Town of Truro Comprehensive Watershed Management Plan

Alternatives Screening Analysis Report and Draft Recommended Plan – rev1

Town of Truro
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[Status code]							

GHD 380
Contact: Julia Khrakovsky, Engineer | GHD
1545 Iyannough Road
Hyannis, Massachusetts 02601, United States
T +1 774 470 1630 | **F** +1 774 470 1631 | **E** info-northamerica@ghd.com | **ghd.com**

Executive summary

Introduction

The Truro Alternatives Screening Analysis and Draft Recommended Plan summarizes the evaluation of nitrogen management alternatives to present a draft Recommended Plan to reduce excessive nitrogen loading to the Town of Truro's coastal watersheds. Figure ES-1 shows the planning area for this project, which is the Town of Truro. This report supports compliance with the Massachusetts Department of Environmental Protection (MassDEP) Watershed Permit Regulations (314 CMR 21), and builds upon the findings of the Massachusetts Estuaries Project (MEP) and the Cape Cod Commission (CCC) Watershed Reports.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 10 and the assumptions and qualifications contained throughout the Report.

Background and Purpose

Excess nitrogen from septic systems, fertilizers, and runoff has been identified as the primary cause of eutrophication and degraded water quality in Truro's coastal embayments. Elevated nitrogen concentrations in coastal estuaries contribute to algal blooms and habitat loss for aquatic life, which can negatively impact human and environmental health, degrade recreational water quality, and affect tourism and the local economy. In addition to water quality impacts, increased nitrogen loading in groundwater can increase the risk of elevated nitrogen concentrations in private drinking water wells.

While some nitrogen management strategies, such as upgrading individual septic systems, may appear to provide property specific benefits, the resulting improvements in estuarine health, recreation, and overall water quality represent significant public health benefits. Protecting and restoring water quality supports community well-being, public health, and long-term resilience of Truro's coastal environment. The purpose of this Report is to identify and evaluate feasible nitrogen management reduction strategies for all of Truro's watersheds to improve coastal water quality.

There are three coastal watersheds within the Town of Truro:

– Wellfleet Harbor (located primarily within Wellfleet, with small portions in Eastham and Truro)
– Provincetown Harbor (further referred to as East Harbor; located primarily within Provincetown, with a small portion in Truro)
– Pamet River (located entirely within Truro)

Although the Town has three watersheds, to date, only Wellfleet Harbor has a complete MEP Report and nitrogen Total Maximum Daily Load (TMDL) issued by MassDEP and EPA. The other two watersheds, Pamet River and Provincetown Harbor, do not currently have a MEP Report or an established nitrogen TMDL; however, both have undergone water quality testing that indicates water quality impairments and recommendations for further water quality evaluation. Truro's estimated nitrogen loads and threshold loads are presented in Table ES-1.1. The threshold load represents the maximum nitrogen load in a coastal estuary that will support its established water quality goals.

For Wellfleet Harbor, the nitrogen TMDL was used to determine Truro's threshold load and required reductions. For watersheds without a nitrogen TMDL, the Cape Cod Commission (CCC) 208 Plan recommends that nitrogen-impaired watersheds use an initial nitrogen management planning allowance reduction goal of 25%. The CCC 208 Plan planning allowance was used to establish an initial nitrogen management goal for Pamet River and East Harbor.

Future growth allowances were applied to account for nitrogen loads and required reductions over the 20-year planning period (2027 – 2047). Truro's estimated nitrogen loads and threshold loads are presented in Table ES-1.1.

Table ES-1.1 Estimated Watershed Nitrogen Loads and Threshold Loads

Watershed	Current Total Watershed Nitrogen Load (kg-N/yr)[1,2]	Watersehd Threshold Nitrogen Load (kg-N/yr)	Truro's Portion: Current Watershed Nitrogen Load (kg-N/yr)[4,5]	Truro's Porton: Future (2047) Nitrogen Load (kg-N/yr)[3,4,5]	Truro's Portion: Watershed Threshold Nitrogen Load (kg-N/yr)
Wellfleet Harbor: Herring River / The Gut	10,118	9,902	4,249	4,249	4,159
East Harbor	16,544	4,136	1,158	1,186	869
Pamet River	4,502	3,377	4,502	4,518	3,377
Total	31,164	17,415	9,909	9,953	8,405

Notes:

1. East Harbor and Pamet River current nitrogen load is from the CCC Provincetown Harbor Watershed Report and the CCC Pamet River Watershed Report, respectively.
2. Wellfleet Harbor current nitrogen load is from the Wellfleet Harbor TMDL report.
3. Future nitrogen loads were estimated using the housing developments outlined in the 2025 HPP. The East Harbor future load was estimated using a growth allowance for septic nitrogen load in the Town of Truro.
4. Truro's portion of the watershed load for Provincetown Harbor and Pamet River was calculated using the percent of the load in Truro according to the respective CCC Watershed Report.
5. Truro's portion of the watershed load in Wellfleet Harbor was estimated based on land area.

