



Truro Comprehensive Watershed Management Plan

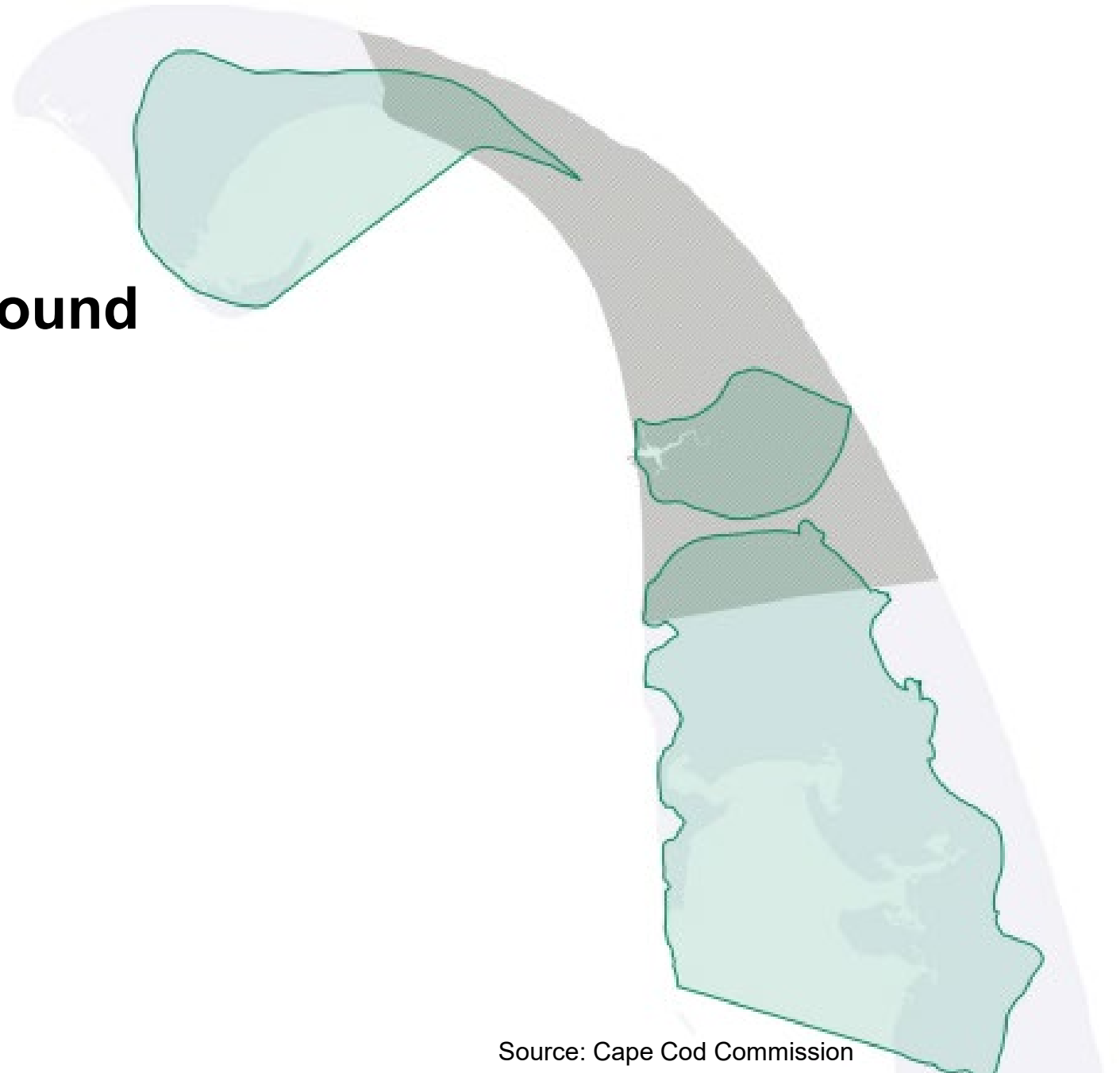
Board of Health Meeting

October 14th, 2025

Welcome

Agenda

- **Project Drivers and Background**
- **Nitrogen Management**
 - Loading to Watersheds
 - Reduction Targets
 - Management Strategies
 - Draft Management Alternatives
- **Public Health Needs**
- **Summary & Next steps**

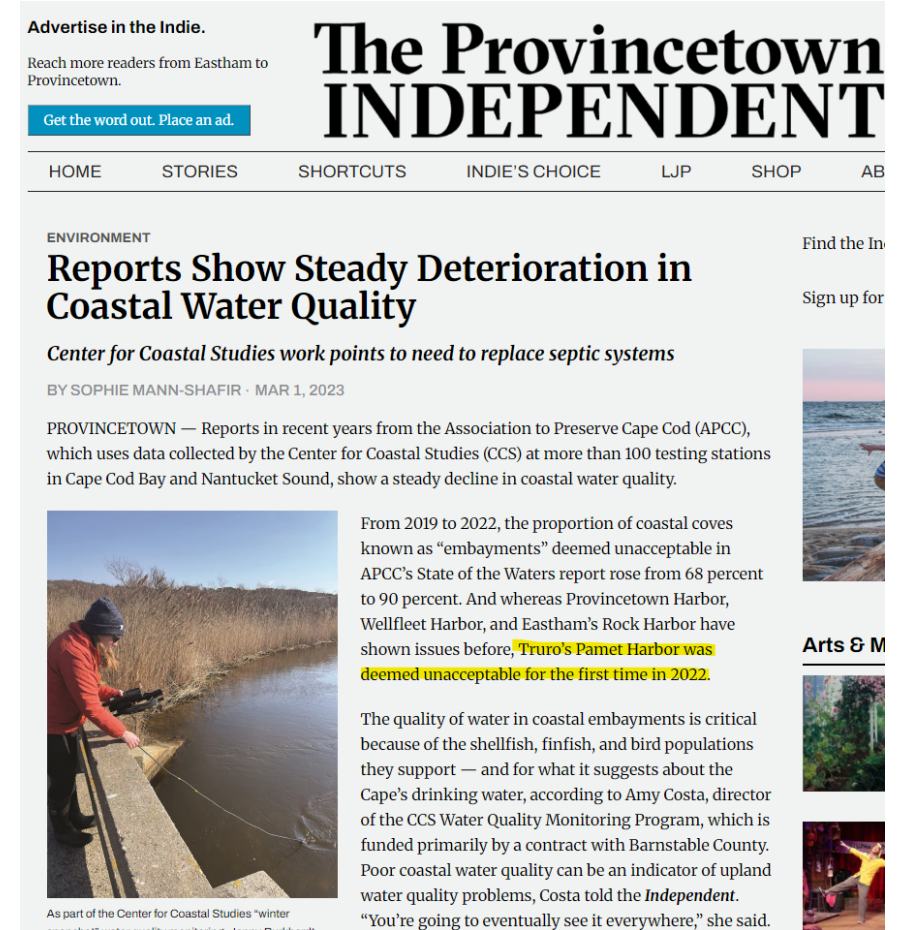


Project Drivers

→ Environmental and Public Health Needs

Environmental Needs

- The Town of Truro needs to **reduce the amount of nitrogen** entering its coastal estuaries to meet MassDEP/EPA requirements
- Excess nitrogen comes primarily from **septic systems**
- Excess nitrogen in the watershed can lead to loss of eelgrass, algae blooms, fish kills and a decline in property values



Background

→ September 25th, 2025 Joint Presentation Refresher

September 25th, 2025 Joint Presentation Refresher

- Wastewater and Nitrogen Management Planning Project focusing on Truro's three coastal estuaries through wastewater and non-wastewater management strategies
 - Provincetown Harbor (shared with Provincetown)
 - Pamet River
 - Wellfleet Harbor (shared with Wellfleet and Eastham)



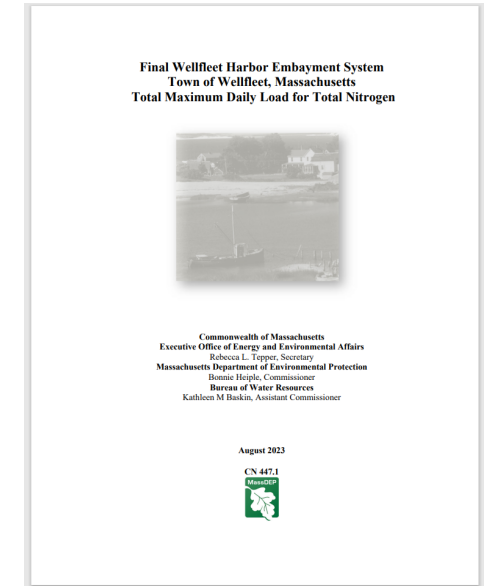
Current Status

Nitrogen Total Maximum Daily Loads (TMDLs)

- Established for Wellfleet Harbor by MassDEP and EPA
- Not yet established for Pamet River and Provincetown Harbor

Cape Cod Commission (CCC) Section 208 Area Wide Water Quality Management Plan

- Includes Watershed Reports which characterize the degree of nitrogen impairment for 53 watersheds on Cape Cod
- For estuaries that do not yet have a MassDEP-approved TMDL, CCC recommends Towns use a 25% nitrogen removal target for initial planning
- CCC 208 Plan Watershed Reports estimates watershed nitrogen sources for Pamet River and Provincetown Harbor (wastewater, fertilizer, stormwater and other).

