform, and Prepare the Industry and Public on Nutrient Reducing Technologies
3. Update Outdated Regulations (Code, Ordinances, Guidance Documents and Memos)
4. Study and Identify Priority Areas for Advanced Treatment
5. Public Funding to Incentivize Large Number of Installation & Eventually the Development of Long-Term Funding Sources

Approximately
$60 million
invested in IA grants on Long Island Since 2017

SUFFOLK COUNTY'S SUCCESS

- Leadership from the top down with significant State, County, and Town investments
- Accelerated program development
- Reignited IA innovation in the US
- Bipartisan Legislative Support
- Excellent public education and outreach
- Most stringent technical evaluation and approval process
- Meets the NY's definition of RME
- Fantastic online permitting program
- Clear delineation of subwatersheds and nitrogen load reduction goals
- Training and industry support
- Robust grant program
- Thousands of systems installed



SUFFOLK COUNTY'S STRUGGLES & LESSONS LEARNED

- Expensive to develop and implements (benefited from generous state funding)
- Difficult to reproduce without state funding
- High staff demand
- Minor short-term stumbles from moving too quickly
- Still allow the deep leaching structures that were partially responsible for creating the nitrogen pollution issues
- **Lack of focus of soil-based treatment, focus on dispersal through sand and gravel**
- **Establishing a reoccurring revenue stream may be difficult in today's climate**
- Can be replicated but other counties don't have the resources Suffolk county has which creates the need to adapt and learn from the Suffolk program and streamline the process and scope for other NY counties

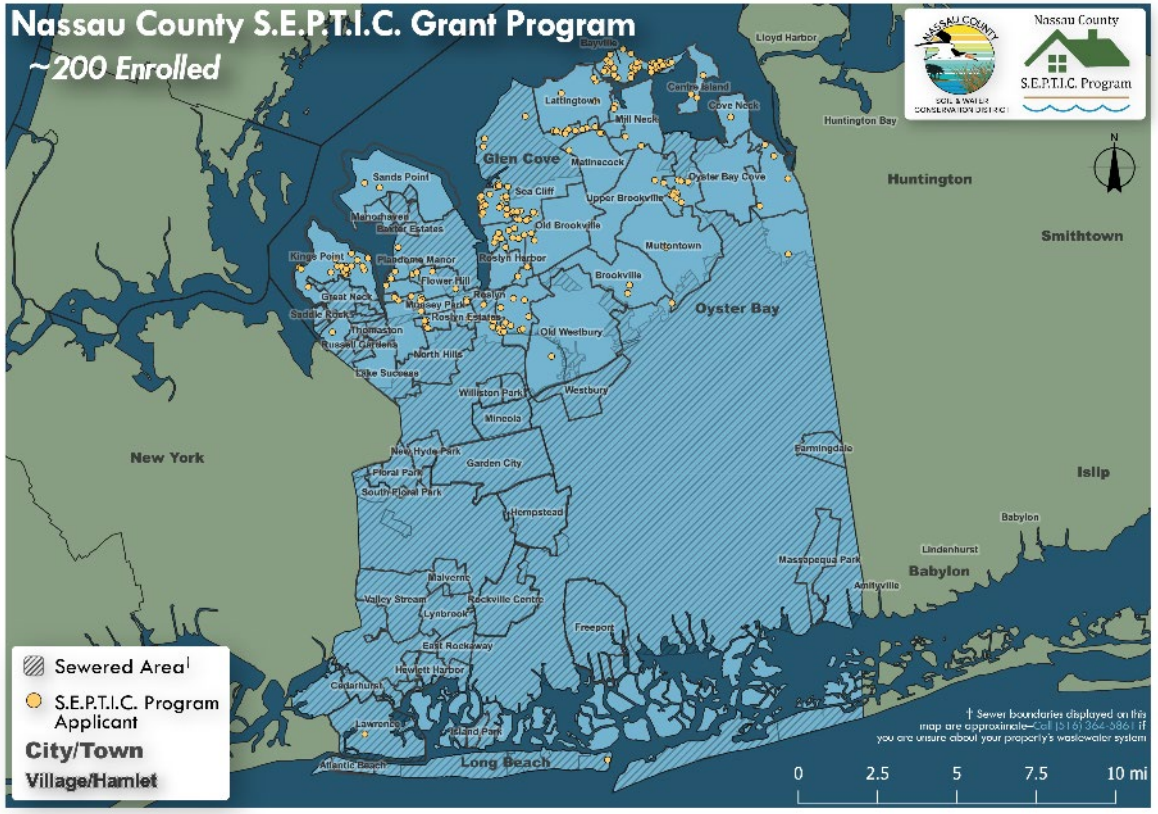
Replicating Suffolk County's Success in neighboring Nassau County, NY