Table ES-1.2 summarizes Truro's estimated nitrogen reduction goals.

Table ES-1.2 Planning Period Nitrogen Reduction Goals[5]

Watershed	Current Nitrogen Reduction Goal (kg-N/yr)	Future Nitrogen Reduction Goal[4] (kg-N/yr)
Wellfleet Harbor[1]	90	90
East Harbor[2]	289	317
Pamet River[3]	1,125	1,141
Total	**1,504**	**1,548**

Notes:

1. Nitrogen reduction goal is based on Truro's contribution to the Wellfleet Harbor Watershed, in accordance with the MEP reduction goal and methodology. Loads for Wellfleet Harbor are attenuated, in accordance with MEP reports. Attenuation in Wellfleet Harbor is minor.
2. Nitrogen reduction goal is 25% of Truro's load within the Provincetown Harbor watershed. Truro accounts for 7% of the Provincetown Harbor watershed load according to CCC. Loads for East Harbor are unattenuated, as presented in the CCC reports.
3. Nitrogen reduction goal is 25% of the watershed load. Loads for Pamet River are unattenuated, as presented in the CCC reports.
4. Future reduction goals are estimated using the established threshold loads and estimated future loads are based on the housing production plan.
5. For reference, an average single-family home with a Title 5 septic system is estimated to discharge approximately 4.7 kg-N/yr. (Source: Wellfleet Harbor MEP Report).

Alternatives Screening Analysis

An Alternatives Screening Analysis was conducted to evaluate different combinations of nitrogen management strategies to meet the Town's reduction goals for the 20-year planning period in each of its watersheds. Both conventional and alternative nitrogen management strategies were evaluated.

The MassDEP Watershed Permit Regulations (314 CMR 21) define conventional control technologies as *'a combination of physical, chemical, and biological processes that provide primary, secondary, or tertiary treatment and have been proven to be consistently effective for treating wastewater or sewage to remove suspended solids, dissolved solids, biological decomposition of organic matter, pathogens, and nutrients from wastewater. Examples of Conventional Control Technology include but are not limited to sewage treatment plans and enhanced nutrient removal alternative septic systems that the Department accepts as conventional.'*

The MassDEP Watershed Permit Regulations (314 CMR 21) define alternative control technologies as *'a technology or approach that is not a conventional control approach or technology but can be effectively used to remove pollutants from a waterbody or prevent or reduce the introduction of pollutants into a waterbody.'*

Each alternative was screened for its technical feasibility, nitrogen removal efficiency, and cost-effectiveness. Following the technologies screening analysis, a Recommended Nitrogen Management Plan (Recommended Plan) and Contingency Nitrogen Management Plan (Contingency Plan) was developed. The Recommended Plan includes several Alternative Strategies; in accordance with 314 CMR 21, a contingency plan that consists only of Conventional Control technologies is provided. Adaptive management allows the Town to implement Alternative Control technologies, monitor performance over time, and adjust strategies as needed. Pilot strategies will be closely monitored for performance to confirm if nitrogen reduction targets are being met as intended.

Nitrogen Management Alternatives

Based on the Alternatives Screening Analysis, nitrogen management strategies for Truro's three coastal estuaries were selected for the Recommended and Contingency Plans. Tables ES-1.3 through ES-1.5 summarize the nitrogen management strategies and anticipated nitrogen reductions for each of Truro's watersheds.