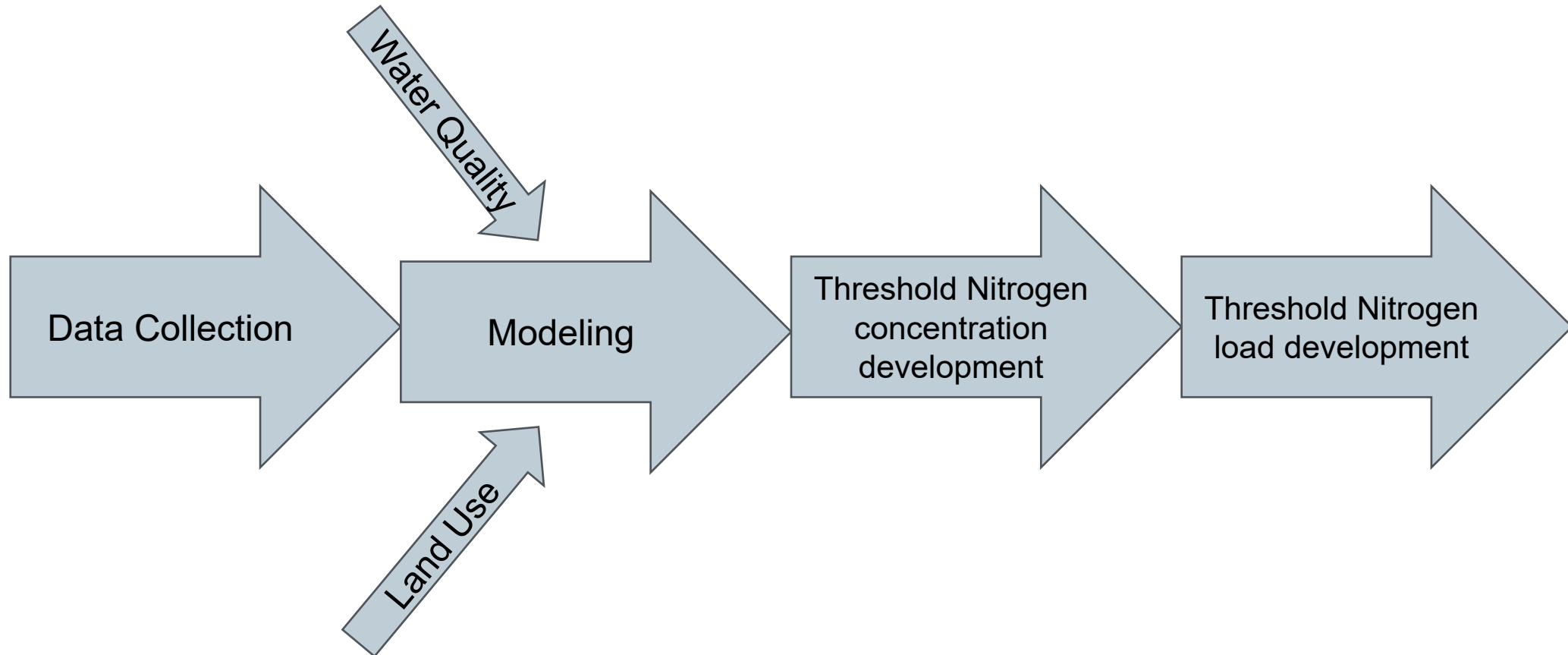


Nitrogen Loading to Watersheds



Massachusetts Estuaries Project

The Massachusetts Estuaries Project uses a linked model to determine an embayment's nitrogen sensitivity and nitrogen threshold levels.



Wellfleet Harbor Sentinel Station



Figure 5: Wellfleet Harbor Long Term Monitoring Stations. Sentinel Station is Station WH-5 for benthic habitat recovery.

Source: Wellfleet Harbor TMDL Report

Sentinel Stations: key monitoring points (typically sensitive areas within the watershed) used to track water quality and set a target nitrogen concentration that protects habitats

- TMDL nitrogen concentrations in Cape Cod estuaries range from 0.34 mg/L to 0.55 mg/L
- Wellfleet Harbor TMDL (target nitrogen concentration) = 0.53 mg/L

Cape Cod Commission (CCC) 25% nitrogen reduction allowance: For watersheds that don't yet have a TMDL, the CCC recommends that communities plan to reduce total nitrogen loads by approximately 25% from existing conditions.

Nitrogen Loading

Source / System	Typical Total Nitrogen Concentration (mg/L)	Notes
Natural background	< 1 mg/L	USGS estimate
Title 5 Septic System Effluent	26.25 mg/L	Massachusetts Estuaries Project estimate
Drinking water	<10 mg/L of nitrate-nitrogen	EPA limit to protect human health (maximum contaminant level)
Wastewater treatment facility with biological treatment effluent	3 – 10 mg/L	After biological or chemical nitrogen removal process

Nitrogen Reduction Targets



Wellfleet Harbor

System Component	Present Attenuated Watershed Load ¹ (kg/day)	Target Threshold Watershed Load ² (kg/day)	Percent watershed reductions needed to achieve target threshold loads
Herring River/The Gut	27.72	27.13	-2.1%

Source: Wellfleet Harbor TMDL Report

- Herring River is the only subembayment within the Wellfleet Harbor watershed in Truro.
- The estimated portion of Herring River in Truro based on land area, is approximately 42%.

Truro’s estimated removal goal =
(Total subembayment load – target threshold load) x percent of load in Truro

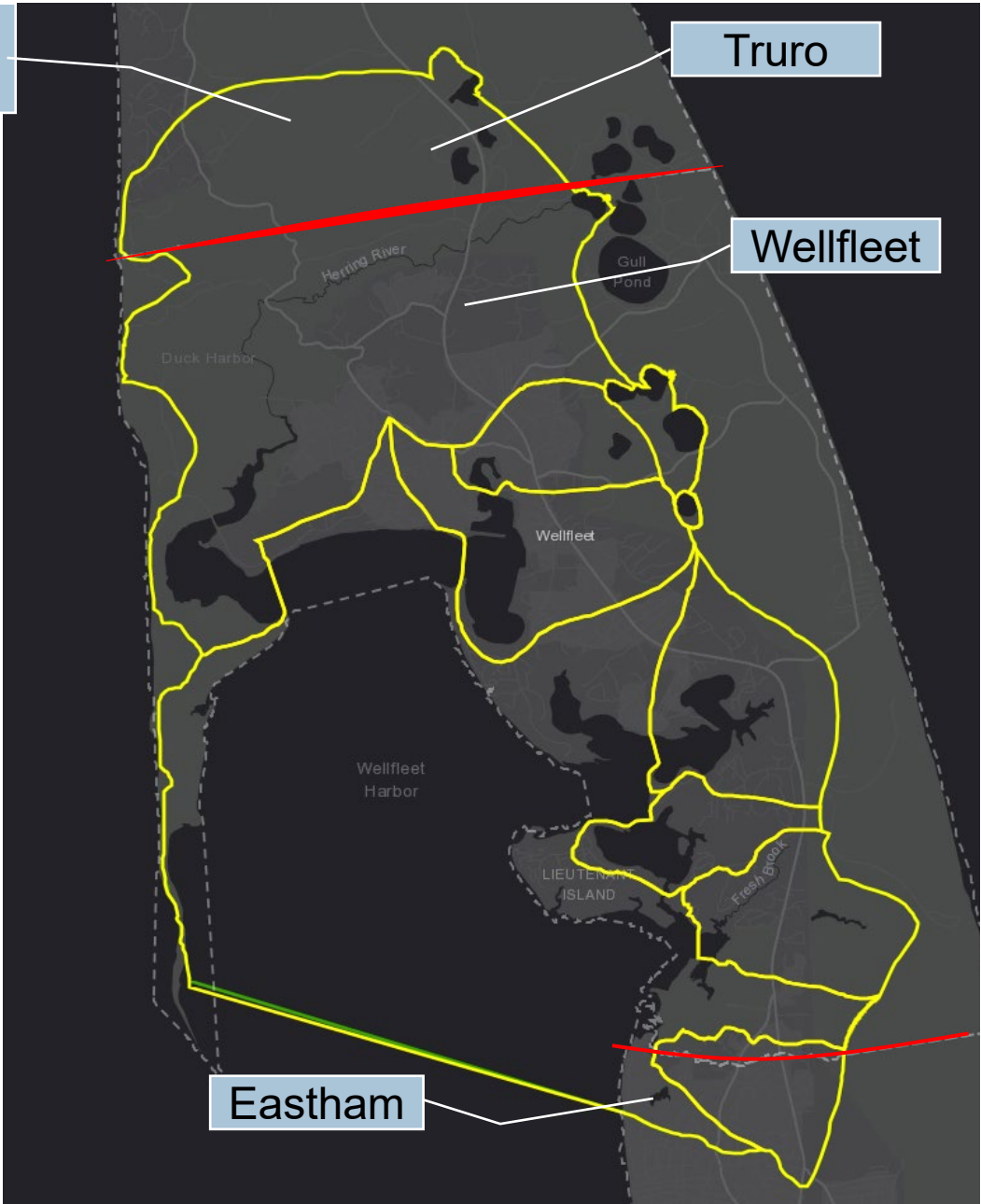
Truro’s estimated removal goal =
(27.72 kg/d – 27.13 kg/d) * 42% = **0.25 kg-N/day**

