A Blueprint for Watershed Resource Protection through Community-Scale Integrated Infrastructure Management

Matthew Dowling & Alissa Cox, PhD

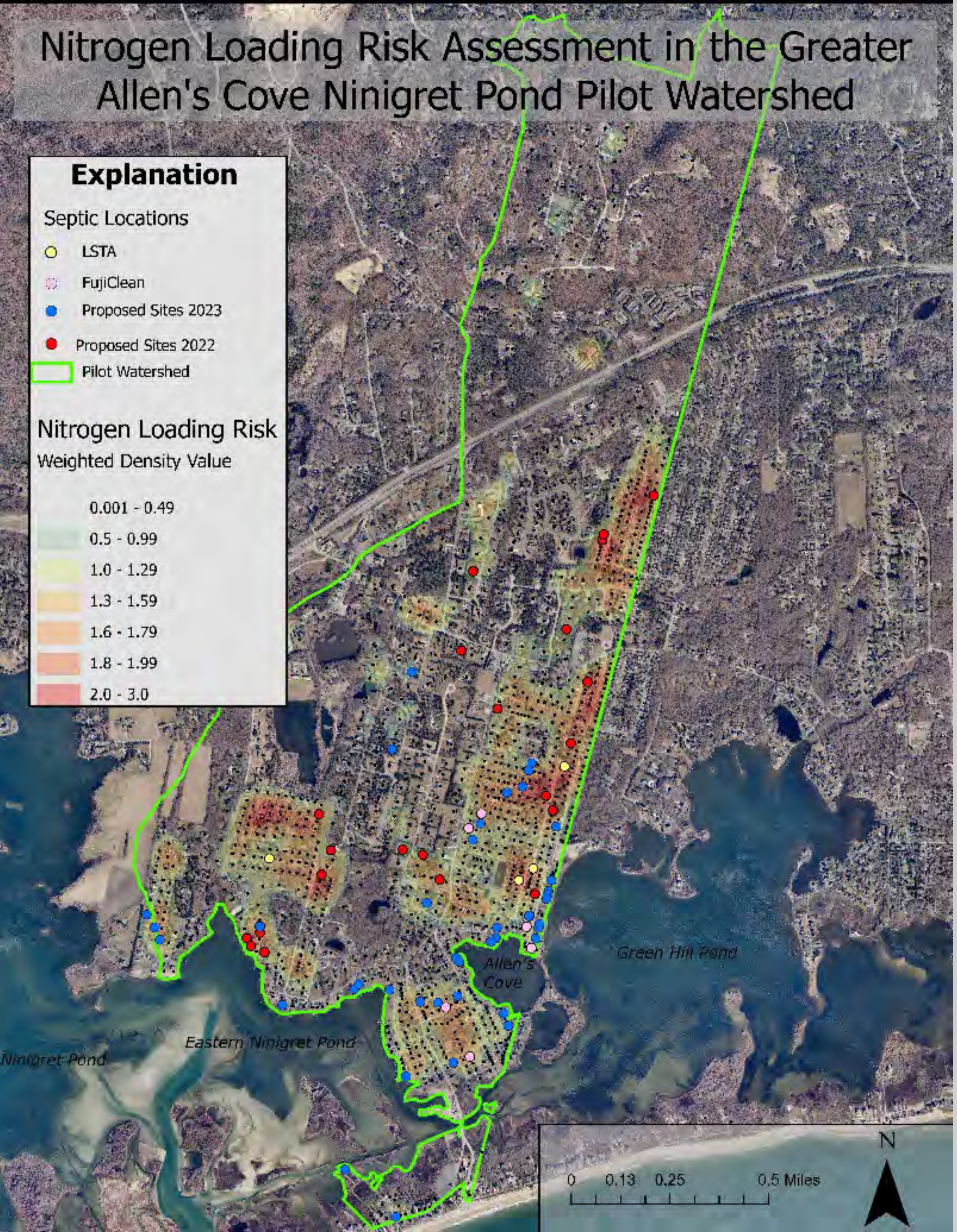
CHARLESTOWN

THE UNIVERSITY OF RHODE ISLAND

Summary of today's talk

Using the Town of Charlestown, RI as an example:

- Issues that communities face from watershed impairment
- Benefits of local watershed management with an emphasis OWTS
- Implementing a local Watershed Management Program by:
  - Recognizing Water Quality Issues and Generating Initial Momentum
  - Assessing Impairment
  - Identifying Target area(s) and Sourcing Funding
  - Implementing Programs - OWTS inspections
    - ✓ Gathering and tracking OWTS data
    - ✓ Community Engagement
    - ✓ Enforcement
    - ✓ Outside funding
    - ✓ Sharing Findings



THE PROBLEM: INTERCONNECTED WATER-RESOURCE CHALLENGES

- Outdated septic system/stormwater infrastructure with unknown or varying performance
- High intensity land uses – outdated or uninformed planning / zoning frameworks or state development mandates
- Impaired groundwater and surface water resources
- Groundwater reliance for potable water
- High development pressures
- Aging or inadequate stormwater infrastructure
- Lack of coordinated local management