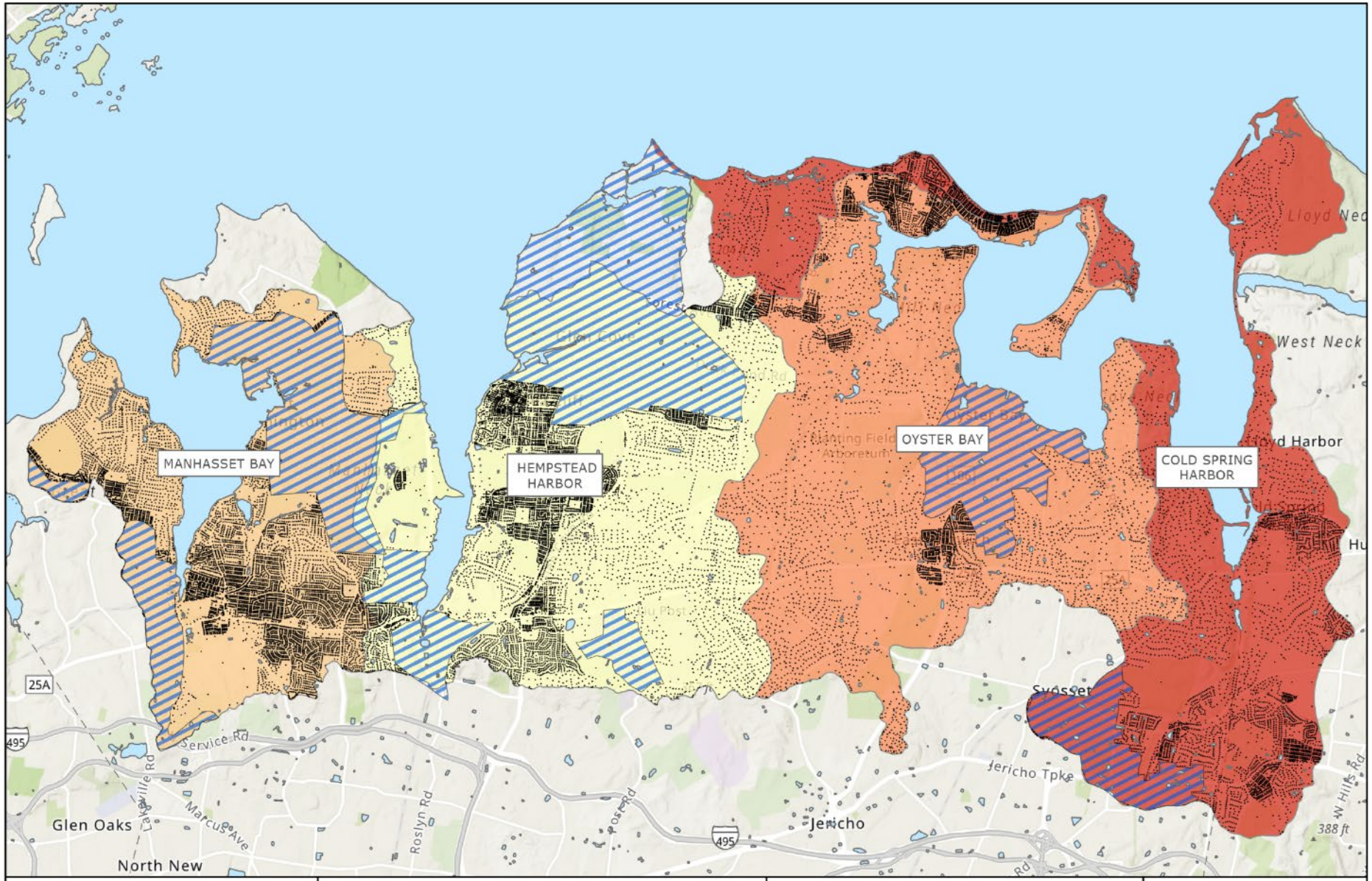
https://www.nassaucountyny.gov/SepticReplace

Nassau's S.E.P.T.I.C. Program – Refining the Approach

Program Differences:

- 90% of County is Sewered
- 10% unsewered = 90% of north shore communities
- Less funding than Suffolk
- Limited program administration capabilities at County level
- For the most part, the regulatory jurisdiction falls to the ~40 individual towns and villages





NORTH SHORE OF LONG ISLAND WATERSHED NITROGEN-REDUCTION TARGETS

LEGEND:

- APPROXIMATE SEPTIC TANK LOCATION
- SEWAGE SERVICE AREA WITHIN WATERSHED BOUNDARY

WATERSHED BOUNDARY AND % NITROGEN REDUCTION TARGET

- 19.5% HEMPSTEAD HARBOR
- 42.2% MANHASSET BAY
- 48.7% OYSTER BAY
- 63.3% COLD SPRING HARBOR

N

0 0.5 1 2 3

MILES

Data Sources:
Nassau County GIS
Nitrogen Loading Modeling for Nassau County Watersheds prepared by Stony Brook University, School of Marine and Atmospheric Sciences (2020)
National Hydrography Dataset