Table ES-1.3 Wellfleet Harbor Watershed Nitrogen Management Plan

Nitrogen Management Strategy	Estimated Nitrogen Reduction (kg-N/yr)	
	Recommended Plan	Contingency Plan
Stormwater Best Management Practices	54	0
Fertilizer Bylaw	51	0
Conversion of Existing Title 5 Systems to General Use Nitrogen-Reducing Systems – Single and Multi-Family Residential Properties[1]	0	92
Estimated Nitrogen Removed through Nitrogen Management Plan	**105**	**92**
Nitrogen Reduction Goal to Meet TMDL - Truro (Current)	**90**	**90**
Nitrogen Reduction Goal to Meet TMDL - Truro (2047)	**90**	**90**

Notes:

1. General Use Nitrogen-Reducing systems are approved for residential use.

Table ES-1.4 East Harbor Nitrogen Management Plan

Nitrogen Management Strategy	Estimated Nitrogen Reduction (kg-N/yr)	
	Alternative 1[1]	Alternative 2[1]
Stormwater Best Management Practices	51	0
Fertilizer Bylaw	21	0
Conversion of Existing Title 5 Systems to Provisional Use Nitrogen-Reducing Systems[2]	246	
Sewering[3]	0	989
Estimated Nitrogen Removed through Nitrogen Management Plan	**318**	**989**
Nitrogen Reduction Goal - Truro (Current)	**288**	**288**
Nitrogen Reduction Goal - Truro (2047)	**318**	**318**

Notes:

1. Alternatives 1 and 2 are presented in place of Recommended and Contingency plans because the findings of this report conclude that additional analyses should be performed in East Harbor prior to providing a Recommended Plan. For additional information, refer to Section 4.5.3.
2. Provisional Use Nitrogen-Reducing systems are approved for residential and commercial use.
3. Alternative 2 sewering load is the estimated nitrogen load reduction removed by connecting a portion of Beach Point to the Provincetown Wastewater Treatment Facility. The portion selected during discussions with the Town of Truro includes parcels between 361 Shore Drive - 563 Shore Drive.

Table ES-1.5 Pamet River Watershed Nitrogen Management Plan

Nitrogen Management Strategy	Estimated Nitrogen Reduction (kg-N/yr)	
	Recommended Plan	Contingency Plan
Stormwater Best Management Practices	186	0
Fertilizer Bylaw	66	0
Permeable Reactive Barrier	112	0
Cluster System – Pamet River East	220	303
Cluster System – Pamet River West	0	227
Conversion of Existing Title 5 Systems to Provisional Use Nitrogen-Reducing Systems[1]	561	0
Conversion of Existing Title 5 Systems to General Use Nitrogen-Reducing Systems – Single and Multi-Family Residential Properties[2]	0	614
Estimated Nitrogen Removed through Nitrogen Management Plan	**1,145**	**1,144**
Nitrogen Reduction Goal - Truro (Current)	**1,125**	**1,125**
Nitrogen Reduction Goal - Truro (2047)	**1,141**	**1,141**

Notes:

1. Provisional Use Nitrogen-Reducing systems are approved for residential and commercial use.
2. General Use Nitrogen-Reducing systems are approved for commercial use.

Comprehensive Watershed Management Plan

The Comprehensive Watershed Management Plan presents the Recommended and Contingency Nitrogen Management Plans for the Town of Truro through a combination of septic and non-septic nitrogen management strategies.

The Recommended Plan integrates multiple nitrogen management strategies including stormwater best management practices, fertilizer management, onsite nitrogen-reducing septic systems (currently in Provisional Use Status), cluster systems, and permeable reactive barriers.

The Contingency Plan outlines a strategy comprised of traditional nitrogen management technologies (onsite nitrogen-reducing systems (currently in General Use status), centralized wastewater collection, and cluster systems) that would be implemented if the pilot technologies included in the Recommended Plan did not perform as anticipated.

The Adaptive Management Approach will enable the Recommended Plan to be adjusted based on the monitoring results of the various pilot technologies. Coordination with MassDEP will be conducted throughout this process. The Contingency Plan will then only require implementation through this Adaptive Management Program, in whole, or in part, based on the performance of the Recommended Plan.

A Responsible Management Entity (RME) will need to be established to implement the nitrogen-reducing onsite septic system program outlined in the Recommended Plan. The RME is anticipated to oversee the monitoring of the nitrogen-reducing onsite program as part of the Town's Recommended Plan. RME responsibilities could be fulfilled through a Town department or subcontracted.

Planning Level Capital Cost Estimates for the Recommended and Contingency Plan are summarized in Table ES-1.6.