Herring River /
The Gut

Truro

Wellfleet

Eastham



Source: Watershed MVP

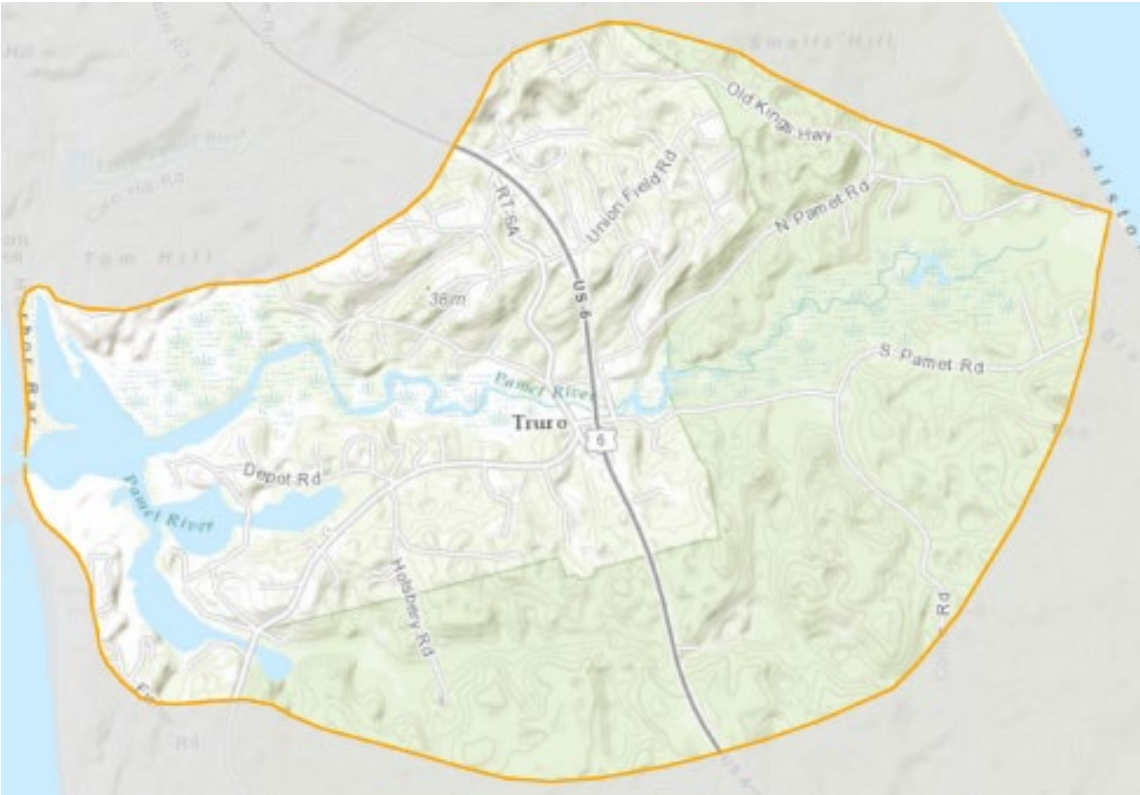
Pamet River

TOTAL UNATTENUATED NITROGEN LOAD VALUES (FROM WMVP)	
Pamet River Nitrogen Sources	Total Unattenuated Watershed Nitrogen Load (kg-N/yr)
Wastewater ¹	3,069
Fertilizer ²	266
Stormwater	738
Other ³	429
TOTAL WATERSHED LOAD	4,502
Total Watershed Threshold ⁴	3,376
TOTAL UNATTENUATED LOAD TO BE REMOVED	1,125

■ **TRURO: 100%**

Source: CCC Watershed Report: Pamet River

Truro’s current estimated nitrogen
removal goal (based on 25% reduction)
= 1,125 kg-N/yr = 3.1 kg-N/day



Provincetown Harbor

TOTAL UNATTENUATED NITROGEN LOAD VALUES (FROM WMVP)	
Provincetown Harbor Nitrogen Sources	Total Unattenuated Watershed Nitrogen Load (kg-N/yr)
Wastewater ¹	11,939
Fertilizer ²	1,174
Stormwater	2,929
Other ³	503
TOTAL WATERSHED LOAD	16,544

■ PROVINCETOWN: 93%

■ TRURO: 7%

Source: CCC Watershed Report:
Provincetown Harbor

Truro's estimated removal goal =
Total watershed load x percent of
load in Truro x 25% removal
target

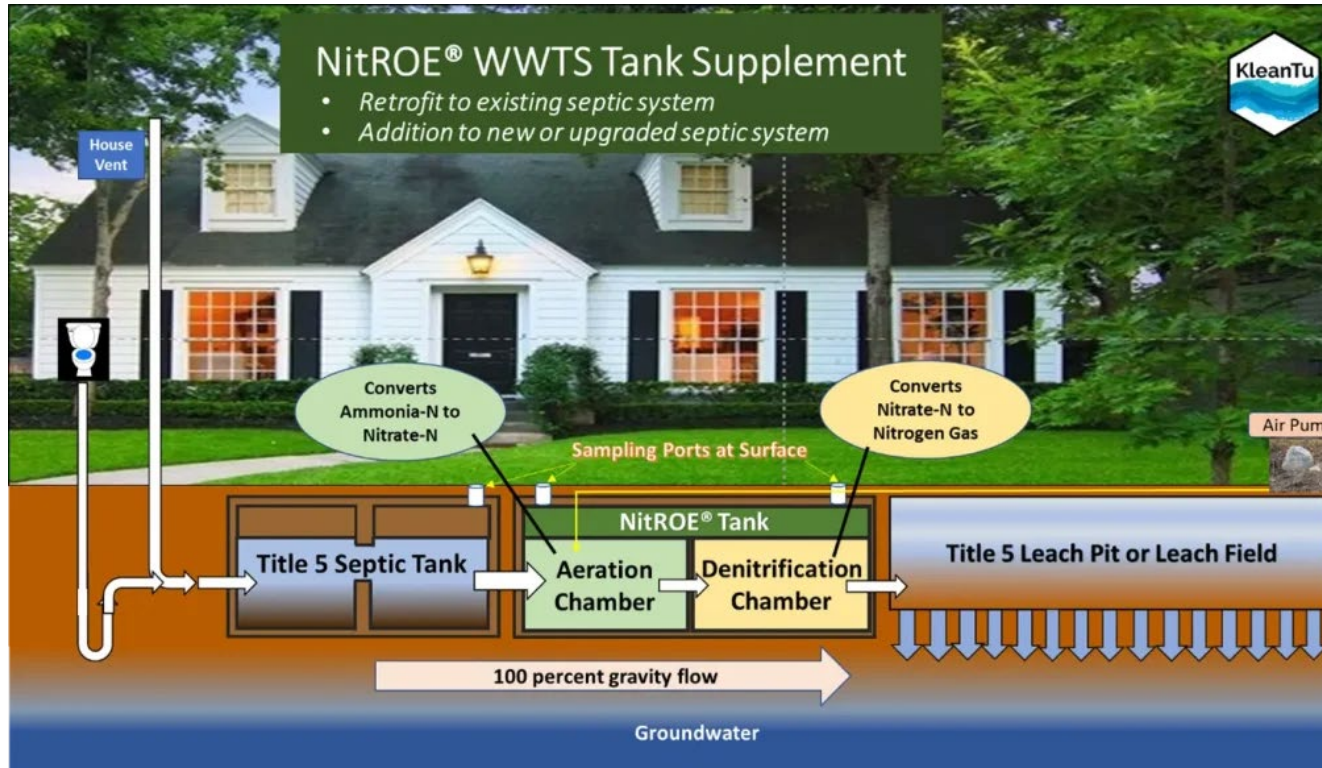
**Truro's estimated nitrogen
removal goal = 290 kg-N/yr = 0.8
kg-N/day**



