A BLUEPRINT FOR WATERSHED RESOURCE PROTECTION THROUGH COMMUNITY SCALE OWTS MANAGEMENT

MATT DOWLING
TOWN OF CHARLESTOWN, RI

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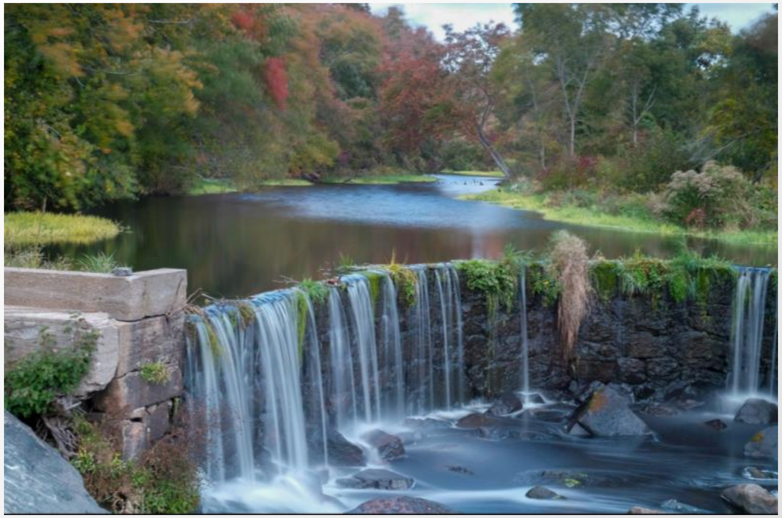
TOWN OF CHARLESTOWN

MATT DOWLING, CHARLESTOWN, RI

- URI – Geology/Natural Resource Science
- 23 years project coordination experience in groundwater hydrogeology, groundwater remediation, and watershed management
- Licensed RIDEM OWTS Designer and Installer
- Licensed RIDEM Class IV Soil Evaluator and Soil
- Qualified RIDEM Wetlands Professional
- Developed Charlestown's OWTS program - 15 years of employment
- Established the Charlestown Laboratory of Applied Watershed Management
- Leverage experience and community interest to bring in over $5M in outside funding to the Town
- Website: https://charlestownri.gov/wastewater-management Email: Mdowling@charlestownri.gov

A BLUEPRINT FOR WATERSHED RESOURCE PROTECTION THROUGH COMMUNITY SCALE OWTS MANAGEMENT



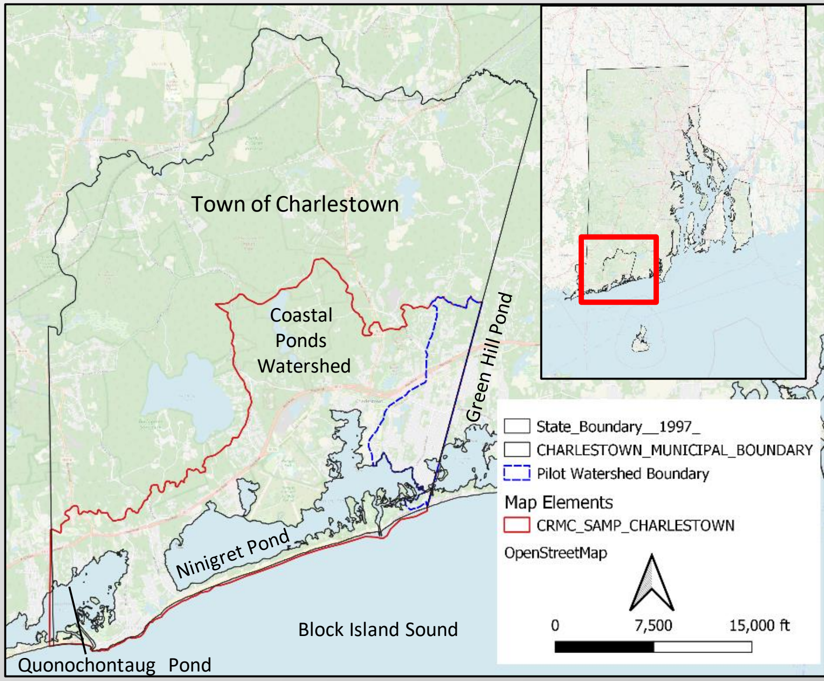
Horseshoe Falls, Charlestown, RI

Ninigret and Green Hill Ponds. Charlestown, RI

Using the Town of Charlestown RI as an example:

- Issues that communities face from OWTS
- Benefits of OWTS management
- Implement OWTS Management Program
  1. Identify Target area(s) and implement OWTS inspections
  2. Gather and track OWTS data
  3. Community Engagement
  4. Enforcement
  5. Outside funding
  6. Research

CHARLESTOWN – A COMMUNITY RELIANT ON OWTS



- A coastal community located on the South Shore of RI
- Situated on three coastal lagoons and associated barriers and headlands
- All potable water is groundwater primarily from private wells
- Local economy is dependent on the Town's coastal geography
  - Multiple beaches, coastal recreation, coastal industry, rentals and high value vacation properties
- 2/3 of dwelling units located within the Salt Ponds Region Watersheds

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CHARLESTOWN – ISSUES OUR COMMUNITY FACES RELATING TO OWTS

- Charlestown relies solely on groundwater for drinking water and on septic systems (OWTS) for wastewater management – Has densely developed areas (>10 units/Ac)
- Groundwater nitrogen (N) concentrations exceed the drinking water standard, posing public health risks and negatively affecting water quality of coastal ponds[2,3]
- 80% of nitrogen (N) in groundwater in densely developed areas of Charlestown originates from septic systems[1]
- Research has identified a significant relationship between density of septic systems and groundwater NO_3-N concentrations
- Town allocated fiscal resources to implement program ~$125,000/year program operating budget

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- EPA Established the Voluntary National Guidelines fro management of Onsite and Clustered Wastewater Treatment Systems

- Five models for OWTS management increasing in oversight

  - Model 1 – Homeowner Awareness
  - Model 2 – Maintenance Contract
  - Model 3 – Operating Permit*
  - Model 4 - Responsible Management Entity (RME) Operation and Maintenance
  - Model 5 – RME Ownership

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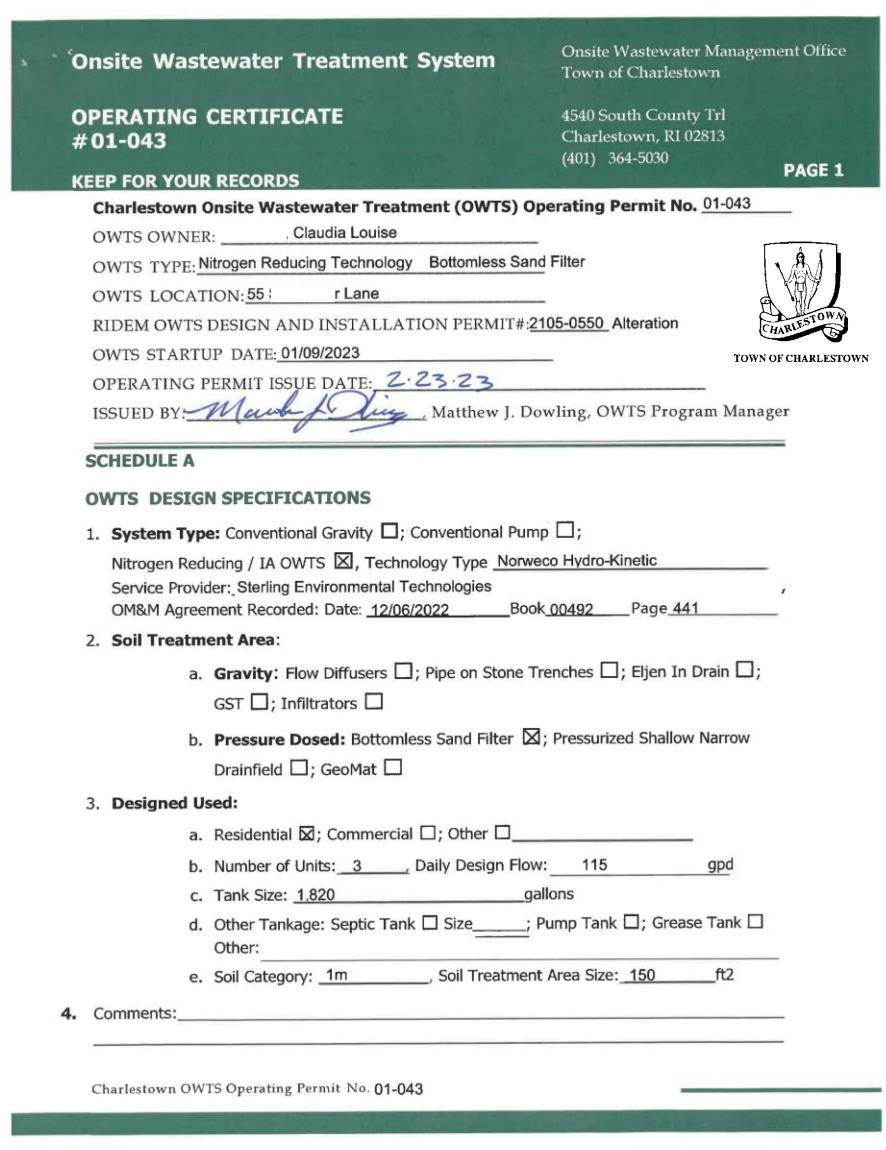
- Starting in 2008 – **Model 3 EPA Management Model – "OWTS Operating Permit"**
- OWTS owners are responsible for required maintenance and operation of OWTS,
- Town approved 3rd party OWTS service providers,
- EPA designed five models increasing in regulatory oversight from 1-5,
- We found "**Model 3**" works well in our jurisdiction - minimizes perception of over regulation and keeps operating costs down with high success