Table ES-1.6 Truro Comprehensive Watershed Management Plan – Planning Level Capital Cost Estimates

Strategy	Recommended Plan – Full Estimated Capital Costs (2025 $)	Contingency Plan – Full Estimated Capital Costs (2025 $)
Fertilizer Management Allowance[1,2]	$-	$-
Stormwater Best Management Practices Allowance[2]	$8.66 M	$-
Permeable Reactive Barrier Allowance[2]	$1.38 M	$-
Nitrogen Reducing Onsite Septic System Program[3,4]	$9.06 M	$32.82 M
Centralized Sewering (Treated at Provincetown WWTF)[5,6]	$-	$14.78 M
Cluster System – Pamet River East[7]	$4.46 M	$5.94 M
Cluster System – Pamet River West[7]	$-	$6.31 M
Total Capital Costs (2025 $)	**$23.56 M**	**$59.86 M**

Notes:

1. No capital cost is carried for a fertilizer management allowance because this strategy does not involve any construction projects. All implementation measures are regulatory actions.
2. Stormwater best management practices, and permeable reactive barrier costs were based on planning level costs from the Cape Cod Commission 208 Plan 2015 Update. Stormwater BMP cost includes budget for implementation of non-structural strategies, including street sweeping, maintenance of stormwater utilities, education and public outreach programs, land use planning, and impervious cover reduction and control.
3. General Use nitrogen-reducing system costs were developed based on the planning values outlined in the 'Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod – Guidance to Cape Cod Towns Undertaking Comprehensive Wastewater Management Planning,' prepared by the Barnstable County wastewater Cost Task Force – April 2010, updated by AECOM (updated April 2014).
4. Provisional nitrogen-reducing system costs are based on recent (2023) construction bids from other Cape Cod towns.

Strategy	Recommended Plan – Full Estimated Capital Costs (2025 $)	Contingency Plan – Full Estimated Capital Costs (2025 $)
5. Recent regional construction bids from Chatham, Barnstable, and Falmouth were used to develop an average per parcel construction cost for the collection system. The sewering cost includes allowances for Truro's contribution to Provincetown for capacity and infrastructure costs. 6. Centralized sewering cost includes an allowance for contributions to Provincetown for infrastructure and capacity costs which were established through discussions between Truro and Provincetown. 7. Cluster system cost estimates were based on vendor quotes obtained in 2025. 8. Planning level project costs are presented in 2025 dollars (ENR January 2025 = 13731.6). Once a construction timeframe is finalized for each project, project costs should be adjusted to the anticipated mid-point of construction. Planning level capital cost estimates for infrastructure recommended as part of a multi-year planning project are typically developed as part of the planning process. As the project progresses, it is critical that these initial estimates are updated and refined at each stage of the planning and design process and prior to construction financing to accurately reflect items that may affect the cost estimates.		

The targeted milestone implementation schedule is included in Table ES-1.7.

Table ES-1.7 Truro Comprehensive Watershed Management Plan – Targeted Milestone Implementation Schedule

Phase	Years		Activity	Nitrogen Reduction (kg/yr)
	Up to 2027		Develop methodology to implement nitrogen-reducing onsite septic system program (i.e. BOH triggers or phased approach)	
1	1 to 5	2027 - 2031	Obtain Watershed Permit for Wellfleet Harbor (by 2030)	
			Enact Fertilizer Reduction Bylaw	138
			Implement Non-Structural Stormwater Best Management Practices and Regulations	291
			Initiate installation of Nitrogen-Reducing Onsite Septic Systems	202[1]
			Initiate recommended evaluations including: Pamet River: PRB location groundwater characterization and piloting, Little Pamet delineation and evaluation Provincetown Harbor: discussions with Provincetown, vulnerability assessment, culvert sizing evaluation Structural stormwater BMPs: site evaluation Cluster systems: conceptual layout development, coordination with property owners, development of design and construction milestones	
1st Watershed Management Plan Update Report Goals: 1. Evaluate monitoring data 2. Outline any changes in Recommended Plans identified through the Adaptive Management Program				
2	6 to 10	2032 - 2036	Install Permeable Reactive Barrier in Pamet River watershed	112
			Install Pamet River East cluster system	220
			Install Nitrogen-Reducing Onsite Septic Systems	202[1]
2nd Watershed Management Plan Update Report Goals: Goals to be established in the 1st Watershed Management Plan Update.				

Phase	Years		Activity	Nitrogen Reduction (kg/yr)
3	11 to 15	2037-2041	Install Nitrogen-Reducing Onsite Septic Systems	202[1]
3rd Watershed Management Plan Update Report Goals: Goals to be established in the 2nd Watershed Management Plan Update.				
4	16 to 20	2042-2046	Install Nitrogen-Reducing Onsite Septic Systems	202[1]
4th Watershed Management Plan Update Report Goals: Goals to be established in the 3rd Watershed Management Plan Update.				

Notes:

1. For planning purposes, it is assumed that the nitrogen-reducing onsite septic system program achieves 25% of its total estimated reduction in each implementation phase.