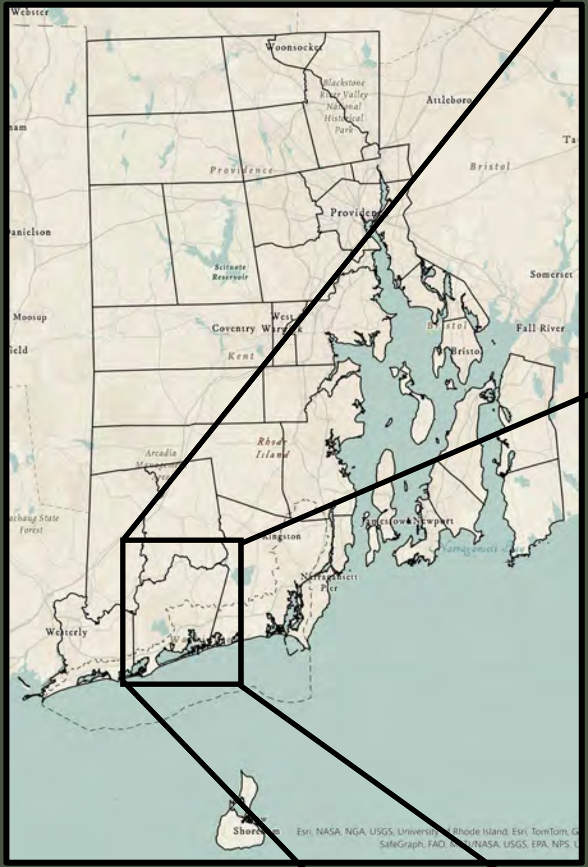
OUR EXPERIENCE IN SOUTHERN RHODE ISLAND

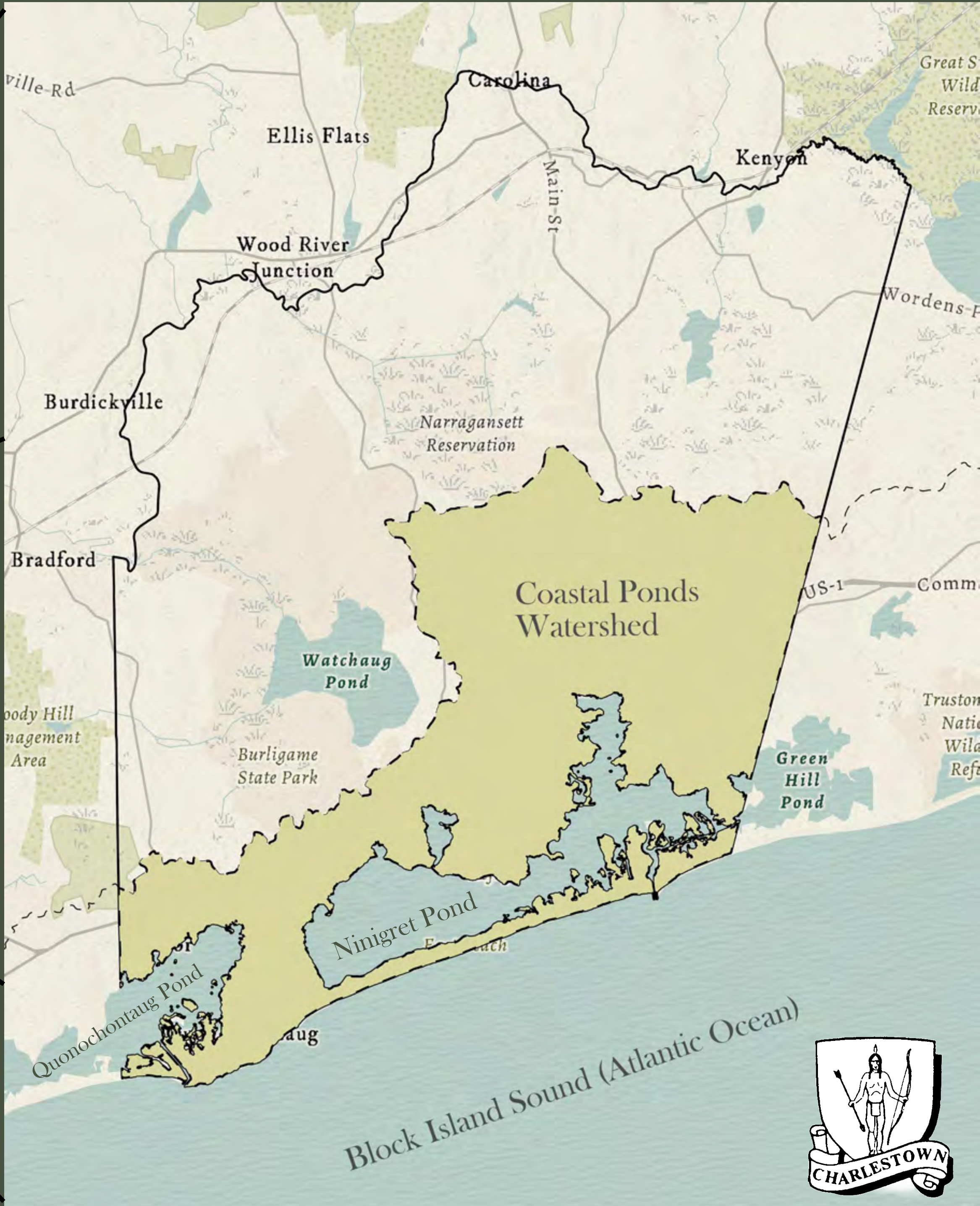
- 20+ years coordinating watershed + groundwater + OWTS management
- Established applied watershed management program
- Successfully leveraged multi-million-dollar investments
- This real-world experience informs the new scalable framework

CHARLESTOWN

CHARLESTOWN – A COMMUNITY RELIANT ON WATER RESOURCES

- A coastal community located on the South Shore of RI
- Situated on three coastal lagoons and associated barriers and headlands
- Groundwater is only source of potable water 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





LOCAL WATER RESOURCE ISSUES

- Some of the densest developed areas on the south shore of RI
- Some areas have >10 dwelling units per acre situated adjacent to coastal resources, all using OWTS and private wells
- ~80% of systems do not utilize modern Nitrogen Reducing Technology
- 80% of groundwater N originates from OWTS