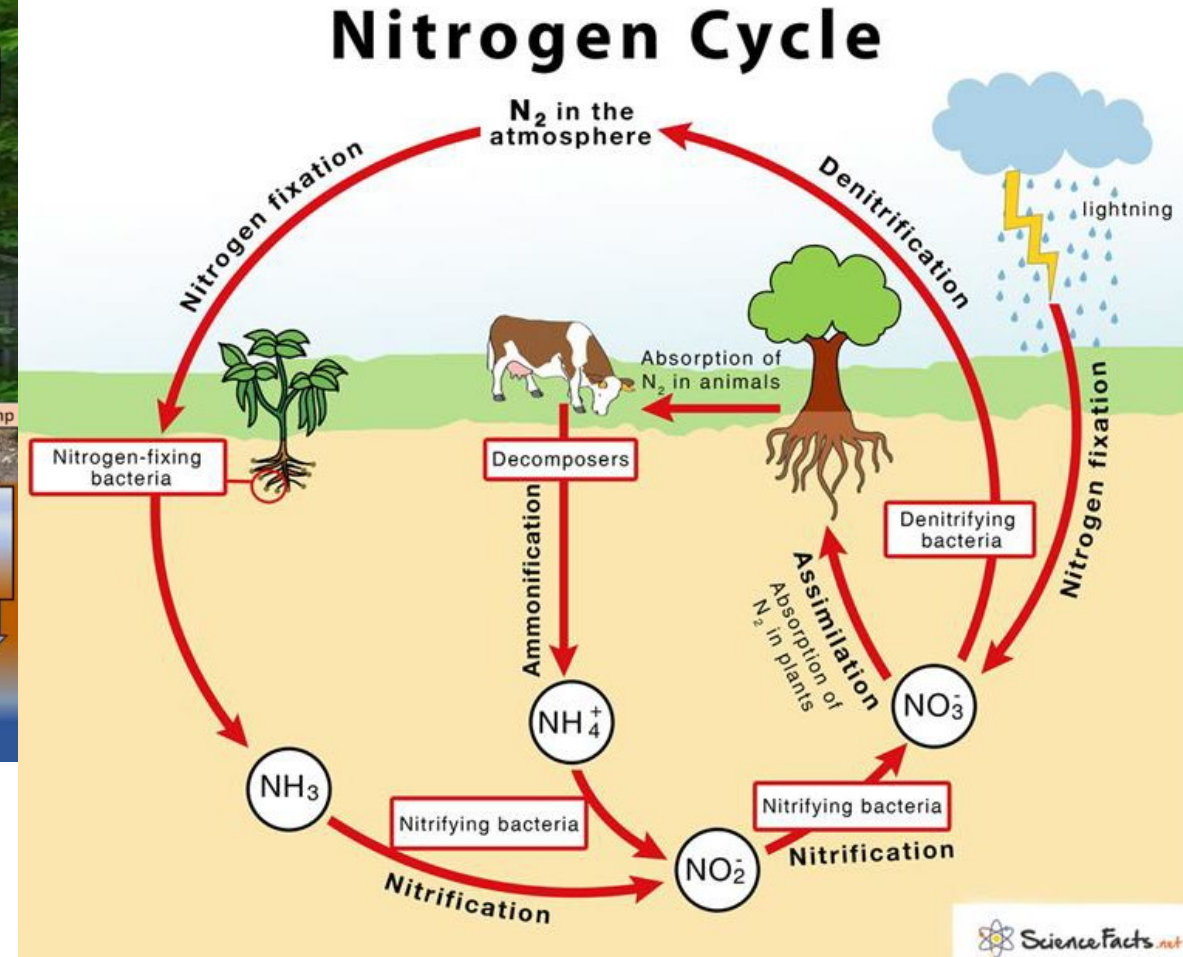
Nitrogen Management Strategies



Nitrogen Reducing Septic Systems



Unlike Title 5 Septic Systems, nitrogen-reducing septic systems add **aeration and/or a carbon source** to promote biological processes that **convert nitrogen into harmless nitrogen gas** (denitrification).



Stormwater Best Management Practices

DESCRIPTION

Non-Structural Stormwater strategies. These strategies include street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and IC reduction and control.

SITING NEEDS

- Varies

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity
- Promotes Green Space / Conservation / Recreation
- Improves Management of Flooding / Extreme Events

PERFORMANCE CHALLENGES

- Requires the creation and enforce of stormwater regulations and policies

Permitting

POTENTIAL PERMITTING AUTHORITIES

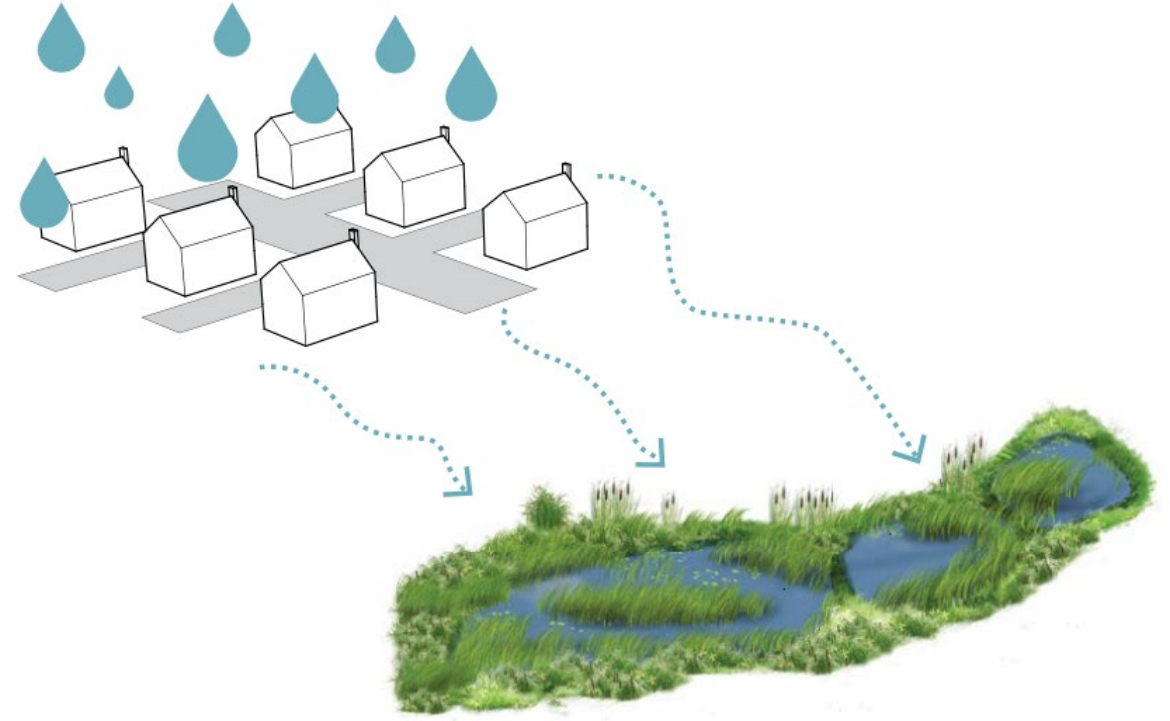
- Municipal Conservation Commission
- Massachusetts Department of Environmental Protection

CLIMATE RESILIENCE: RISKS

- Reduced effectiveness of biological processes as a result of more frequent inundation or exposure to saline water (surface or ground water)

CLIMATE RESILIENCE: SOLUTIONS

- Ensure frequent maintenance inspections to monitor condition and performance of technology (e.g. achieving nutrient removal targets, health of vegetation)
- Project design and species selection to ensure adequate performance in increasingly saline environments



Source: CCC 208 Plan

Constructed Wetland - Source: CCC 208 Plan

Fertilizer Bylaws

DESCRIPTION

This approach relies on managing fertilizer application rates to lawns, golf courses, athletic facilities and cranberry bogs. Residential lawn loading rates could be reduced on existing developed parcels through an intensive public education/ outreach program. This could include a “Cape Cod Lawn” branding program, replacing some turf areas with native vegetation, establishing naturally-vegetated buffer strips on waterfront lots, and reducing application rates. Fertilizer loading rates for new development could be accomplished by reducing lot sizes (cluster development), by restricting lawn sizes and/or by incorporating more naturally-vegetated open space areas. Municipalities could directly reduce fertilizer applications on athletic fields and other properties. Golf courses can significantly reduce nitrogen loading rates by using slow-release fertilizers and reducing application rates in rough areas. Cranberry bog fertilizer exports from the bogs can be reduced using tail water recovery systems. Site-specific assessments are needed to estimate load reductions.

SITING NEEDS

- Fertilizer management does not have specific site requirements.

ECO-BENEFITS

- Enhances Habitat / Wildlife / Biodiversity

Permitting

POTENTIAL PERMITTING AUTHORITIES

- Municipal Board of Health
- Massachusetts Department of Agricultural Resources

PERFORMANCE CHALLENGES

- Resulting nutrient removal rates are highly dependent on homeowner / landowner behavior and participation in the program
- Site-specific assessments are needed to estimate load reductions

CLIMATE RESILIENCE: RISKS

- Fertilizer management does not result in significant climate resiliency risks.

CLIMATE RESILIENCE: SOLUTIONS

- Climate resiliency solutions are not needed for Fertilizer Management.