NORTH SHORE LAND ALLIANCE

Nassau's S.E.P.T.I.C. Program – Refining the Approach

Applying Lessons Learned:

- Scale Suffolk's overall IA Acceptance, Use, and Management approach to Nassau
- Identify additional funding sources
- Simplify Application and Grant Agreement Process
- Pay contractor directly and be up-front about potential taxability of grants

Nassau's S.E.P.T.I.C. Program – Refining the Approach

Program Modifications Specific to Nassau:

- Identify partnership for program administration
- Provide Consultation and Guidance to 40+ Individual Town's and Villages (permitting authority)
  - *Guidance Memo #1 – Program Rules for Administration of IA Grant Program*
  - *Guidance Memo #2 – Guidelines for the Acceptance, Use and Management of IA OWTS in Nassau County*
  - *Guidance Memo #3 – Guidance for relaxing NYS 75-A Setbacks in Certain Instances when Utilizing IA OWTS Tech.*
  - *Recommended Minimum Guidelines Relating to Location, Design, and Construction of Innovative and Alternative Onsite Wastewater Treatment Systems (I/A OWTS) in Nassau County, NY (Nassau County / Soil and Water Conservation District)*
  - *IA OWTS Installation Certification Packet (Nassau County Soil and Water Conservation District)*

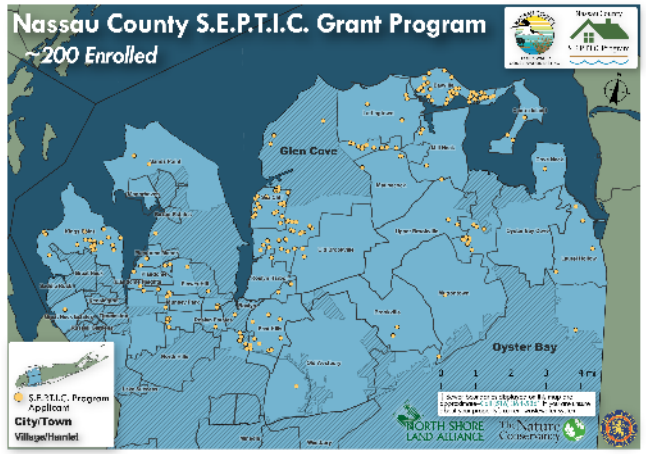
Nassau's S.E.P.T.I.C. Program – Refining the Approach

A Multi-Jurisdiction Tour Set in Motion an Accelerated 5-Pronged Approach to a Clean-Water Septic System Evolution on LI

Green = Completed Blue = Underway

- ✓Develop Capacity to Evaluate, Approve, Permit, and Regulate Technologies
- ❑Train, Inform, and Prepare the Industry and Public on Nutrient Reducing Technologies
- ❑Update Outdated Regulations (Code, Ordinances, Guidance Documents and Memos)
- ✓Study and Identify Priority Areas for Advanced Treatment
- ✓Public Funding to Incentivize Large Number of Installation & Eventually the Development of Long-Term Funding Sources

SUCCESS!



'Our system is better than we could have hoped, and we have peace of mind knowing we are doing our part in keeping Bayville's water clean'

** Photo Courtesy of NYS DEC*

Fostering the Use of Nutrient Removing Septic Systems in Cayuga County, NY

Owasco Lake Overview

- Owasco Lake, located in Cayuga County is one of the New York Finger Lakes and encompasses an area of approximately 6,660 acres. The lake serves as the primary source of drinking water for the City of Auburn and the Town of Owasco. The lake is also a popular spot for fishing and recreational activities.
- As outlined in the Owasco Lake Watershed Management and Waterfront Revitalization Plan, Owasco Lake has a large watershed of 205 square miles and spans 11 towns and one village in Cayuga County, one town in Onondaga County, and three towns and one village in Tompkins County.

Owasco Lake – Water Quality Concerns

- Owasco Lake is on the NYS impaired waterbodies list due to high bacteria counts along the north shore and a recent surge of blue-green algae blooms (cyanobacteria)
- fueled by non-point source nutrient pollution from runoff, wildlife, agriculture, and lakefront septic systems.
- Historically the algal blooms have been limited to nearshore areas. However, In 2020, although the overall phosphorus loading seemingly decreased, data has shown an increase of cyanobacteria in open water (Halfman, Water Quality Status of Owasco Lake, 2020).
- The increase of cyanobacteria could be associated with more intense rain events and warmer water temperatures, and nitrogen loading.

Cayuga County's 9E Plan

- The Watershed Management and Waterfront Revitalization Plan is currently undergoing an update process to incorporate the Environmental Protection Agency's (EPA's) Nine Key Elements for a successful Watershed Protection Plan, aka 9E Plan
- designed to assess loading and address water quality from nonpoint sources.
- The County is examining phosphorus reduction from septic systems as a cumulative approach to addressing nutrient pollution consistent with their 9E Plan.