Onsite Wastewater Treatment System

OPERATING CERTIFICATE
#01-043

KEEP FOR YOUR RECORDS

Onsite Wastewater Management Office
Town of Charlestown

4540 South County Trl
Charlestown, RI 02813
(401) 364-5030

PAGE 1

Charlestown Onsite Wastewater Treatment (OWTS) Operating Permit No. 01-043

OWTS OWNER: , Claudia Louise

OWTS TYPE: Nitrogen Reducing Technology Bottomless Sand Filter

OWTS LOCATION: 55 r Lane

RIDEM OWTS DESIGN AND INSTALLATION PERMIT#: 2105-0550 Alteration

OWTS STARTUP DATE: 01/09/2023

OPERATING PERMIT ISSUE DATE: 2.23.23

ISSUED BY: [signature] Matthew J. Dowling, OWTS Program Manager

TOWN OF CHARLESTOWN

SCHEDULE A

OWTS DESIGN SPECIFICATIONS

1. **System Type:** Conventional Gravity ☐; Conventional Pump ☐;
   Nitrogen Reducing / IA OWTS ☒, Technology Type Norweco Hydro-Kinetic
   Service Provider: Sterling Environmental Technologies
   OM&M Agreement Recorded: Date: 12/06/2022 Book 00492 Page 441
2. **Soil Treatment Area:**
   a. **Gravity:** Flow Diffusers ☐; Pipe on Stone Trenches ☐; Eljen In Drain ☐; GST ☐; Infiltrators ☐
   b. **Pressure Dosed:** Bottomless Sand Filter ☒; Pressurized Shallow Narrow Drainfield ☐; GeoMat ☐
3. **Designed Used:**
   a. Residential ☒; Commercial ☐; Other ☐
   b. Number of Units: 3, Daily Design Flow: 115 gpd
   c. Tank Size: 1,820 gallons
   d. Other Tankage: Septic Tank ☐ Size___; Pump Tank ☐; Grease Tank ☐
   Other:
   e. Soil Category: 1m, Soil Treatment Area Size: 150 ft2
4. Comments:

Charlestown OWTS Operating Permit No. 01-043

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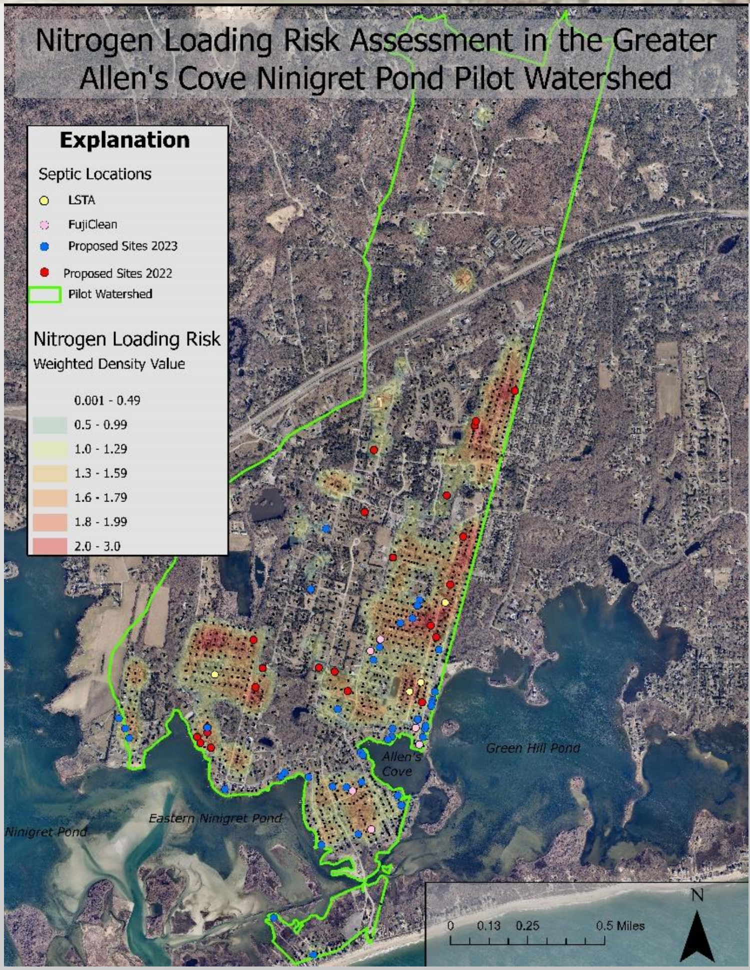
1. IDENTIFY TARGET AREA AND IMPLEMENT OWTS INSPECTIONS

- Delineate area of interest based on public health and environmental risks

- Use local GIS coverages to assess infrastructure, sensitive environmental resources, and narrow target areas

- Under enabling legislation, implement OWTS inspection requirements to require a “First Maintenance Inspection” and O&M requirements for Advanced OWTS.



- First maintenance inspections establish baseline of OWTS type, use and conditions

2. GATHER AND MANAGE OWTS DATA

- All OWTS have a first inspection to determine baseline conditions, type, age, size, condition, location, use profile, etc.,

- Pumping is determined and schedule set for next inspection,
- Inspection data is entered into a database,

- After follow up inspections, we now understand the conditions, use profiles and accumulation rate of material in the Septic Tank,
- This information is utilized to establish required inspection frequency for all OWTS.

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Long Term = 3-5 years

1. Implement OWTS Management Ordinance or Local Zoning Regulation
–Could include a Nutrient Loading requirement as an overlay district
2. Public outreach education and support is BEYOND ESSENTIAL!
3. Inventory every OWTS in the district via an inspection requirement
–Identifies Cesspools, Substandard systems and Failed Systems to manage in short term
4. Seek out low interest loan funding to assist homeowners upgrades
5. Develop an OWTS database
6. Working with GIS is KEY (must have a parcel database)
7. Focus on Critical Zones
8. Start to Manage I/A Systems
9. Branch out to manage other sources of Nutrients