Technology Performance



Nitrogen Removal 25% to 75%



Phosphorus Removal 3% to 10%

\$24

Removal Cost per kg N
(avg life cycle)

\$141

Removal Cost per kg P
(avg life cycle)

20 years

Useful Life

1 to 10 years

Time to See Results



Source: CCC 208 Plan

Permeable Reactive Barrier

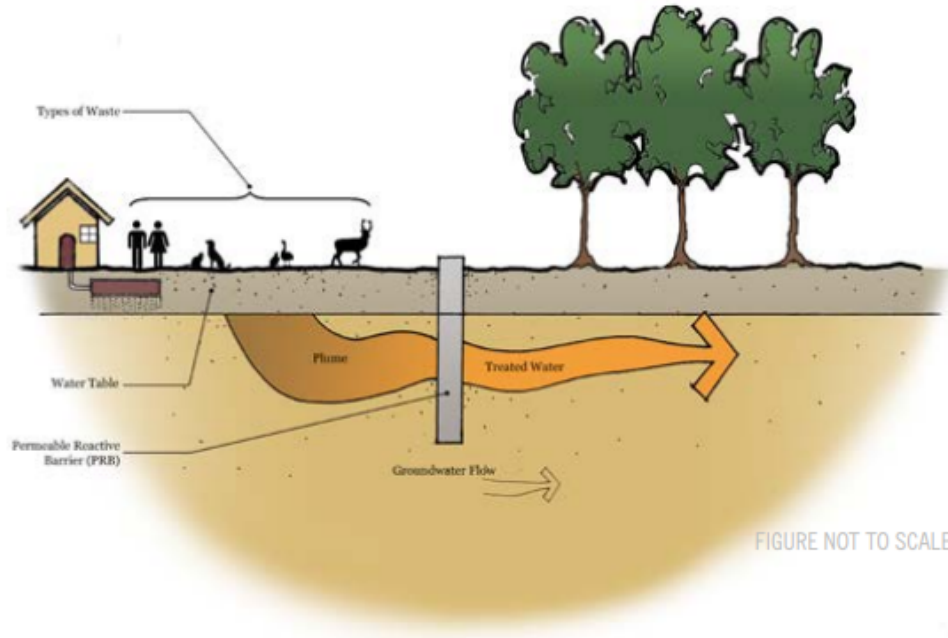


Figure 4-15

Permeable Reactive Barriers (PRBs) Trench Method



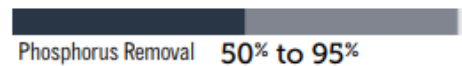
SCALE: SITE/NEIGHBORHOOD
APPROACH: REMEDIATION

SCENARIO PLANNING: SELECTED FOR USE
IDENTIFIED FOR PILOTING

DESCRIPTION

A permeable reactive barrier (PRB) is an in-situ (installed within the aquifer) treatment zone designed to intercept nitrogen enriched groundwater. Through use of a carbon source (the PRB medium), microbes in the groundwater uptake the nitrogen, denitrifying the groundwater. The trench method PRB uses large trenching equipment to install a mixture of coarse sand, wood chips, compost and/or other materials (medium) in the trench created by the trencher. The vertical wall can be installed to a depth of 40 feet with a width of 1.5 to 3 feet; PRBs can also be installed in large diameter columns. As groundwater flows through the wall, the medium provides a carbon source for microbes living in the groundwater. The microbes consume the carbon source as well as oxygen, developing an anaerobic environment which releases nitrogen gas to the atmosphere, reducing the groundwater nitrogen load before reaching the estuary.

Technology Performance



\$158

Removal Cost per kg N
(avg life cycle)

\$743

Removal Cost per kg P
(avg life cycle)

20 years

Useful Life

1 to 10 years

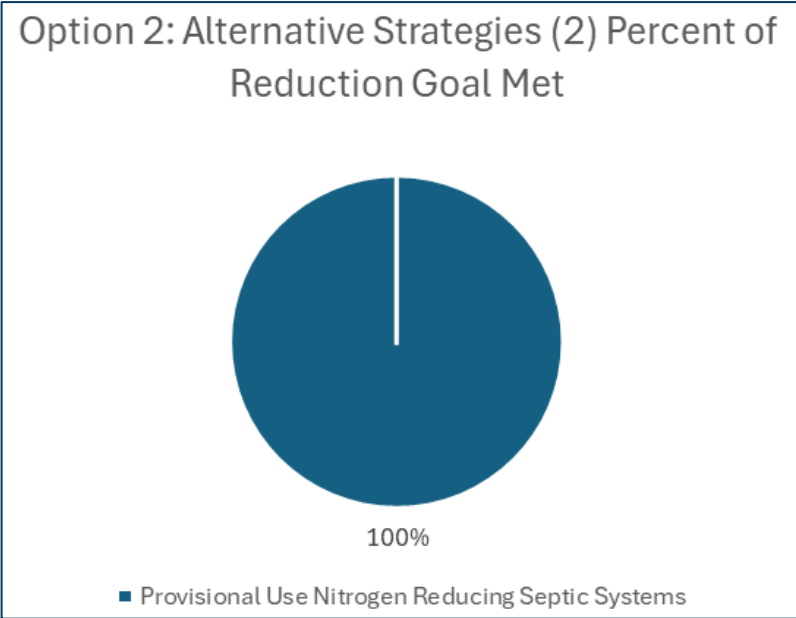
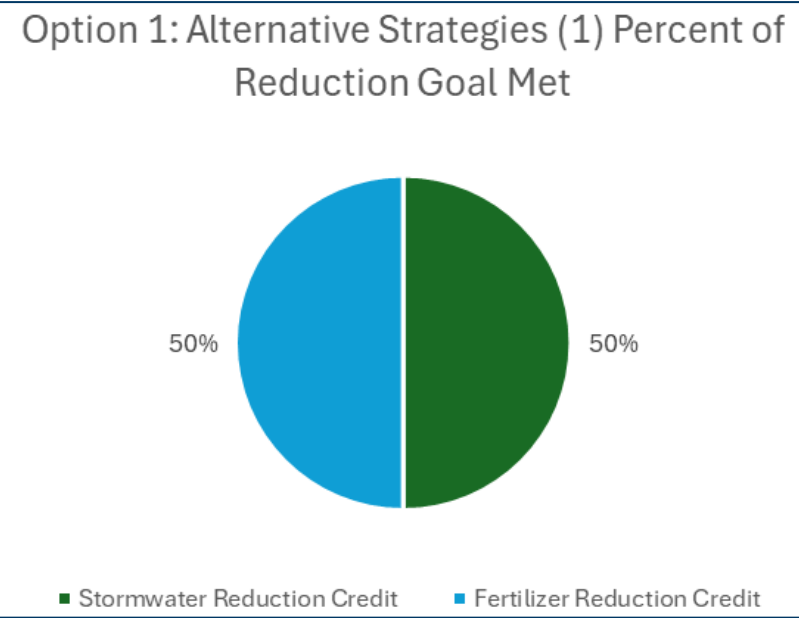
Time to See Results

Draft Nitrogen Management Plans

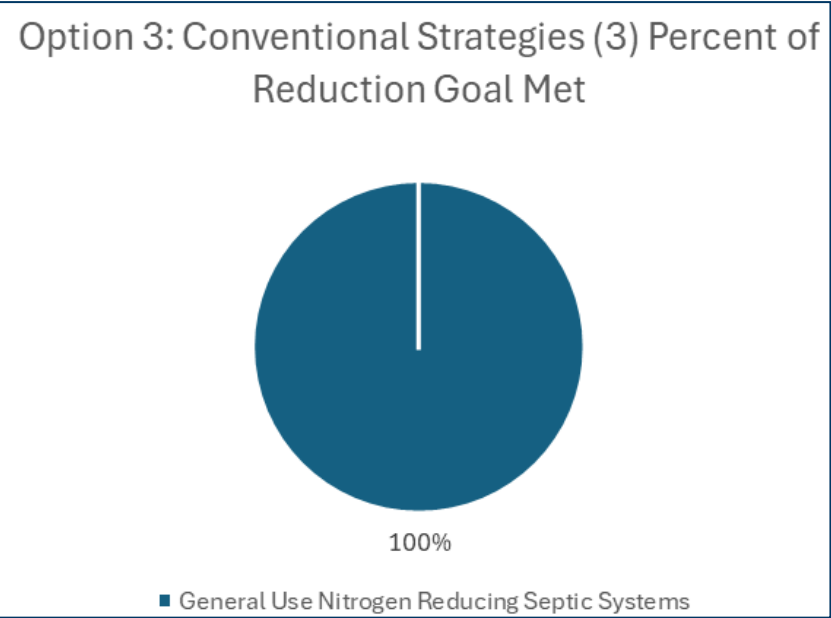


Wellfleet Harbor: Nitrogen Management Strategies Estimated Reductions

Estimated nitrogen reduction goal: 0.25 kg-N/day (based on the TMDL)



~24 nitrogen-reducing systems
(or 26%)

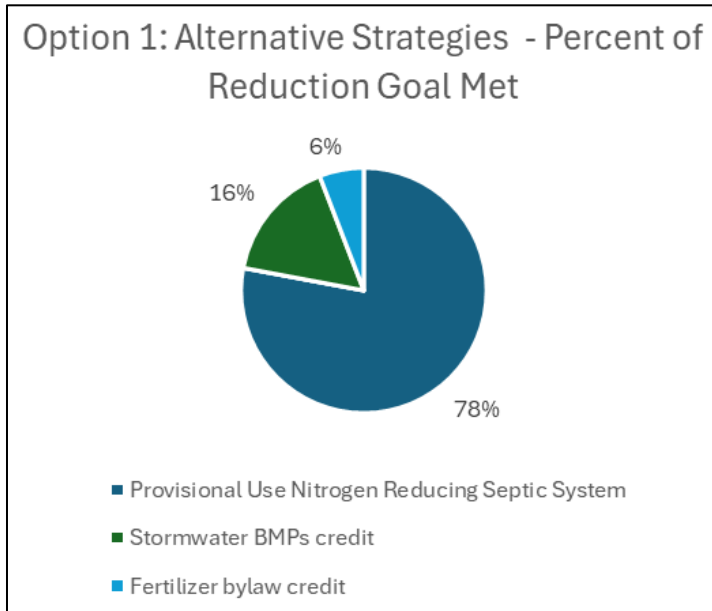


~61 nitrogen-reducing systems
(or 66%)