Cayuga County's 9E Plan Recommendations

RECOMMENDATIONS: Wastewater infrastructure

- Encourage adoption of the updated **Watershed Rules and Regulations**
- Encourage residents to utilize the NYS septic system replacement program
- Maintain and inspect on-site wastewater disposal systems
- Encourage Tompkins & Onondaga Counties to adopt a septic inspection program
- Continued investment in wastewater collection & treatment
- Investigate cluster systems in developed areas
- Monitor and assess effectiveness (adaptive management)
- *Provide financial & technical support to enable these recommendations*

NEW YORK STATE OF OPPORTUNITY. | Department of Environmental Conservation | Department of Health | Agriculture and Markets

HARMFUL ALGAL BLOOM ACTION PLAN OWASCO LAKE

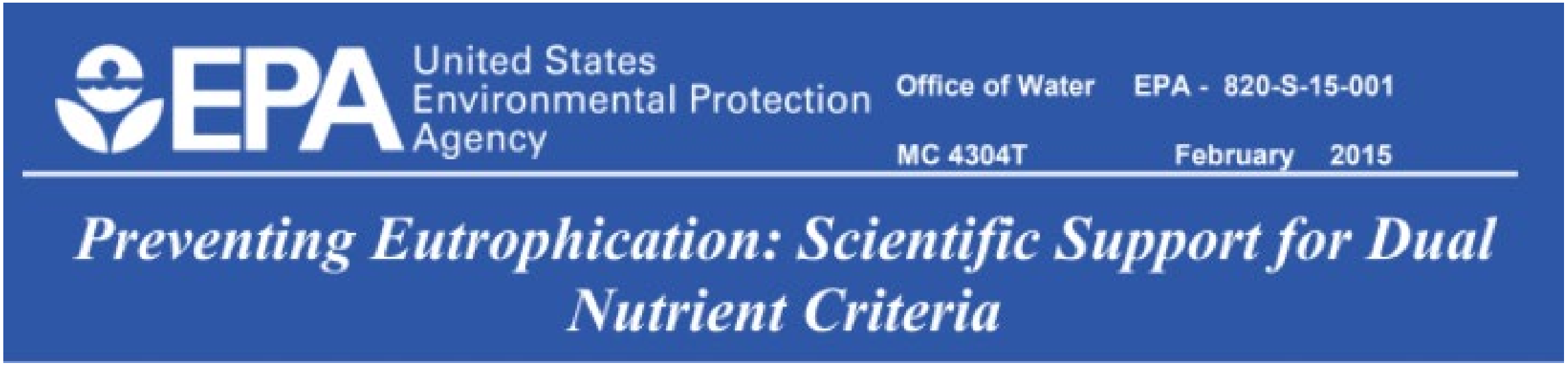
North end Owasco Lake algae bloom (*Source:* Owasco Watershed Lake Association)

Coastal Wastewater Solutions, LLC was contracted to:

- provide a review of the current state of phosphorus removal and loading associated with septic systems.
- provide recommendations for the development of a phosphorus-reducing clean-water septic system demonstration program, consistent with Cayuga County's 9E Plan.
- examine the feasibility and assist in the development and implementation of a Clean-Water Septic System Demonstration Program.
- recommend responsible management resources that could assist the county in the management of septic systems for nutrient reduction
- Assist with public education and outreach

Phosphorus in Onsite Wastewater

- The amount of phosphorus leaving a conventional septic tank tends to range from 9 – 16 mg/l.
- Currently, phosphorus-treating septic systems are expected to reach phosphorus concentrations of 1 mg/L or less. This represents the removal of approximately 90 % of phosphorus from the waste stream.
- Soils low in aluminum and iron oxides typically remove only a small fraction of the P introduced from onsite wastewater.
- The calcium content of sand is the best predictor of P removal. However, in order for calcium to remove P the domestic wastewater needs to be fairly alkaline.
- Soils high in clay and silt content have been shown to remove 90% of phosphorus at a depth of 100 cm
- Following advanced treatment and maximizing travel time through the soil, through either time dosing or the following flow modulating, an advanced treatment septic system is the best way to ensure maximum N and P removal.



- Although phosphorus may be the limiting nutrient when it comes to the formation of blue-green algae blooms, recent studies have shown that cyanobacteria in some algal blooms are so rich in phosphorus that nitrate is fueling excessive toxicity and enhancing the life span of these blooms.
- This data is causing scientists to stress the necessity of managing nutrient loading from both nitrogen and phosphorus to significantly impaired fresh waterbodies plagued by frequent blue-green algae blooms.