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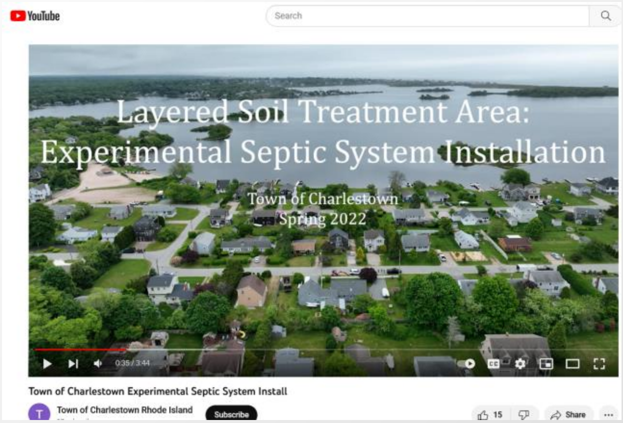
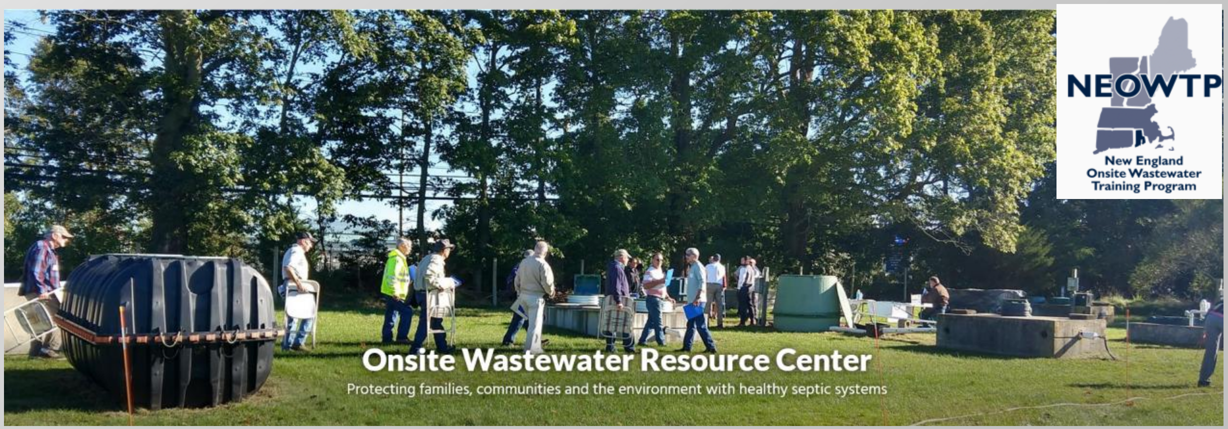
3 – COMMUNITY ENGAGEMENT

1. Engage residents in meaningful watershed education programing and experiences.
2. Field based hands-on training for resource protection practitioners.
3. Share findings and methods widely.





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4 – ENFORCEMENT

- A necessary, but sometimes unpleasant part of our job as regulators
- Implement Enforcement Actions per established code
- Key component is guidance toward compliance – non punitive when applicable
- Established Municipal Court per enabling legislations, other methods available

5 – LEVERAGE PROGRAMING FOR OUTSIDE FUNDING

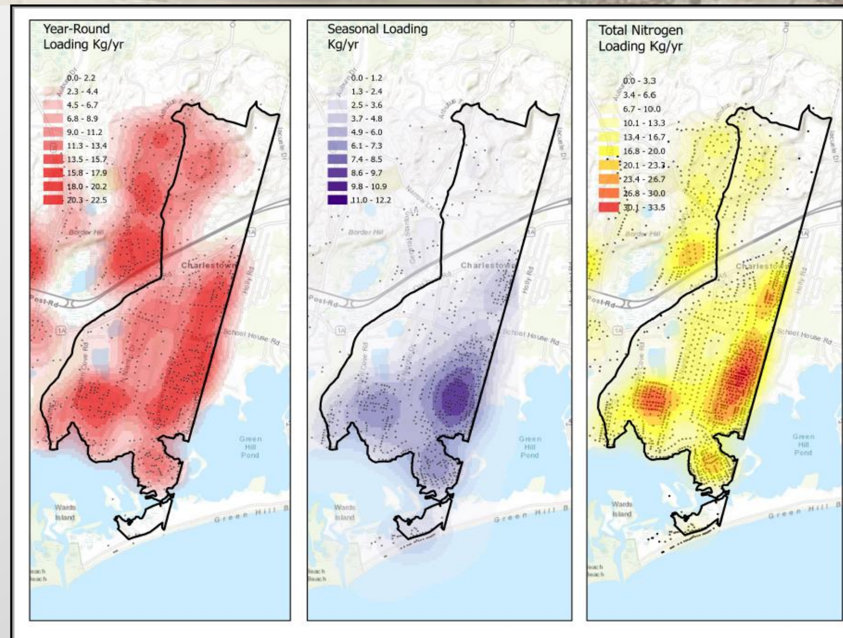
- Use programing as in-kind / fiscal contributions to implement water resource mitigation programs