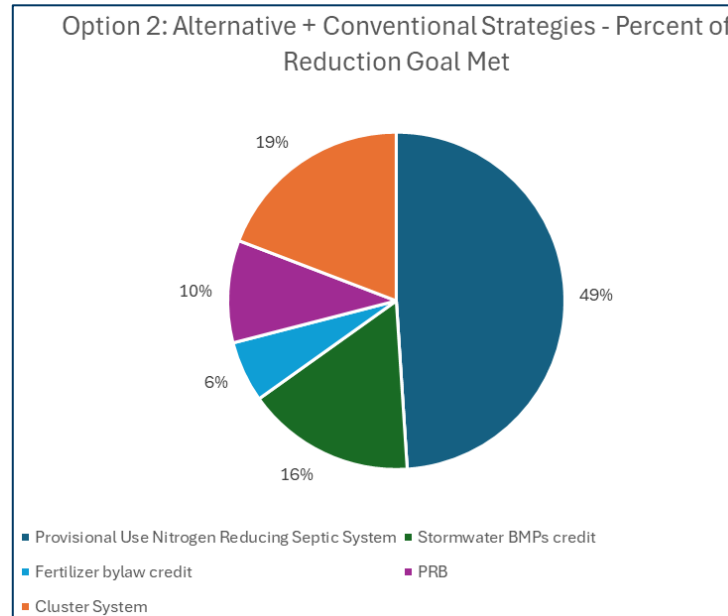
Pamet River: Nitrogen Management Strategies

Estimated Reductions

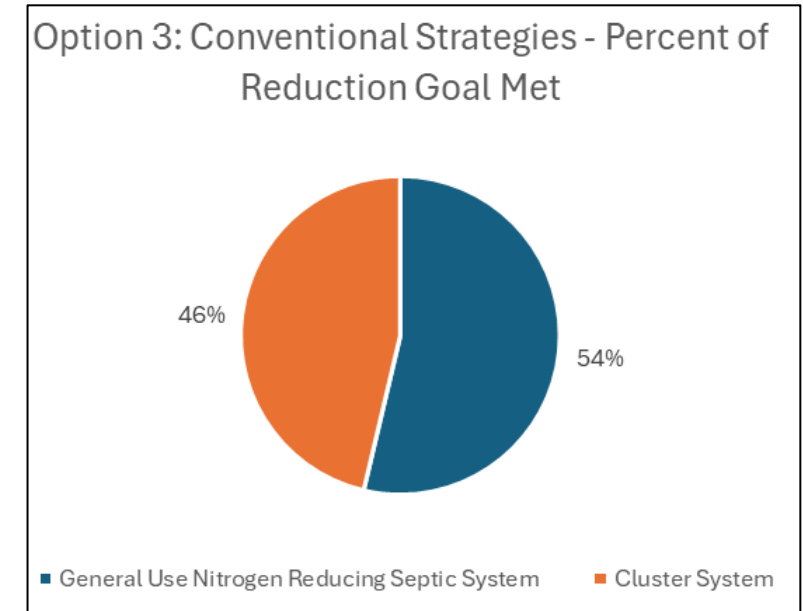
Estimated nitrogen reduction goal: 3.1 kg-N/day (based on the CCC)



~218 nitrogen-reducing systems
(or 38%)



~98 nitrogen-reducing systems
(or 17%)

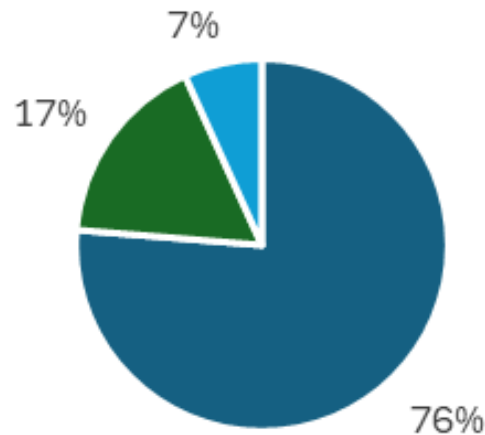


~412 nitrogen-reducing systems
(or 72%)

Provincetown Harbor: Nitrogen Management Strategies Estimated Reductions

Estimated nitrogen reduction goal: 0.8 kg-N/day (based on the CCC)

Option 1: Alternative Strategies - Percent of Reduction Goal Met



- Provisional Use Nitrogen Reducing Septic Systems
- Stormwater BMPs credit
- Fertilizer Bylaw credit

Option 2: Conventional Strategies - Percent of Reduction Goal Met



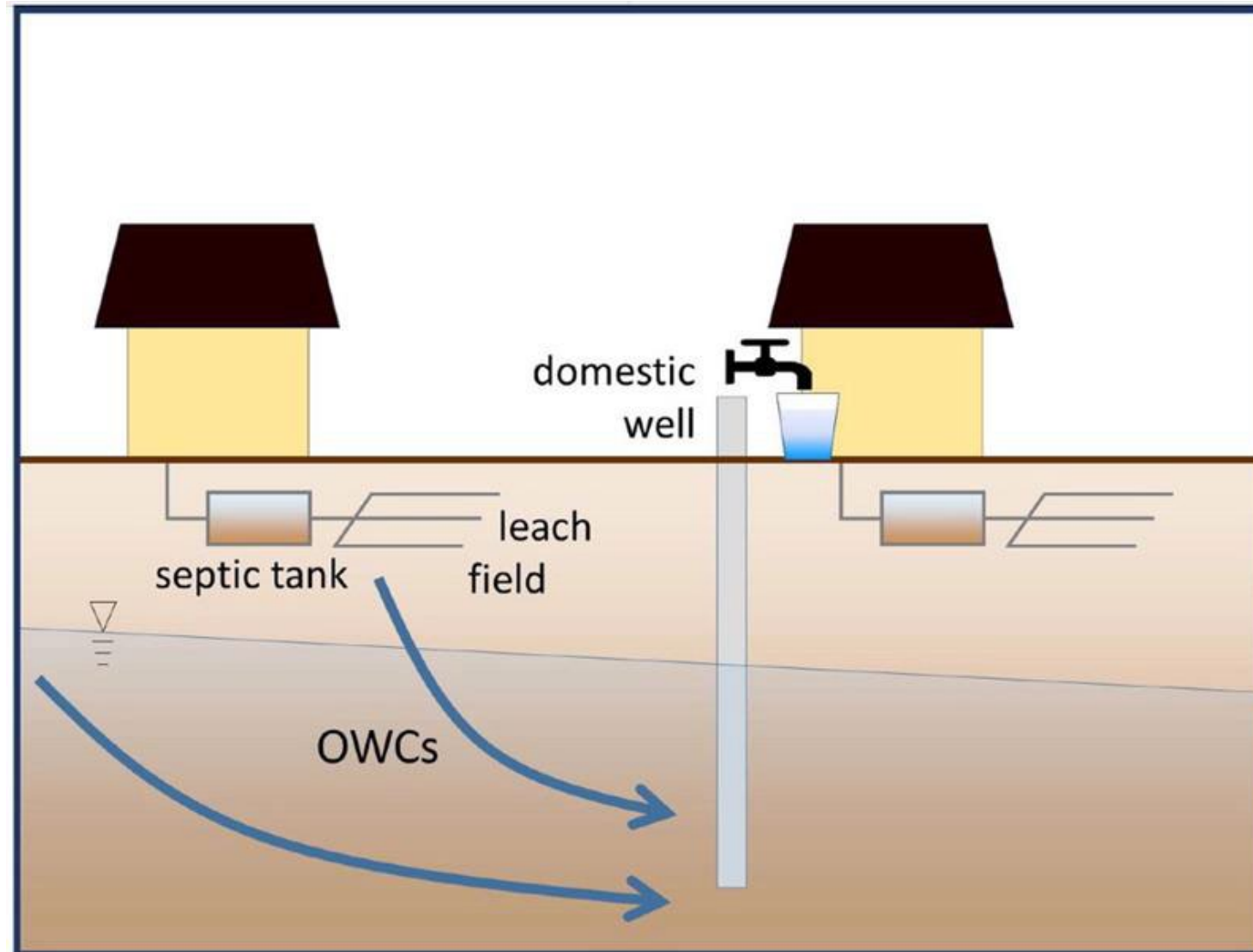
- Sewering

~30 nitrogen-reducing systems (or 30%)