Treatment Processes to Remove Phosphorus from Wastewater

- The state of phosphorus removal septic system technologies in the United States is in its infancy.
- The treatment process be broken down into two main categories: (1) Chemical Treatment; and (2) Enhanced Biological Phosphorus Removal (EBPR).
- Phosphorus removing Clean-Water Septic Systems either utilize one of these processes or a hybrid approach of the two

Pumper Magazine Article by Dr. Sara Heger is a great summary
Of science and state of industry

Chemical Treatment Methods - Precipitation

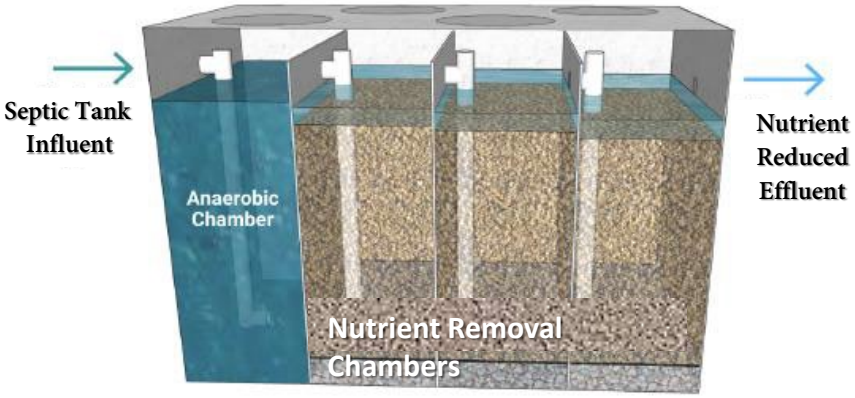
- Metal salts reacting with soluble phosphate and producing solid precipitate which then settles into the sludge either through chemical dosing and ion exchange processes.
- Ion exchange processes can be used to remove phosphorus by utilizing electrodes that release ferric ions that react with the phosphate ions in the wastewater.
- This process can be used following a nitrogen-removing septic system, making it a suitable hybrid process to treat for both nitrogen and phosphorus in septic systems.

Common Metal Salts Used:

- Aluminum Sulfate (alum)
- Sodium Aluminate
- Ferric Chloride
- Ferric Sulfate
- Ferrous Chloride

Chemical Treatment Methods - Adsorption

- Use of Adsorptive Media
- Soluble phosphate reacts with the iron or calcium in the filtration media.
- Current research indicates this could be an effective method to control total phosphorus (TP) below 1 mg/L.
- However, there are concerns regarding wastewater pH and unknown longevity of the media require further evaluation



Enhanced Biological Phosphorus Removal (EBPR)

- The EBPR process uses an activated sludge process (aerobic process) to facilitate the growth of phosphorus accumulating organisms (PAOs)
- PAOs reproduce under aerobic conditions, where they consume phosphates. Solids that accumulate in the aerobic chamber are recirculated back to the septic (anoxic) compartment where the PAOs can consume volatile fatty acids, creating energy and preparing the PAOs for another EBPR cycle.
- Concerns with EBPR in onsite septic systems:
  - nitrifying bacteria are more common and can often crowd PAOs as the prevailing bacteria.
  - PAOs are also more reliant on pH than nitrifying bacteria, making this process difficult to achieve in onsite septic systems.

Available and Promising Technologies

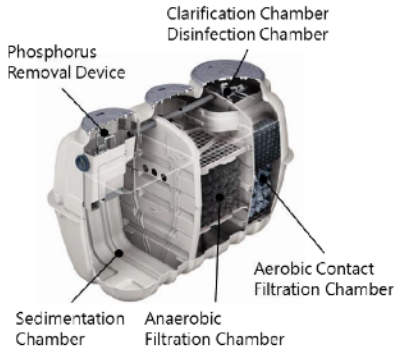


Fig. 1 Structure of CRX Ⅱ model

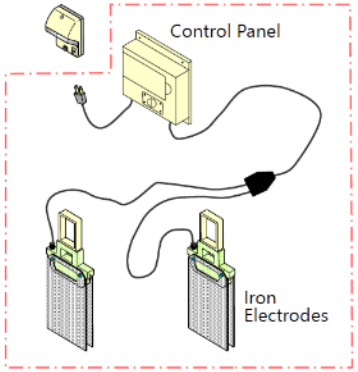


Fig. 2 Phosphorus removal device

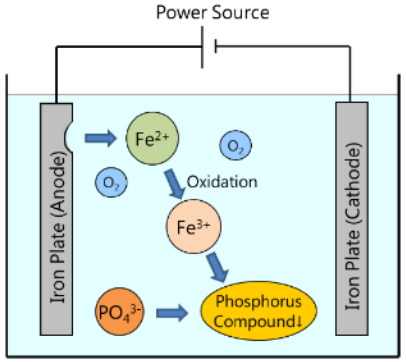
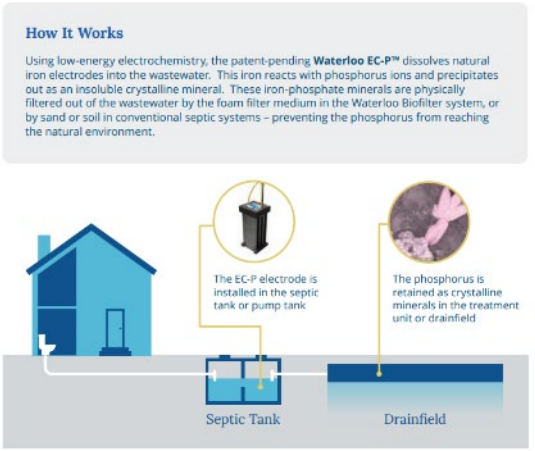