A Nitrogen reducing OWTS is installed to replace a failing metal tank system located less than 100 feet from a coastal wetland under the Charlestown EPA SNEP Grant

- Our program over the last 8 years has received nearly $2M in grant funding to implement OWTS Management and OWTS modernization where needed

6 – CONDUCT RESEARCH

- Conduct research based on data collected to further the science of OWTS and Watershed Management



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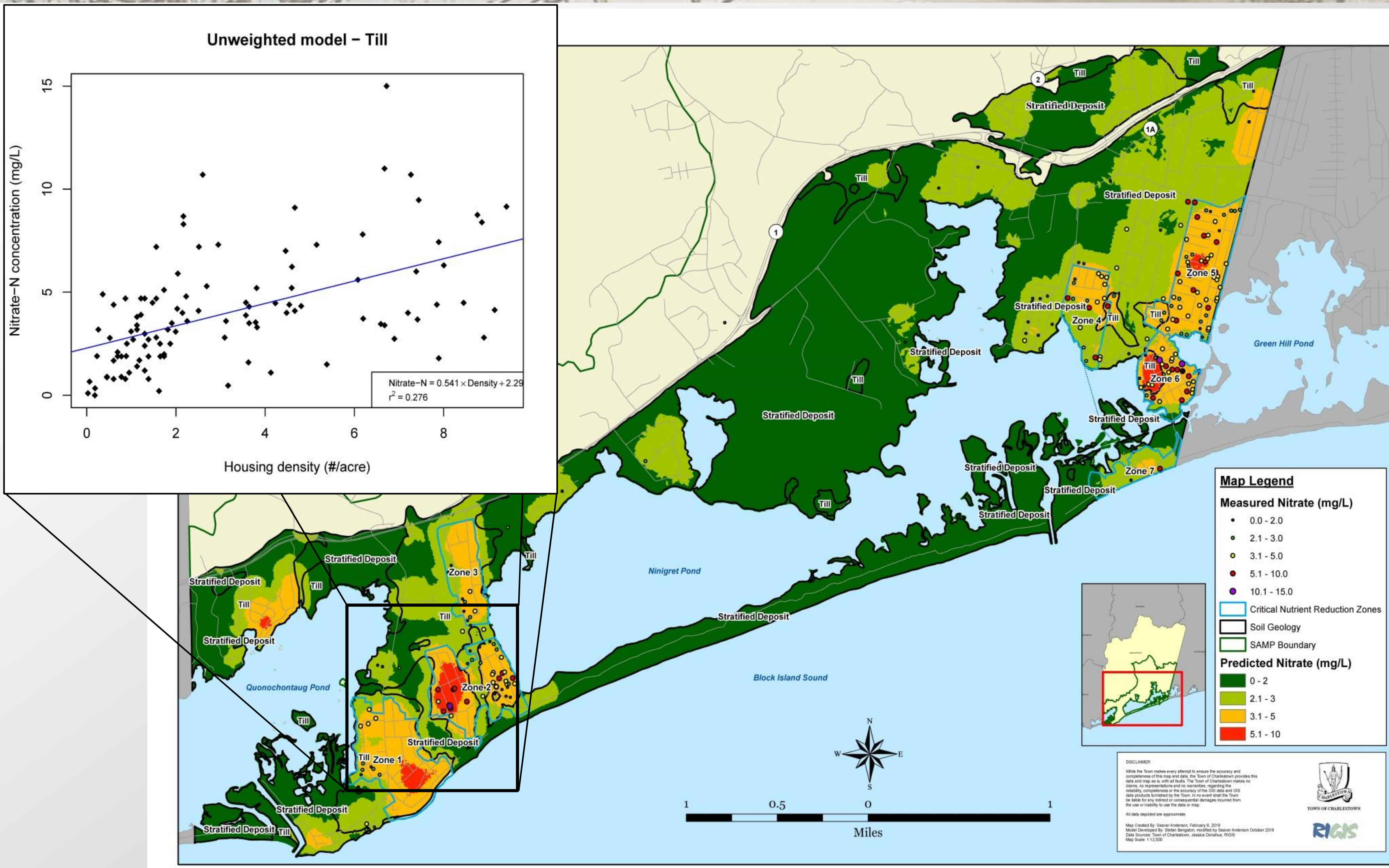