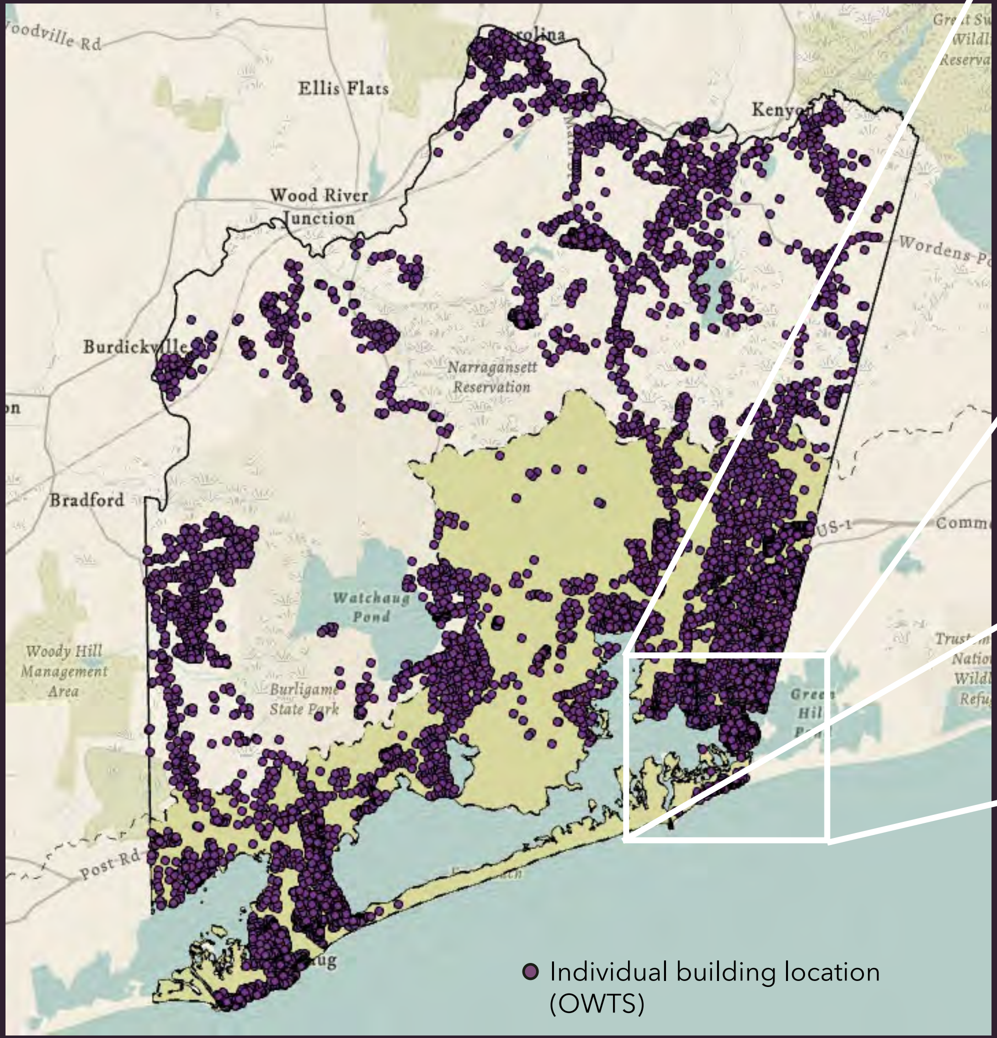


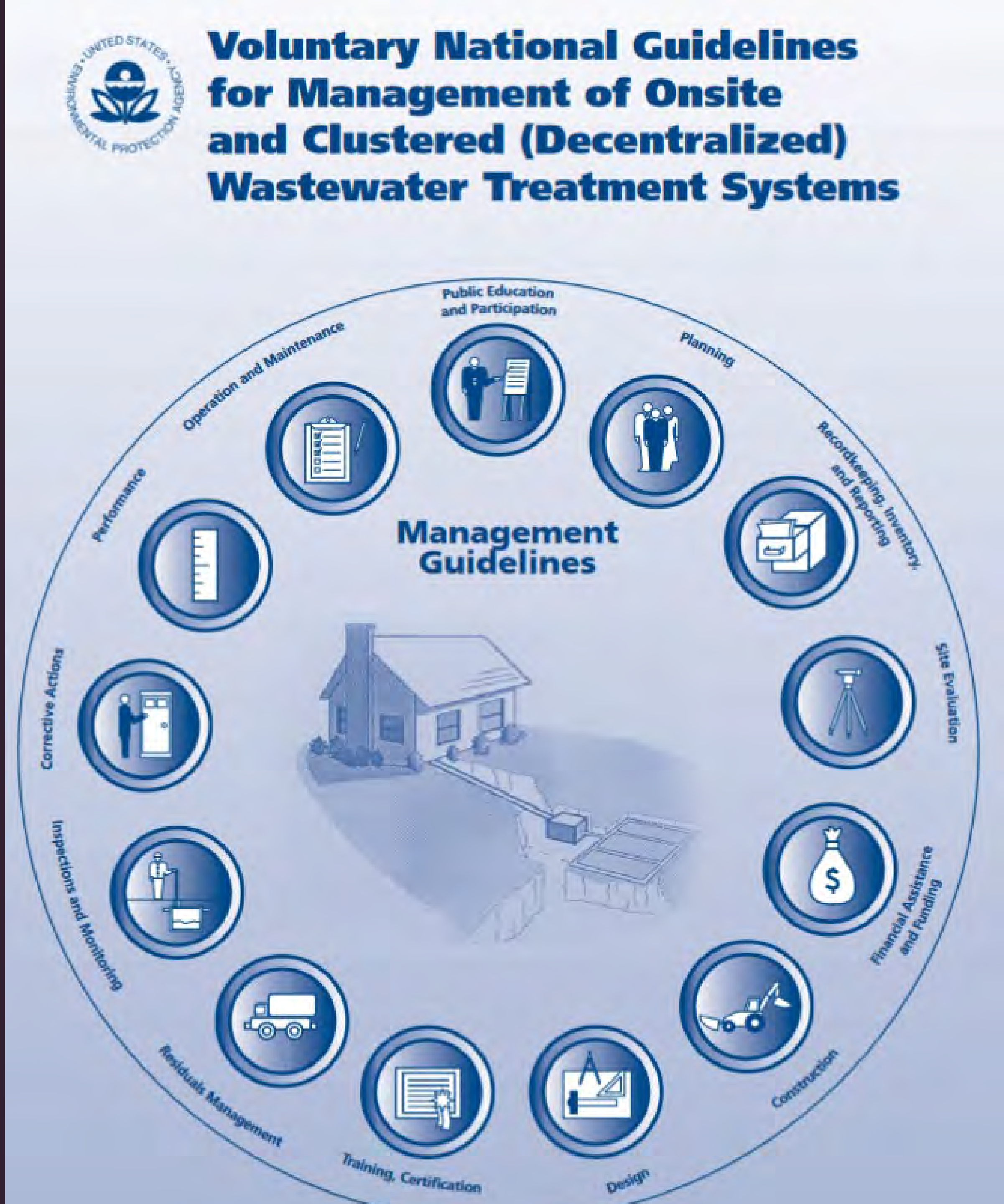

Photo by Town of Charlestown, 2022

MANAGEMENT SOLUTIONS

2003 - EPA Established the Voluntary National Guidelines for 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



Onsite Wastewater Treatment System

Onsite Wastewater Management Office
Town of Charlestown

OPERATING CERTIFICATE
#01-043

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

KEEP FOR YOUR RECORDS **PAGE 1**

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

OWTS OWNER: Granville, Claudia Louise

OWTS TYPE: Nitrogen Reducing Technology Bottomless Sand Filter

OWTS LOCATION: 55 Sandpiper 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