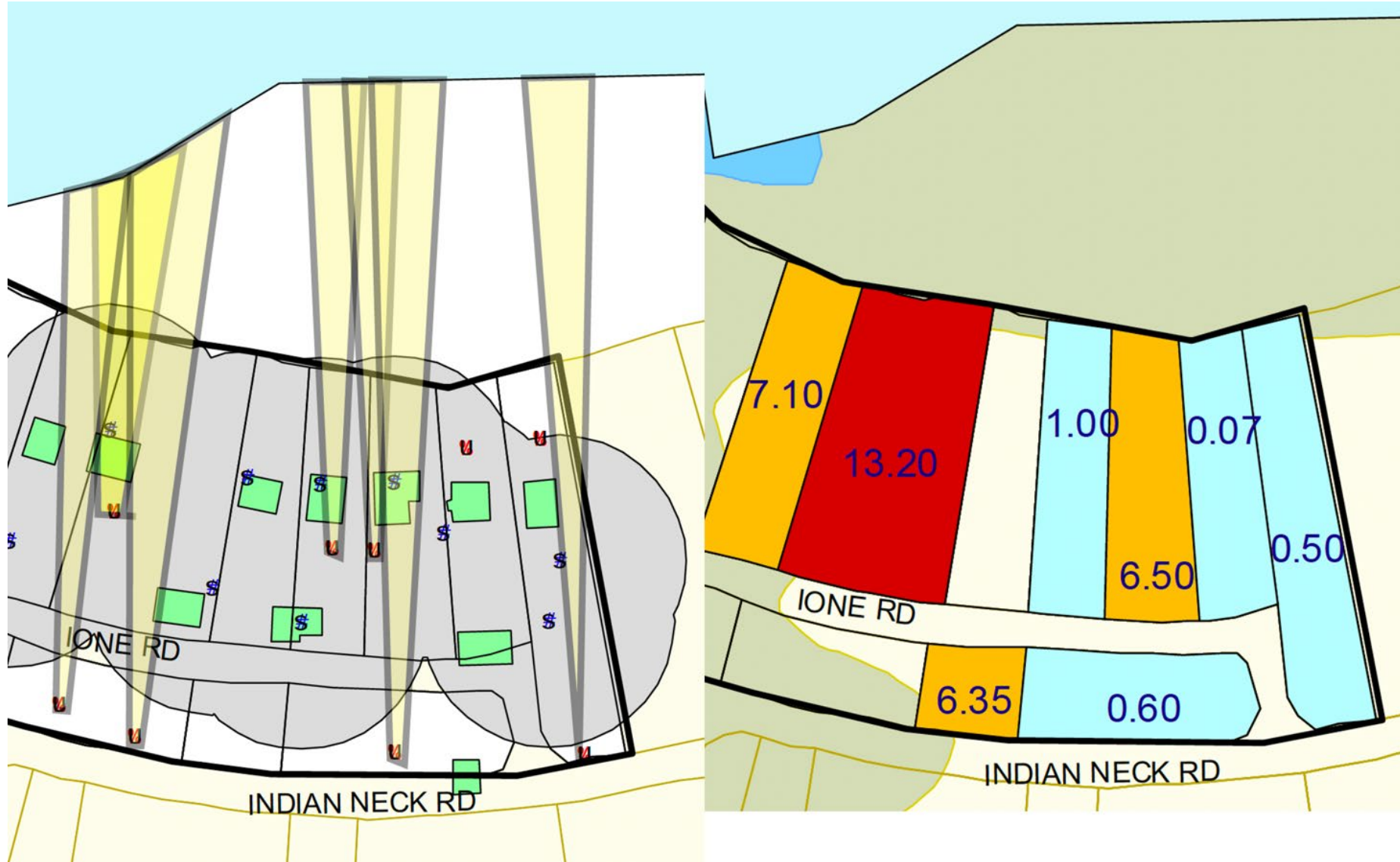
Public Health Needs



Cross Section of On-site septic



Protecting Private Wells



Protecting Private Wells

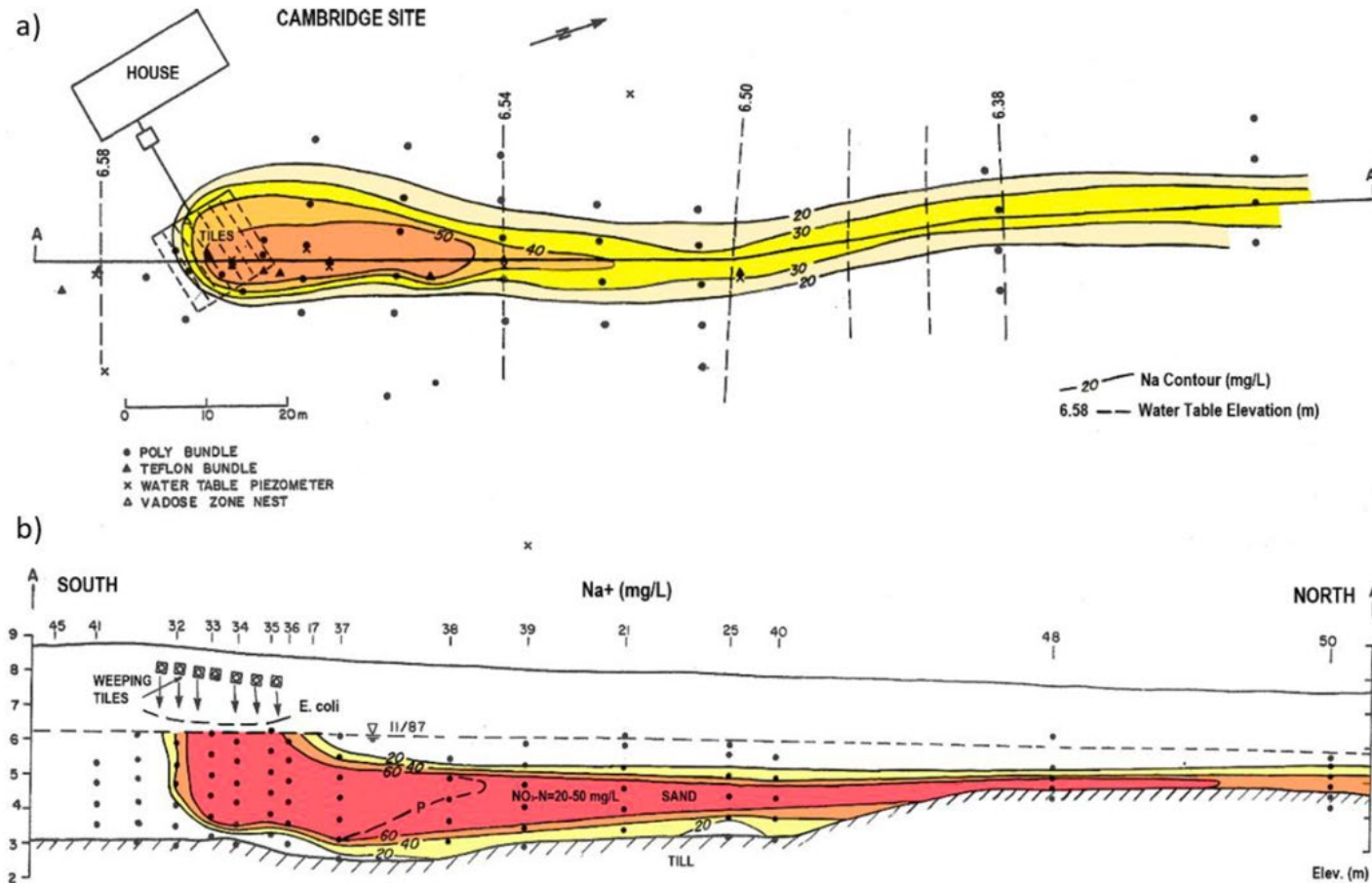
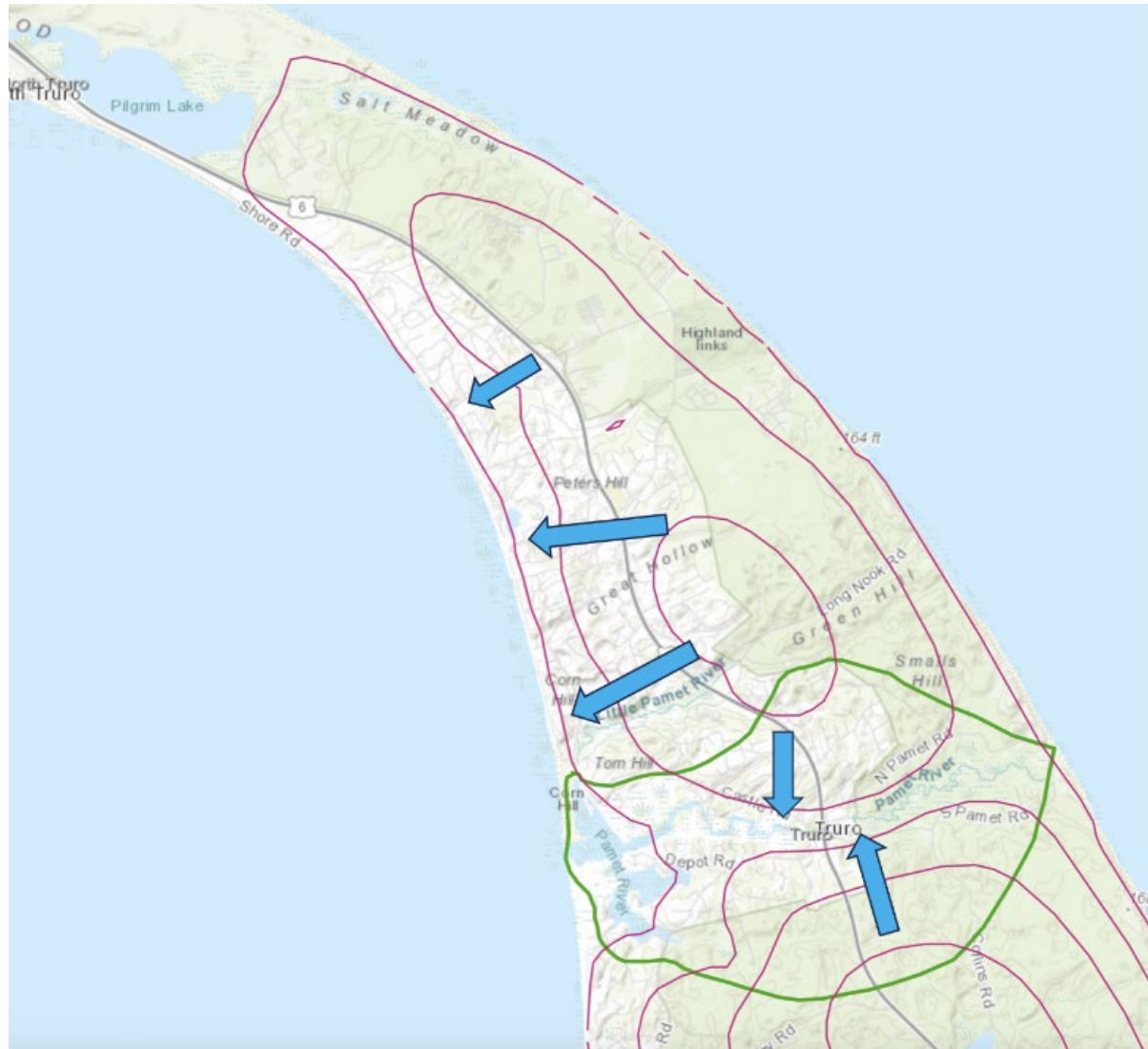
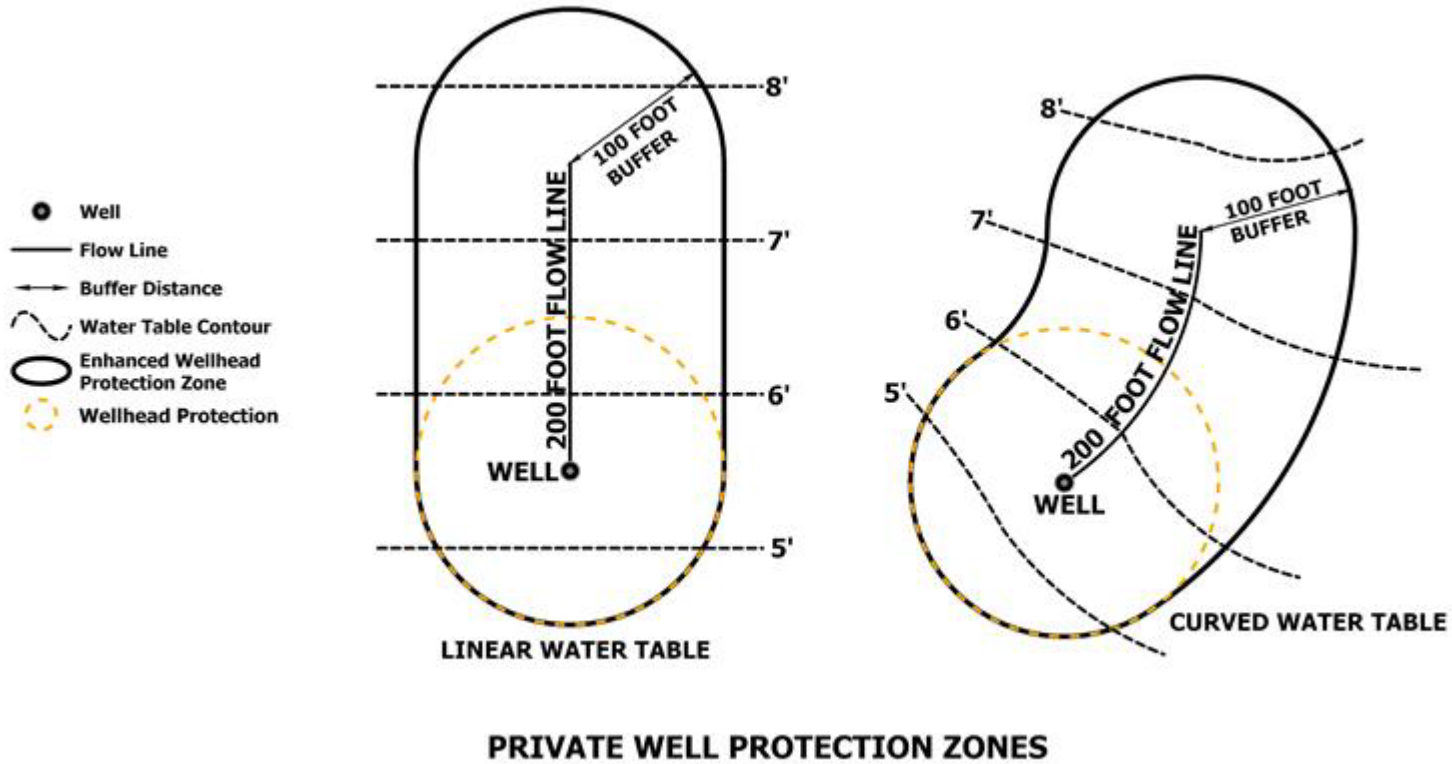