Fig. 3 Process of phosphorus removal

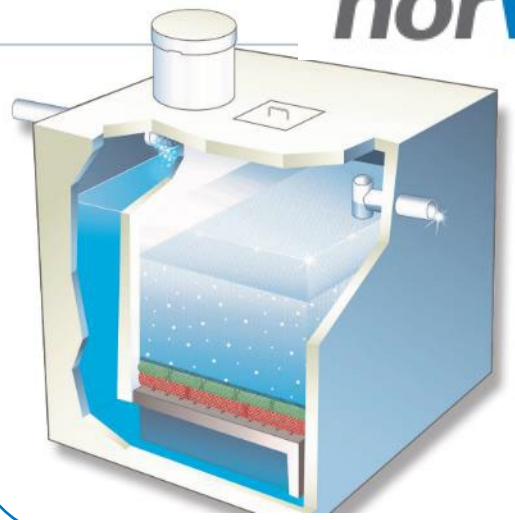
Waterloo EC-P

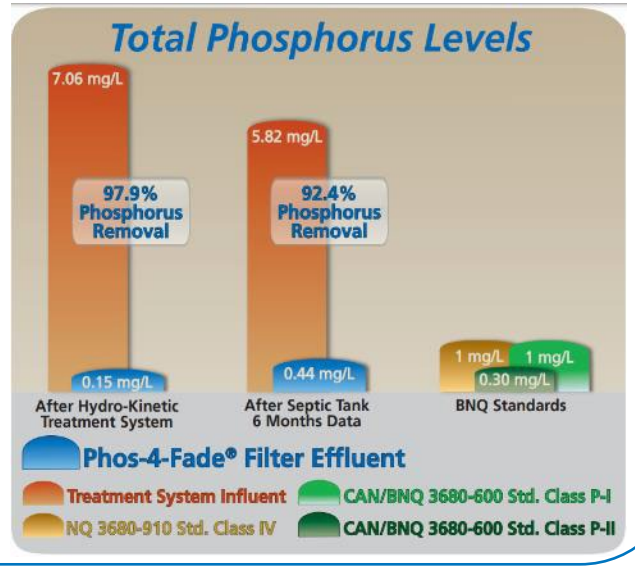


PhosRID™

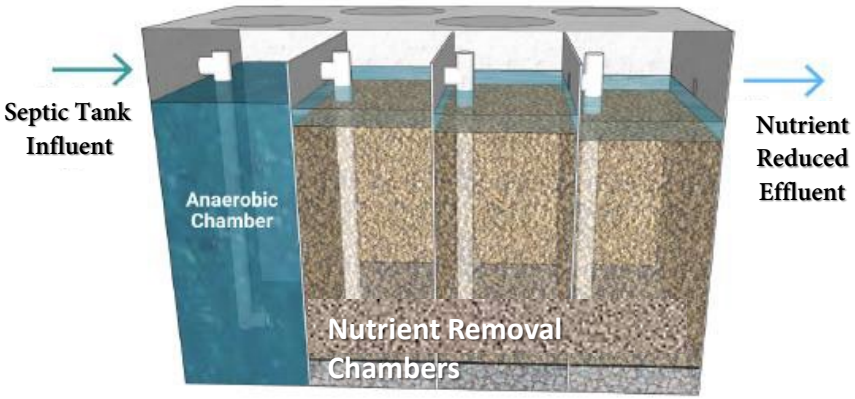
Date	Average Flow for Period (gpd)	Septic Tank Effluent TP (mg/l)	Sand Filter Effluent TP (mg/l)
6/22/2009	1,201	21.8	2.4
7/28/2009	1,701	18.0	1.44
8/26/2009	1,004	12.6	0.9
3/23/2010	2,062		1.98
7/20/2010	2,062	12.5	1.05
10/25/2011	2,062	21.9	2.85
Geometric Mean	*1,682*	**16.8**	**1.6**
Percent P Removal			**90.3%**