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

MANAGEMENT SOLUTIONS

- 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,
- We found "Model 3" works well in our jurisdiction - minimizes perception of over regulation and keeps operating costs down with high success
- Town allocated fiscal resources to implement program ~$125,000/year program operating budget

A Blueprint for Watershed Resource Protection through Community-Scale Integrated Infrastructure Management

1. Initial energy – recognize problem and establish momentum
2. Assess watershed health issues
3. Identify Impairment sources / Land Use and Infrastructure Assessment
4. Prioritize solutions based on risk and feasibility
5. Source Funding and Implement programming
    - Community Engagement, Enforcement, Research, Sharing Findings, Adaptive Management, Leveraging Successes for $

1. INITIAL ENERGY – RECOGNIZE PROBLEM AND ESTABLISH MOMENTUM

- Understand the basics of a local water quality impairment or need (possibly in response to TMDL or other requirement)
- Identify **"Watershed Champion(s)"** to provide leadership and drive resolution
- Shepard establishment of working groups
- Identify stakeholders
- Implement the principals of Translational Ecology (science) and Stakeholder Theory
  - The bridge between science and action (policy)

A public hearing workshop with stakeholders discussing the impacts of septic systems local groundwater quality in Charlestown, RI

2. ASSESS WATERSHED HEALTH ISSUES

2025 Bacteria Data - Salt Pond Sites: Fecal coliform and enterococci

Fecal coliform and enterococci bacteria are monitored to indicate the presense of human sewage and associated pathogens, or disease causing organisms. The Department of Health (RIHealth) uses a single-sample value enterococci standard for licensed swimming beaches. The RI Department of Environmental Management (RIDEM) uses a geometric mean approach for contact recreation (i.e. swimming) standards on all other waters (fresh and salt). For the National Shellfish Sanitation Program, RIDEM also assesses fecal coliform levels for shellfish waters and their tributaries (not to exceed 14 fecal coliform per 100 mL). While URIWW's analytical laboratories are certified by the State, URIWW bacteria data are intended for screening purposes only. Our data help target areas of concerns and track potential sources of bacterial contamination. Starting in 2020, the Salt Pond Coalition tests bacteria every two weeks at select sites to get a better handle on conditions after periods of high bacteria levels in 2019. Any result above the state standard is considered unsafe, and swimmers should refrain from swimming until results return to acceptable levels, or for at least several days after heavy rain. Check out our bacteria factsheet at http://cels.uri.edu/docslink/ww/water-quality-factsheets/Bacteria.pdf to learn more about how bacteria are monitored, where they come from, what bacterial indicators are, and how we can all help to reduce bacterial input into our local water resources.

Salt Pond Coalition Sites 2025 Fecal Coliform Data

	5/21	6/5	6/18	7/2	7/16	7/30	8/13	8/27	9/10	9/24	10/8	GeoMean
Monitoring Location		------ Most Probable Number of Fecal coliform per 100 mL ------										
Green Hill Pond - In Pond (center)	<10	-	<10	-	<10	-	<10	-	10	-	-	**<10**
Green Hill Pond - Indigo Point	<10	-	<10	-	**124**	-	10	-	<10	-	-	**<10**
Green Hill Pond - Sea Lea	<10	-	10	-	<10	-	<10	-	10	-	-	**<10**
Green Hill Pond - Teal Road	<10	-	<10	-	**246**	-	**108**	-	**64**	-	-	**23**
Green Hill Pond - Allen Cove	<10	-	<10	-	<10	-	10	-	<10	-	-	**<10**
Green Hill Trib - Allen Cove Inflow*	-	<10	<4	-	-	-	<4	-	<4	-	-	**<10**
Ninigret Pond - Crawford Dock	<10	-	<10	-	<10	-	<10	-	<10	-	-	**<10**
Ninigret Pond - Eastern Basin	<10	-	<10	-	-	-	<10	-	<10	-	-	**<10**
Ninigret Pond - (Mid) Western Basin	<10	<10	<10	<10	Bottle broke	<10	<10	<10	<10	-	-	**<10**
Ninigret Pond - Potato Point	-	-	<10	-	10	-	<10	-	<10	-	-	**<10**
Ninigret Pond - Stumpy Point	<10	-	<10	**288**	<10	31	<10	10	<10	**62**	-	**12**
Ninigret Pond - Vigna's Dock	42	-	**249**	-	41	-	10	-	<10	-	-	**24**

Please see the Salt Ponds Coalition website for information about the ponds and specific monitoring sites, as well as what you can do to help protect these unique Rhode Island resources (http://www.saltpondscoalition.org/).

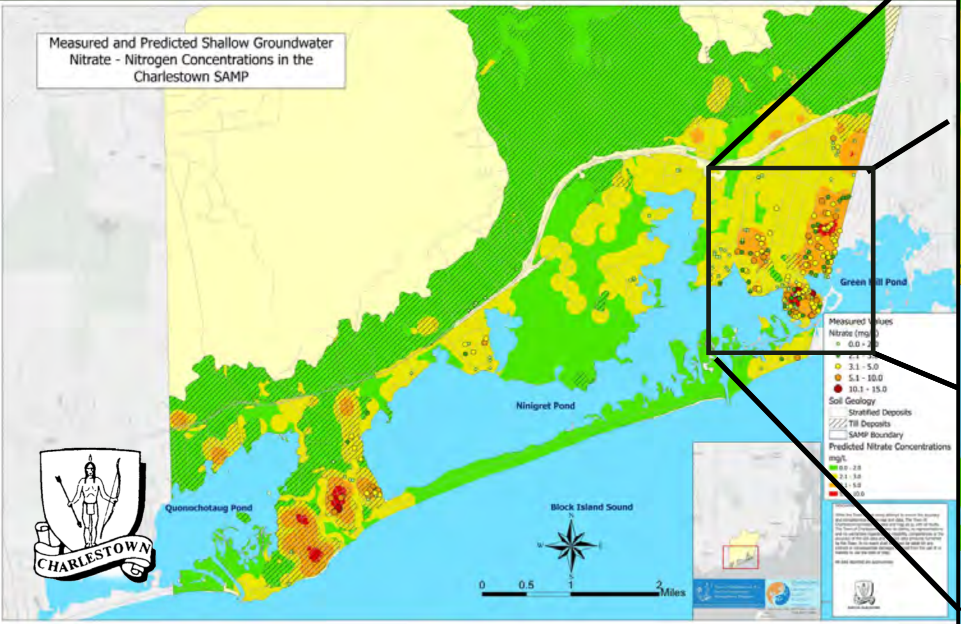
(Next pages for more data, including enterococci values)