Figure 2 – A plan view (a) and cross-sectional view (b) of a groundwater plume from a household septic system at the Cambridge site in Ontario, Canada, showing: Na^+ concentration (mg/L), the extent of *E. coli* (> 1 cfu/100 mL) presence, and phosphate (P) zones with concentration greater than 1 mg/L, dashed lines, and range of NO_3^- -N concentrations (mg/L) in the plume core. Septic tank effluent has mean Na^+ of 98 mg/L, NH_4^+ -N of 30 mg/L and SRP of 8 mg/L (adapted from Robertson et al., 1991; Shadford et al., 1997; and Robertson, 2003).

Truro Groundwater Table & Flow Direction



Protecting Private Wells



Summary

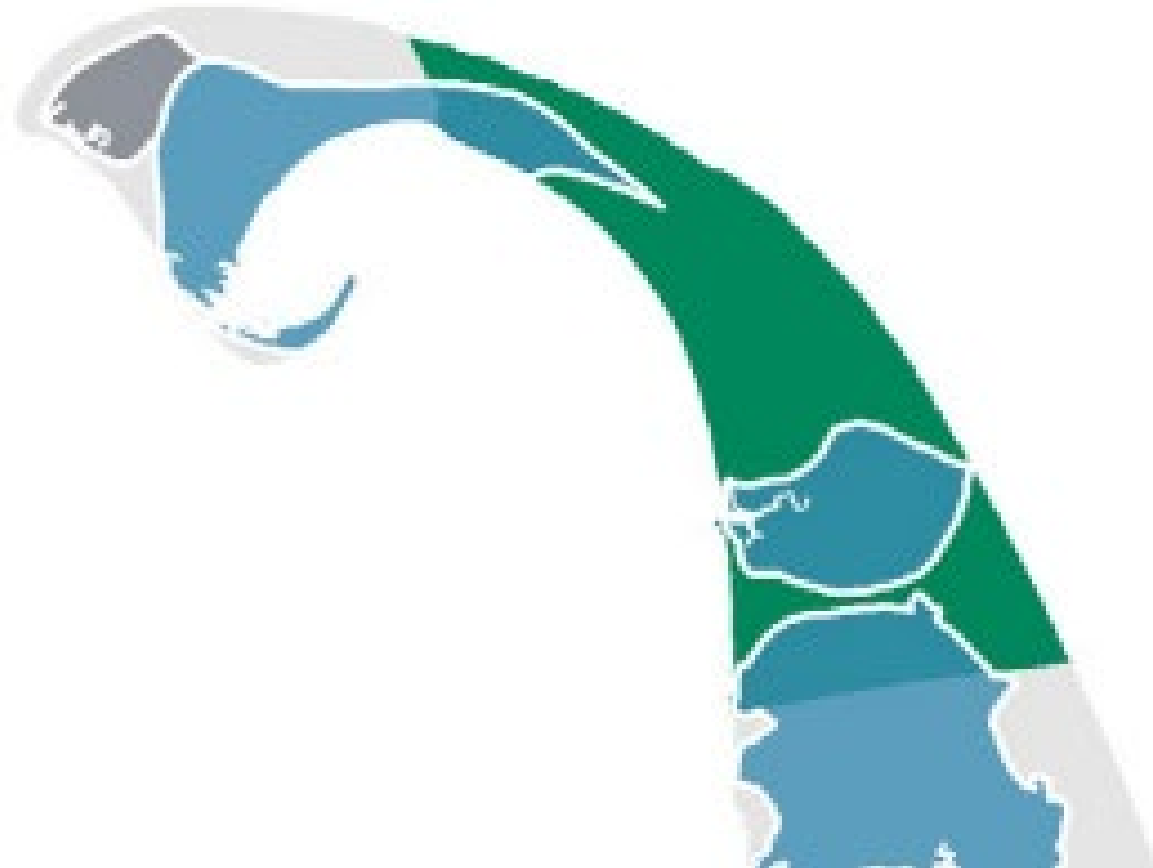
Goal: Reduce the amount of nitrogen entering Truro's coastal estuaries

- Wellfleet Harbor
- Pamet River
- Provincetown Harbor

Implement a variety of nitrogen management strategies that are:

- Cost-effective
- Targeted to sensitive areas

Outcome: Enhanced water quality, human health, and environmental health



Source: Cape Cod Commission

Next Steps

- Finalize Draft Truro Comprehensive Watershed Management Plan, Draft to be available on Town Website Friday, October 31st
- Public meeting: Tuesday, November 18th at 2pm at Truro Town Hall



*** Thank you**