norweco®



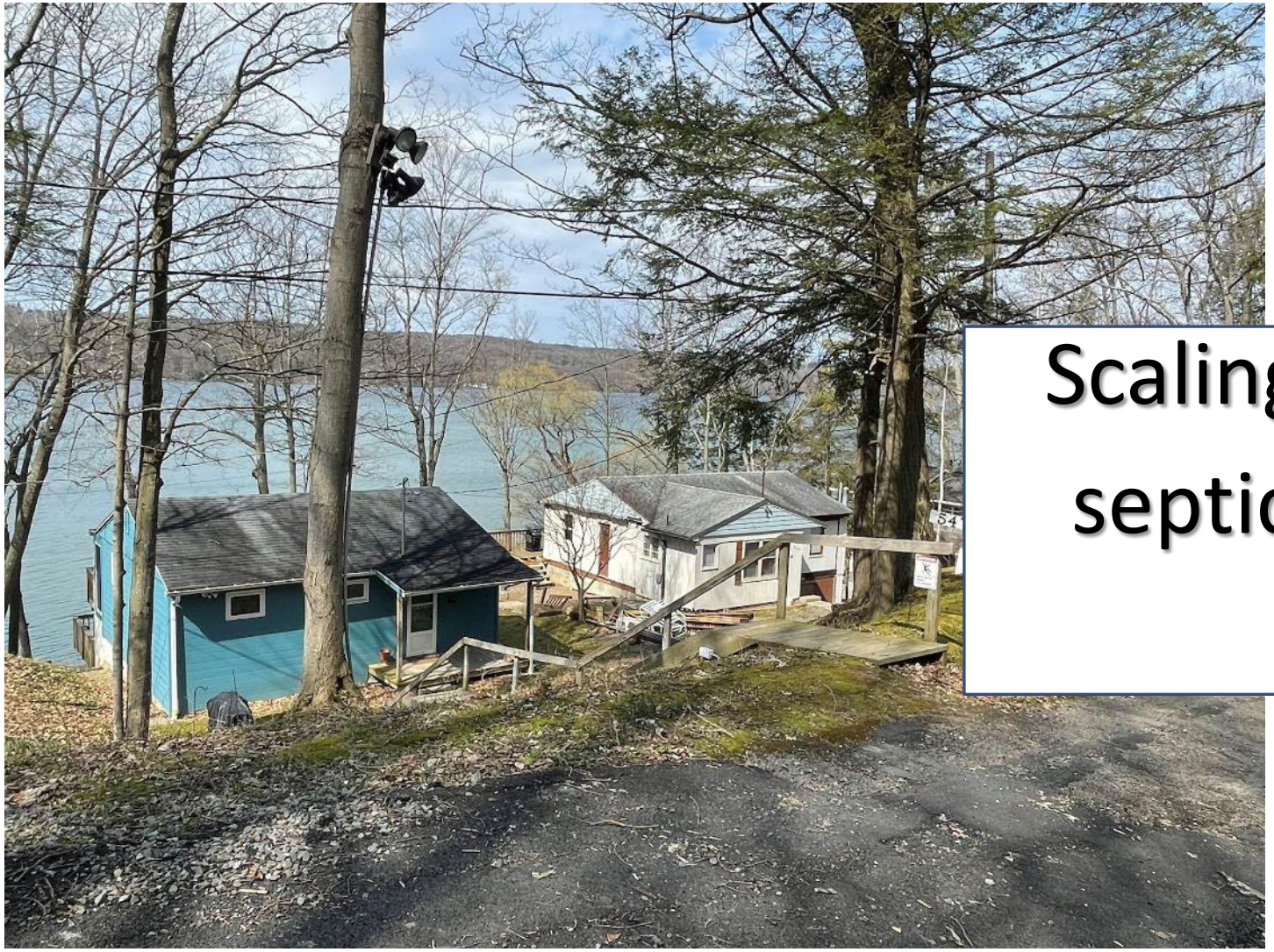


AET Tech's Simul-Clear Solution



Components of Each Technology

Technology	Blower or Aerator	Floats	Recirculation Pump	Control Panel	Media Needs to be replaced
Waterloo EC-P™ & Waterloo Bio-Filter	✗	✓	✓	✓	✗
FujiClean CRX-II	✓	✓	✗	✓	✗
Phos-4-Fade™ by Norweco	✗	✗	✗	✗	✓
Norweco Hydrokinetic NSF 245 System	✓	✓	✓	✓	✗
Simul-Clear Solution by AET Tech	✗	✗	✗	✗	✓
KNuRD Filter by Knight Treatment Systems	✗	✗	✗	✗	✓



Scaling a nutrient-removing septic program for Cayuga County

A Multi-Jurisdiction Tour Set in Motion an Accelerated 5-Pronged Approach for the Evolutions of Nutrient-Reducing Septic Systems

1. Develop Capacity to Evaluate, Approve, Permit, and Regulate Technologies
2. Train, Inform, and Prepare the Industry and Public on Nutrient Reducing Technologies
3. Update Outdated Regulations (Code, Ordinances, Guidance Documents and Memos)
4. Study and Identify Priority Areas for Advanced Treatment
5. Public Funding to Incentivize Large Number of Installation & Eventually the Development of Long-Term Funding Sources

Progress to-date

- ✓Establish Project area and potential technologies
- ✓Engage with NYS State to Support Project
- ✓Identify one site and willing property owner for initial proof of concept
- ✓Install Proof-of-Concept System
- ✓NYS DEC funding for P-Removal research @ NYS CCWT

Proof of Concept:

Nutrient Removing Onsite Wastewater Treatment System at YMCA Camp Bathroom and Shower Facility