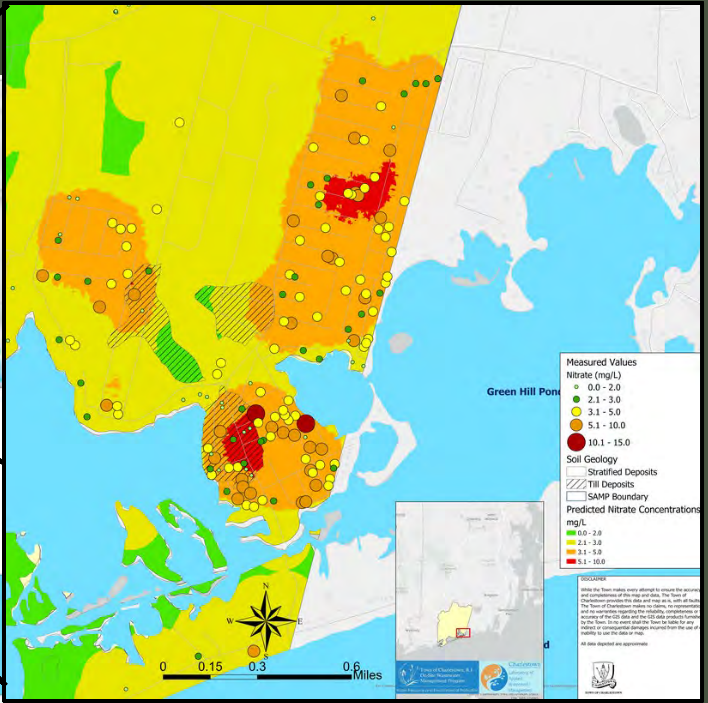
URI Watershed Watch Data - https://web.uri.edu/watershedwatch/

Long Term Surface Water Quality Monitoring Data

Town of Charlestown, R.I.
On-Site Wastewater Management Program
Water Resource and Environmental Protection

Local groundwater quality monitoring data



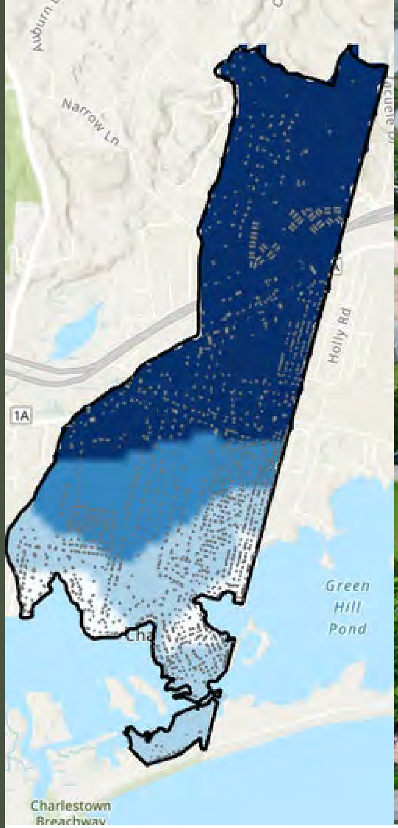


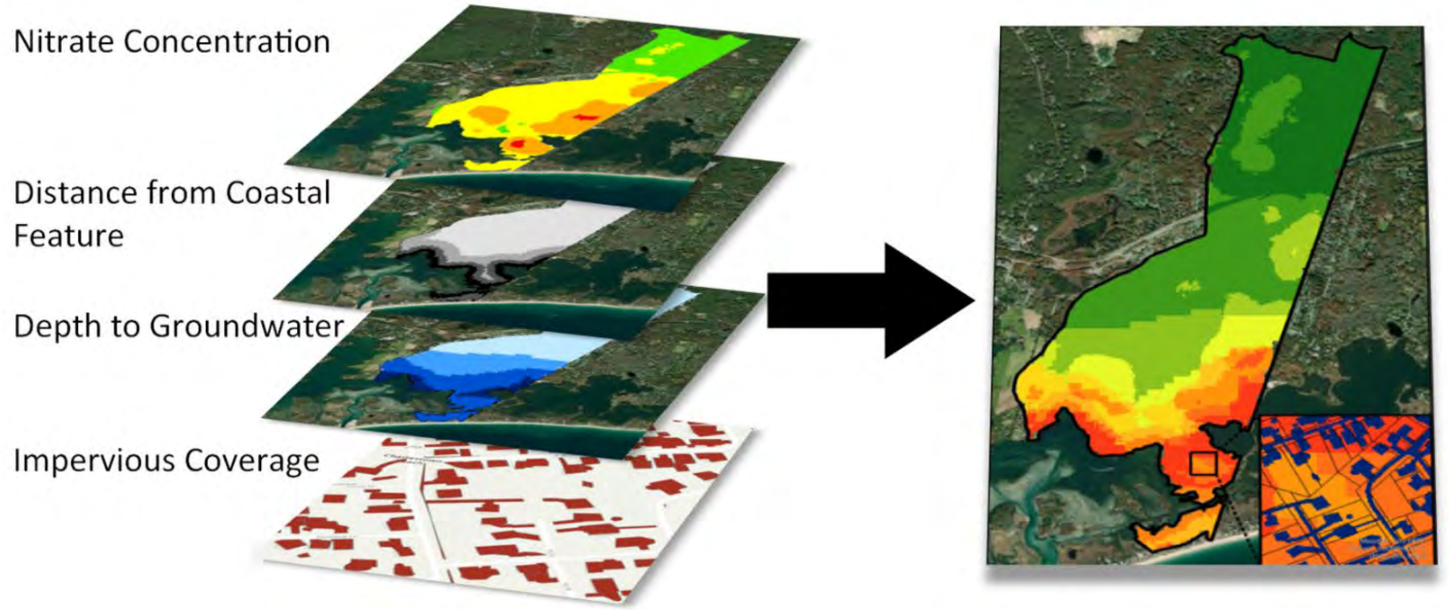
Evaluate Surface & Groundwater Conditions to select target area