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water MDPI

Article

Influence of Season, Occupancy Pattern, and Technology on Structure and Composition of Nitrifying and Denitrifying Bacterial Communities in Advanced Nitrogen-Removal Onsite Wastewater Treatment Systems

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Received: 23 July 2020; Accepted: 26 August 2020; Published: 28…

Abstract: Advanced onsite wastewater treatment systems… (BNR) to mitigate the threat that N-rich wastewater poses… These systems lower the N concentration of effluent vi… denitrification. We used high-throughput sequencing to e… nitrifying and denitrifying bacterial communities in advanc… encoding ammonia monooxygenase (*amoA*) and nitrous o… from 44 advanced systems. We used QIIME2 and the phyl… in taxonomy and alpha and beta diversity as a function of… pattern (seasonal vs. year-round use), and season (June v… diversity index for *amoA* were significantly influenced by… *nosZ* diversity significantly. Season also had a strong influe… *amoA* communities, and had less influence on *nosZ* commu… influence on *nosZ* communities. *Nitrosospira* and *Nitrosom*… advanced N-removal OWTS, and the predominant genera… and *Acidovorax*. Differences in taxonomy for each gene gene… patterns, highlighting the possible importance of season ar… *amoA* and *nosZ*, respectively. Knowledge gained from this s… connections between microbial communities and OWTS pe… in a way that maximizes N removal.

Keywords: onsite wastewater treatment systems; *amoA*; *no*… nitrogen removal

1. Introduction

Nitrogen pollution from wastewater poses a serious thr… watersheds. Advanced onsite wastewater treatment systems… N from wastewater—are often required in areas vulnerable t… vary in their design, but they all have an oxic zone to facilitat…

SW231

Geospatial Modeling Suggests Threats from Stormy Seas to Rhode Island's Coastal Septic Systems

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…s preparing for climate cha… …orms will have on below-g… …ly on onsite wastewater tre… …search describing how the… …model was used to examin… …ents, category 1-4 hurrican… …on geographic location, co… …s, the number of OWTS th… …,000 in a category 1 hurric… …from a category 4 hurrican… …of sea level rise expected o… …ed can cost homeowners f…

Water Air Soil Pollut (2018) 229:389
https://doi.org/10.1007/s11270-018-4039-z
CrossMark

User-Based Photometer Analysis of Effluent from Advanced Nitrogen-Removal Onsite Wastewater Treatment Systems

Bianca N. Ross · George W. Loomis · Kevin P. Hoyt
Jose A. Amador

Received: 10 August 2018 / Accepted: 12 November 2018

Abstract Advanced nitrogen-removal onsite wastewater treatment systems (OWTS) are used to reduce total nitrogen (N) levels in domestic wastewater. Maintaining system performance requires regular monitoring and in situ rapid tests can provide an inexpensive option for assessing treatment performance. We used a portable photometer to measure ammonium and nitrate concentrations in final effluent from 46 advanced N-removal OWTS, sampling each site at least three times in 2017. To assess photometer accuracy, we compared measurements made using the photometer with those determined by standard laboratory methods using linear regression analysis and a two-tailed *t* test to compare regression parameters to those for a perfect linear relationship (slope = 1, intercept = 0). Our results show that photometer-based analysis reliably estimates inorganic N (ammonium and nitrate) concentration in field and laboratory settings. Photometer-based analysis of the sum of inorganic N species also consistently approximated the total N concentration in the final effluent from the systems. A cost-benefit analysis indicated that the photometer is a more cost-effective option than having samples analyzed by commercial environmental testing laboratories after analysis of 8 to 33 samples. A portable photometer can be used to provide reliable, cost-effective measurements of ammonium and nitrate concentrations, and estimates of total N levels in advanced N-removal OWTS effluent. This method can be a viable tool for triaging system performance in the field, helping to identify systems that are not functioning properly and may need to be adjusted or repaired by an operation and maintenance service provider in order to meet treatment standards.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11270-018-4039-z) contains supplementary material, which is available to authorized users.