- **Existing System was comprised of Substandard drywells/galleys/leaching pits and was abandoned**
- New system was designed for Nitrogen and Phosphorus removal and had a daily design flow of 990 gpd
- System was installed starting 6/1/22 and consisted of a FujiClean CEN NSF 245 system, passive upflow phosphorus removal filter, and 4 trenches of Eljen GSF (15 units per trench)
- System will be monitored weekly during operation for a period of two-years

Financial Support Provided by the

The Nature Conservancy

Installation Started 6/2/22

Final Grading

Key Takeaway Points

- **Great site to raise public awareness and use for site visits and training**
- System use is an extreme case scenario and not a good indication of how similar system would perform on *residential lots*
- System was installed starting 6/1/22 and consisted of a FujiClean CEN NSF 245 system, passive upflow phosphorus removal filter, and 4 trenches of Eljen GSF (15 units per trench)
- System will be monitored weekly during operation for a period of two-years
  - Reevaluating the sampling frequency to acquire a better dataset
- Will be working with project partners to refine system and summarize lessons learned in 2023 season

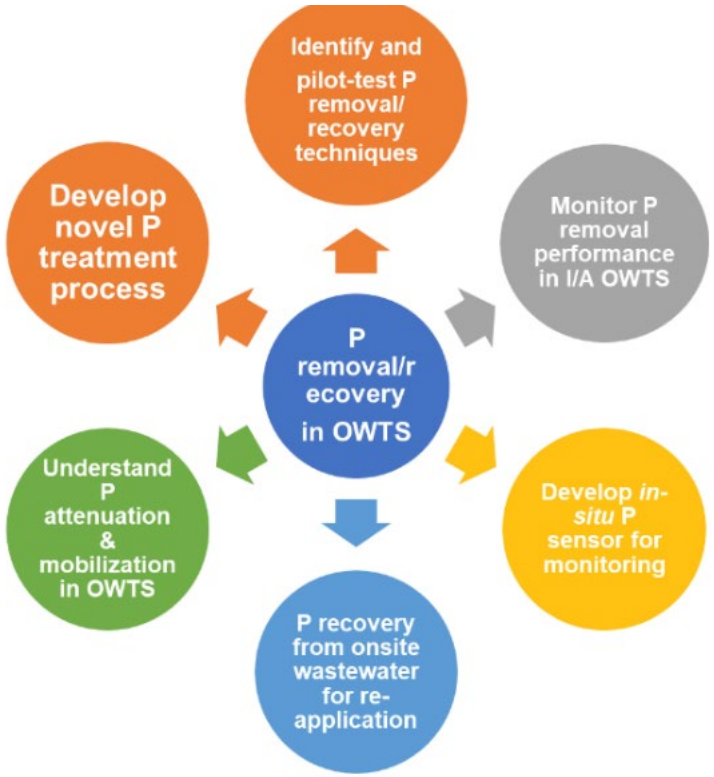
Recommended Next Steps

1. **Work with NYS Center for Clean Water Technology**
   - **Compare evolutions on available technologies**
2. **Continue meetings between County, NYS DEC & DOH**
3. **Design & Installation of 'Proof-of-Concept' System**
4. **Developed Monitoring Plan for YMCA**
5. Refine Monitoring Plan and Adjust System for Maximum Perfo[illegible]
6. Potentially Laungh Residential Property Demo
   - ❑ Call or Participants
   - ❑ Manufacturer Request for Expression of Interest
   - ❑ Site Selection
   - ❑ System Designs
   - ❑ Planning and Installation
7. Develop Additional Monitoring Plans for Installed Systems
8. Develop Training and Information Sessions (Industry, Municipal)
9. Work on Public Education, Engagement, and Outreach
10. Guidance Documents and Standards for the use of Clean-Water Septic in Cayuga County

Phosphorus Removal & Recovery

Removal of phosphorus (P) from onsite wastewater is vital when residences are near freshwater rivers or lakes, or where fractured bedrock can channel nutrients quickly to groundwater and surface water. Successful removal of P from septic tank effluent (STE) is critical to minimize nutrients loading to waterbodies. The Center team aims to develop affordable, reliable, and effective onsite wastewater treatment technologies to remove P from wastewater, groundwater, and surface waters utilizing multiple approaches including adsorption, precipitation reactions and microbial uptake, while concurrently evaluating the performance and function of P removing OWTS. The Center is also developing practical, cost-effective methods of P recovery and re-use for agricultural or other applications. The current focus of the research and development activities include:

- Evaluate P removal performance by current onsite wastewater treatment systems, such as NRBs and other I/A systems.
- Investigate P attenuation and mobilization mechanisms in current OWTSs and the surrounding soils.
- Evaluate and identify the optimal commercially available P removal technologies for onsite wastewater treatment.
- Research on natural-based materials for P removal and recovery from onsite wastewater and develop modular-based filtration system for implementation.
- Develop *in-situ* P sensors that could be used to monitor P removal performance in OWTSs.



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ANY QUESTIONS?

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