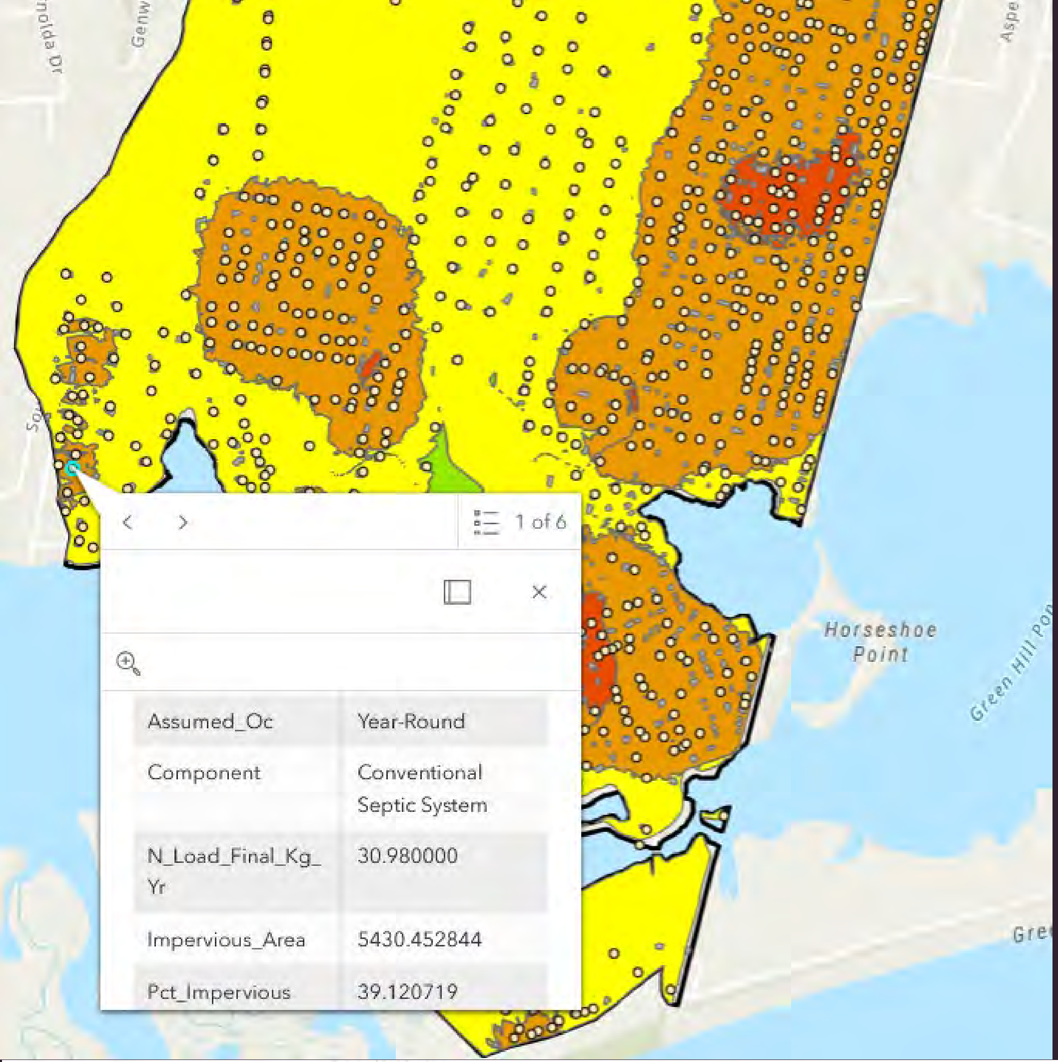
- Identify impaired waters
- Use monitoring data, state assessments & TMDLs, local sampling, State 303d lists, other resources
- Map groundwater contamination risks
- Determine watershed or sub-basins for focus

3 – IDENTIFY IMPAIRMENT SOURCES / LAND USE AND INFRASTRUCTURE ASSESSMENT

- 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
- Map land use intensities
- Evaluate pollution risk to GW
- Delineate and classify high risk areas







4 - PRIORITIZE SOLUTIONS BASED ON RISK AND FEASIBILITY

- Prioritization **inputs**:
  1. Community health impacts
  2. Environmental risk
  3. Cost + available funding
  4. Political feasibility
  5. Readiness of local partners
- **Output:** A ranked matrix of intervention zones.

Depth to Groundwater (Feet)	Ranking Score	Predicted Groundwater N Concentrations (mg/L)	Ranking Score	OWTS Year Installed	Ranking Score	Occupancy	Ranking Score	OWTS Type	Ranking Score	Percent Impervious Lot Coverage	Ranking Score
< 2	10	5-10	10	<1972	10	Full Time	5	Cesspool	10	>40	6
2-5	7	3-5	7	1972-1984	7	Seasonal	0	Substandard	10	25 > 40	4
5-10	3	2-3	3	1984-1994	1			Conventional	5	12 > 25	2
>10	0	1-2	0	>1994	0			Modern N Reducing	Removed	0>12	0

Dowling Ranalli, 2024

5 - SOURCE FUNDING AND IMPLEMENT PROGRAMMING

- Through targeted initiatives by combinations of volunteer efforts, local funding and leveraging local action for agency grant funding conduct:
  - Assessment
  - Implementation / Mitigation
  - Education
  - Community engagement
- Adaptively Manage Programing

TOWN OF CHARLESTOWN

Fiscal Year 2025 - 2026

ADOPTED BUDGET
June 9, 2025

Town Council	Budget Commission	Ex-Officio Members
Deborah A Carney, President	Timothy P. Kenefick, Chairman	Stephen J. Stokes, Town Council Liaison
Rippy Serra, Vice-President	Paula A. Anderson, Vice-Chairman	Jeffrey S. Allen, Town Administrator
Craig Marr	Gregory J. Plunkett, Secretary	Patrick Gormley, Town Treasurer
Peter Slom	William J. Dunn	
Stephen J. Stokes	Michael Marcelynas	

CASE STUDY FROM THE TOWN OF CHARLESTOWN

1 – INITIAL ENERGY AND PROGRAM MOMENTUM

- Late 1990s - In a grassroots movement residents Implemented a Wastewater Management Commission to manage impaired water quality
- Under enabling legislation, Wastewater Management Ordinance Developed – WWMD established
- 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
- 2008 Full time staff allocated to manage district and Operating Certificate Management implemented