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Keywords Onsite wastewater treatment system · Wastewater · Rapid test · Photometer · Nitrogen · Regression analysis

1 Introduction

Advanced nitrogen-removal onsite wastewater treatment systems (OWTS) are used to mitigate the impact of residential wastewater on ecosystems. Because nitrogen (N) is a limiting nutrient in coastal watersheds, increased N inputs from wastewater promote

Published online: 23 November 2018

Springer

Water Air Soil Pollut (2020) 231:543
https://doi.org/10.1007/s11270-020-04911-5

Effectiveness of Advanced Nitrogen-Removal Onsite Wastewater Treatment Systems in a New England Coastal Community

Bianca N. Ross · Kevin P. Hoyt · George W. Loomis · Jose A. Amador

Received: 12 June 2020 / Accepted: 26 October 2020

Abstract Wastewater is a major source of nitrogen (N) to groundwater and coastal waterbodies, threatening both environmental and public health. Advanced N-removal onsite wastewater treatment systems (OWTS) are used to reduce effluent N concentration; however, few studies have assessed their effectiveness. We evaluated the total N (TN) concentration of effluent from 50 advanced N-removal OWTS in Charlestown, Rhode Island, USA for 3 years. We quantified differences in effectiveness as a function of N-removal technology and home occupancy pattern (seasonal vs. year-round use), and examined the relationship between wastewater properties and TN concentration. RX30 systems produced the lowest median TN concentration (mg N/L) (13.2), followed by FAST (13.4), AX20 (14.9), and Norweco (33.8). Compliance with the state's regulatory standard for effluent TN concentration (19 mg N/L) was highest for RX30 systems (78%), followed by AX20 (73%), FAST (67%), and Norweco (0%). Occupancy pattern did not affect effluent TN concentration. Variation in TN concentration was driven by ammonium and nitrate for all technologies, and also by temperature for FAST and pH for Norweco. Median daily (g N/day) and annual (kg N/yr) N loads were significantly higher for year-round (5.3 and 2.3) than for seasonal (3.7 and 0.41) systems, likely due to differences in volume of wastewater treated. Our results suggest that advanced N-removal OWTS vary in their compliance with the state regulatory standard for effluent TN and can withstand long periods of non-use without compromising effectiveness. Nevertheless, systems used year-round do produce a higher daily and annual N load than seasonally-used systems.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11270-020-04911-5.

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Keywords Onsite wastewater treatment systems · Wastewater · Nitrogen · Biological nitrogen removal

1 Introduction

Effluent from onsite wastewater treatment systems (OWTS) is an important source of nitrogen (N) to coastal watersheds (Valiela et al. 2010). Because N is a limiting nutrient in coastal ecosystems, increased inputs of N to groundwater and poorly flushed coastal systems promote eutrophication, which results in anoxia that

Published online: 05 November 2020

Springer

A BLUEPRINT FOR WATERSHED RESOURCE PROTECTION THROUGH COMMUNITY SCALE OWTS MANAGEMENT

RESULTS – AFTER 15+ YEARS OF IMPLEMENTATION

- 10,000+ inspections conducted
- Currently 6,331 Systems Permitted and Tracked
- Over 500 cesspools replaced
- 313 failing systems identified over last 10 years, average 26 per year (~2% of inspections), managed, tracked and upgraded
- >$2M disbursed in 1% loans for failing system upgrades
- Other watershed management spinoff projects
- Over $2M in grant funding for OWTS infrastructure modernization
- Partnerships built; Research laboratory established

Charlestown Laboratory of Applied Watershed Management

NEOWTP New England Onsite Wastewater Training Program

LSEM Laboratory of Soil Ecology & Microbiology University of Rhode Island

SAVE THE BAY® NARRAGANSETT BAY

EPA United States Environmental Protection Agency

SNEP Southeast New England Program

DEM RHODE ISLAND

SALT PONDS COALITION

UNIVERSITY OF Rhode Island

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