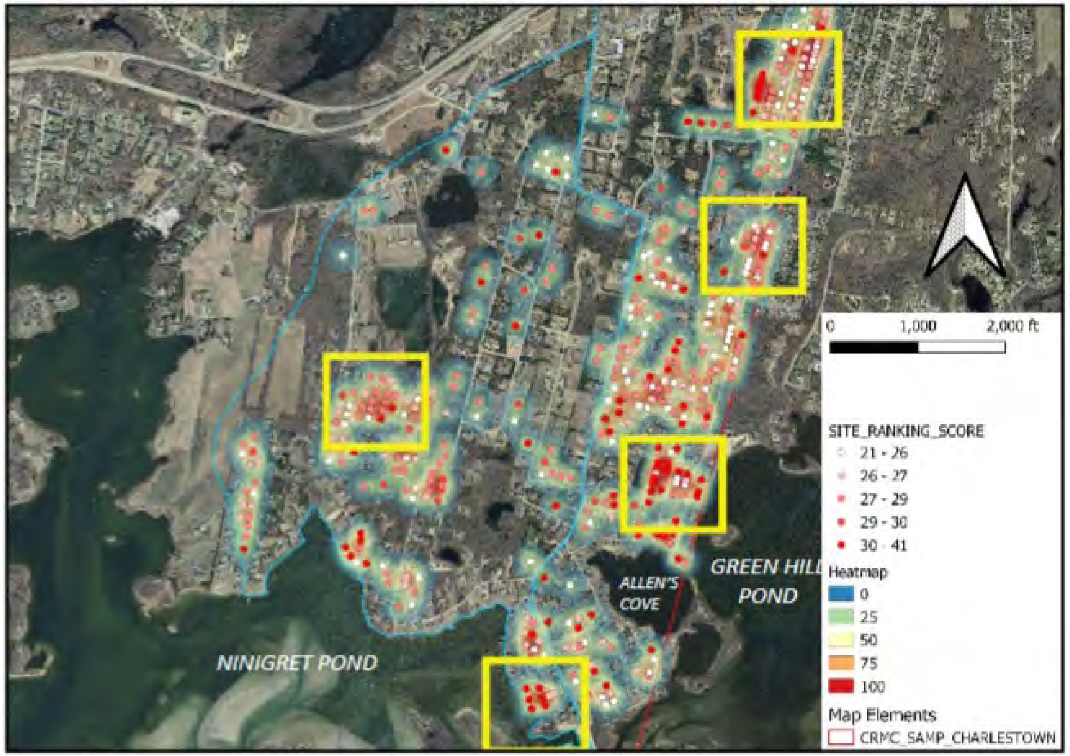
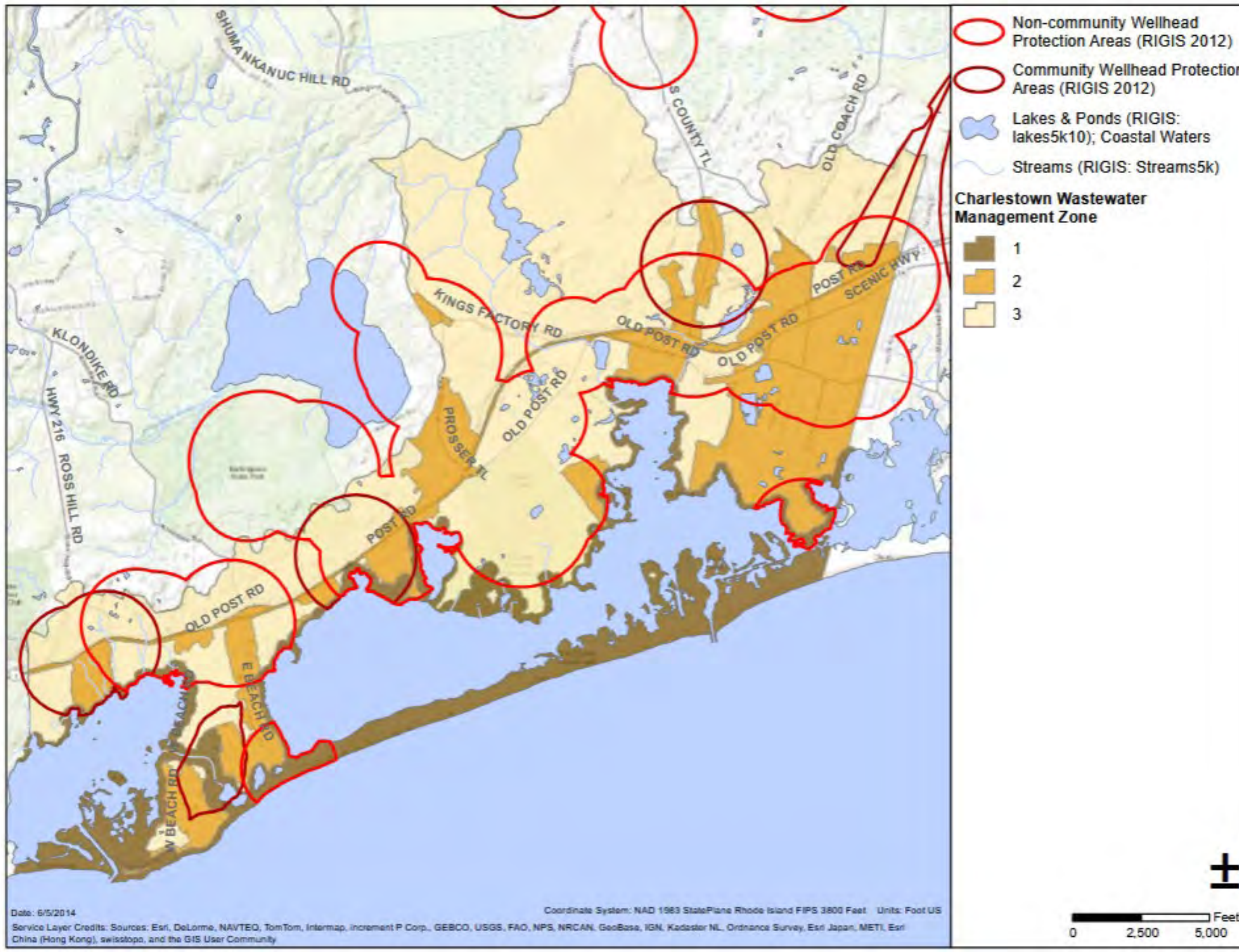


Figure 4 – Charlestown Coastal Watershed critical resource area nutrient loading hotspot analysis and delineation of targeted mitigation areas under an EPA funded Charlestown septic system upgrade program

STEPS 2-3 - ASSESS THE TARGET WATERSHED

- A 2008 assessment of public wells and septic system density used to evaluate risk to groundwater and surface water resources
- This information is utilized to establish cesspool phaseout and inspection frequency



CHARLESTOWN

STEP 4 & 5 – DEVELOP PROGRAMING AND DATA COLLECTION (STARTING 2008)

- 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, triage OWTS repairs/upgrades

STEP 5 - COMMUNITY ENGAGEMENT (2010 – TODAY)

- Frequent communication regarding programing
- Engage residents in meaningful watershed education programing and experiences
- Field based hands on training for resource protection practitioners
- Strong partnerships
- Share findings widely

STEP 5 – ENFORCEMENT (2010 - TODAY)

- 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 2016 - TODAY

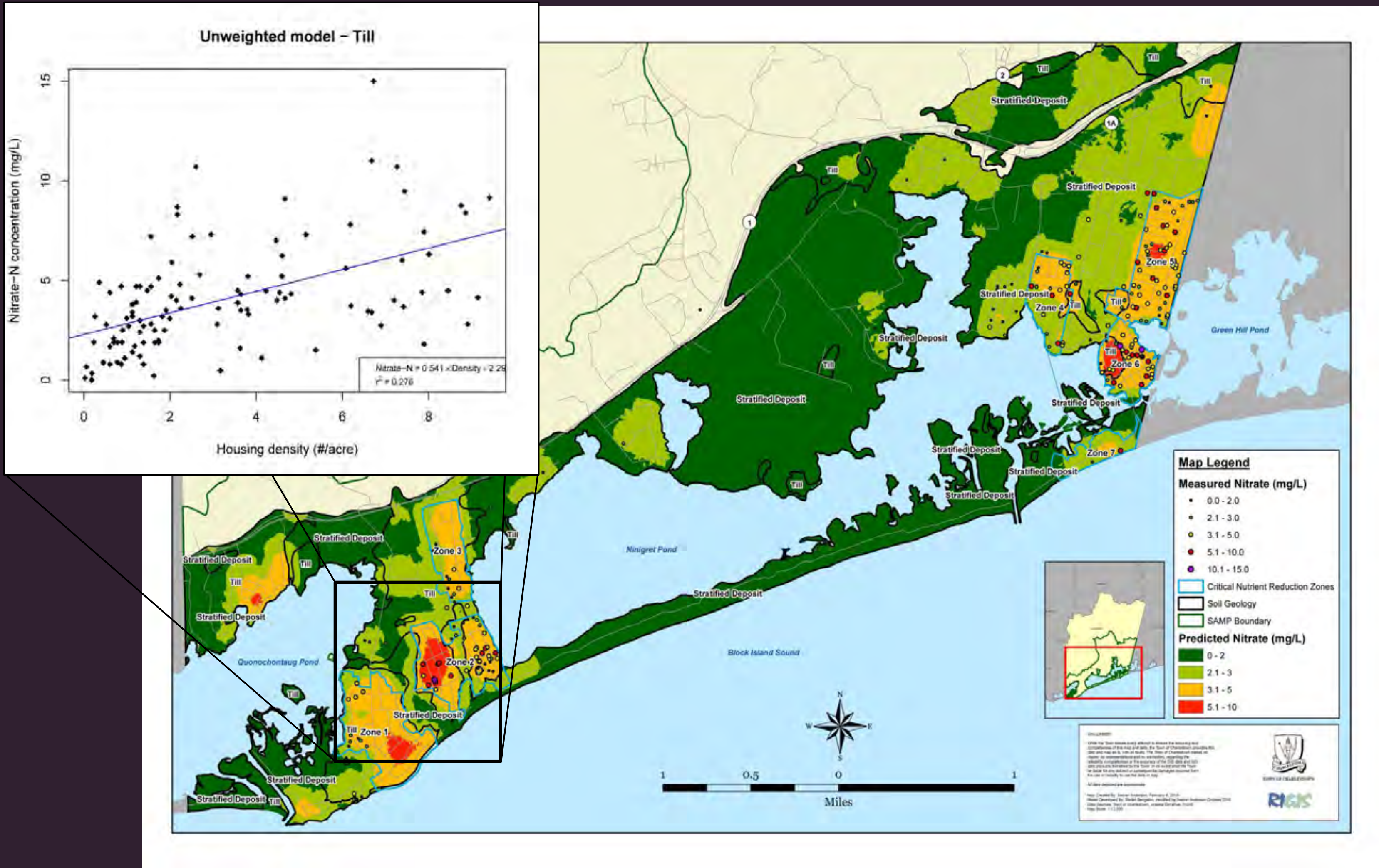
- Use programing as in-kind / fiscal contributions to implement water resource mitigation programs

Nitrogen reducing OWTS installed to replace substandard systems located less than 100 feet from a coastal wetlands under the Charlestown EPA SNEP Grant

- Our program over the last 9 years has received nearly $3M in grant funding to implement OWTS Management and OWTS modernization where needed

5- CONDUCT RESEARCH AND SHARE FINDINGS (2018 – TODAY)

- Leveraging local capacity and data collection
- Share findings to further the science of OWTS and watershed management
- Drive science backed policy development



7 – CONDUCT RESEARCH AND SHARE FINDINGS (2018 – TODAY)

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

SW231

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

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

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

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

ASCE

Relationship between Groundwater Nitrate Concentration and Density of Onsite Wastewater Treatment Systems: Role of Soil Parent Material and Impact on Pollution Risk

Matthew J. Dowling[1]; Jose A. Amador[2]; Seaver Anderson[3]; Stefan Bengtson[4]; Kristen Hemphill[5]; and George W. Loomis[6]

CHARLESTOWN

RESULTS – AFTER 17+ YEARS OF IMPLEMENTATION

- 12,000+ inspections conducted
- Currently 6,331 Systems Permitted and Tracked
- Over 500 cesspools replaced
- 373 failing systems identified over last 13 years, average 29 per year (~2% of inspections), managed, tracked and upgraded
- >$2.5M disbursed in 1% loans for failing system upgrades
- Many other watershed management spinoff projects
- Assist multiple other communities
- Nearly $3M in grant funding for OWTS infrastructure modernization and Community engagement
- Partnerships built; Research/GIS laboratory established

Website: https://charlestownri.gov/wastewater-management Email: Mdowling@charlestownri.gov