

# Executive Summary

## 1. Introduction

The Great Pond Targeted Watershed Management Plan (GPTWMP) outlines Falmouth’s comprehensive strategy for wastewater and nitrogen management in Great Pond to meet the watershed Total Maximum Daily Load (TMDL) requirements for Total Nitrogen (TN). Figure ES-1 (see Attachments) shows the extent of the Great Pond watershed.

This document was prepared in accordance with the February 7, 2020 Executive Office of Energy and Environmental Affairs (EOEEA) Secretary’s Certificate. This document has been prepared by GHD, the Falmouth Water Quality Management Committee (WQMC) and its contractor Science Wares, Inc., the Department of Public Works’ Wastewater Division and will have been approved by the Falmouth Select Board before submittal.

## 2. Great Pond TWMP Planning Basis

To meet the Great Pond TMDL, the Town of Falmouth has developed a nitrogen TMDL Compliance Preferred Alternative for Great Pond which integrates multiple nitrogen management strategies for this watershed including centralized sewerage, shellfish aquaculture, stormwater improvements, permeable reactive barriers, and fertilizer reductions.

The Town has also developed a TMDL Compliance Contingency Alternative, which provides a conservative estimate of additional centralized wastewater collection and treatment that would be required if the pilot projects included in the Preferred Compliance Approach do not perform as anticipated.

The Town has implemented a robust monitoring program for pond water quality and for pilot projects and will continue to monitor performance through its adaptive management program. The Town may adjust its TMDL Compliance Approach over time if/as needed through a Massachusetts Environmental Policy Act (MEPA) Notice of Project Change, based on the monitoring program findings.

An alternatives analysis was conducted to identify a preferred treated effluent discharge site for future wastewater flow. Three planning horizons (with associated wastewater flow rates) were established for the analysis, to allow each site to be evaluated for both near-term and longer-term treated effluent discharge needs. The planning flows are outlined in Table ES.1 and described below.

- **Planning Flow 1 (short-term planning flow)** represents anticipated average annual wastewater flow for the Great Pond Preferred Alternative. Planning Flow 1 (Figure ES-2 – see Attachments) includes flow allocations for existing permitted flow (2021 Permit), an Existing Sewer Area Redevelopment Allocation (ESRA), and the Teaticket / Acapesket Sewer Area estimated future flow (TASA).
- **Planning Flow 2 (medium-term planning flow)** represents anticipated average annual wastewater flow for the South Coast Preferred Alternative. Planning Flow 2 (Figure ES-3 – see Attachments) includes Planning Flow 1 and an allocation for potential future sewer service areas outlined by the Town of Falmouth WQMC in the South Coast estuaries in Seacoast Shores (Waquoit Bay watershed), Antler Shores (Waquoit Bay watershed), Seapit (Waquoit Bay watershed), Fishermans Cove (Bournes Pond watershed), and Oyster Pond (Oyster Pond watershed).
- **Planning Flow 3 (long-term/contingency planning flow)** represents anticipated average annual wastewater flow for the Great Pond Contingency Alternative. Planning Flow 3 includes Planning Flow 1, Planning Flow 2, and

an allocation for contingency sewerage in the Great Pond watershed if pilot nitrogen management strategies do not perform as anticipated.

**Table ES.1. Centralized Wastewater Management Alternatives Analysis Planning Flows 1 through 3**

Planning Flow	Flow Components	Average Wastewater Flow (mgd)
Planning Flow 1: Great Pond Preferred Alternative	Existing Permitted Flow <sup>1</sup>	0.71
	Existing Sewer Area Redevelopment Allocation (ESRA) <sup>2</sup>	0.14
	Teaticket / Acapesket Sewer Area (TASA) <sup>3,6</sup>	0.36
Planning Flow 2: South Coast Preferred Alternative	Potential Bourne Pond, Oyster Pond and Waquoit Bay Sewer Area <sup>3,4,7</sup>	0.34
Planning Flow 3: Great Pond Contingency Alternative	Great Pond Contingency Sewering <sup>5</sup>	0.19
<b>Planning Flow 1 Total</b>		<b>1.21</b>
<b>Planning Flow 2 Total</b>		<b>1.55</b>
<b>Planning Flow 3 Total</b>		<b>1.74</b>
<p>Notes:</p> <p>Groundwater Discharge Permit No. 168-6, effective date February 5, 2021 (2021 Permit).</p> <p>For this analysis, the ESRA was estimated as 20% of existing permitted flow.</p> <p>Flow includes WQMC allowance for infiltration/inflow (I/I) in a gravity system. Estimated I/I is not included in nitrogen load calculations.</p> <p>Potential future sewer area outlined by the WQMC which includes Seacoast Shores, Antler Shores, Seapit, Fishermans Cove, and Oyster Pond. WQMC analysis is based on the MVP tool future projections for these areas. These areas are all located outside of the Great Pond watershed.</p> <p>Great Pond Contingency sewerage provides an estimate of additional sewerage to meet TMDL if load removal targets are not met by proposed pilot technologies.</p> <p>Estimated wastewater flows for TASA were developed using water use data from 2014-2016 and a 20% wastewater allocation to account for undesignated redevelopment and potential development of currently un-developable parcels.</p> <p>All wastewater flow in Planning Flow 2 is anticipated to be collected outside of the Great Pond watershed.</p>		

### 3. Great Pond Non-Traditional Nitrogen and Wastewater Management Technologies Update

#### 3.1 Introduction

The February 2020 Secretary’s Certificate issued to the Town of Falmouth recognized the efforts the Town had made in evaluating and piloting nitrogen removal measures to improve water quality in its coastal pond watersheds. Section 3 of this document provides a summary of pilot project implementation progress since the 2019 Notice of Project Change Report.

The following technologies are discussed: shellfish aquaculture, permeable reactive barriers (PRBs), eco-toilets, stormwater management, fertilizer management, nitrogen attenuation augmentation, and innovative and alternative (I/A) septic systems.

## 3.2 Shellfish Aquaculture

Using shellfish to reduce nitrogen concentrations is a non-traditional approach for improving estuarine water quality. Oysters (*Crassostrea virginica*) have been used because they grow rapidly, typically growing from seed to a harvestable (and marketable) size in less than two years. Pilot shellfish projects continue to show beneficial results for using shellfish to reduce nitrogen concentrations as a means for improving water quality.

Town of Falmouth projects that have concluded since 2019 include the examination of oyster aquaculture growing and overwintering strategies to maximize survival and growth potential; evaluation of denitrification rates in the sediments in Bournes Pond, Little Pond and Waquoit Bay; and evaluating the analytical technique to quantitatively estimate the nitrogen sequestered by shellfish growth.

These projects have demonstrated that large numbers of oysters can be successfully grown in floating gear in the Town of Falmouth's estuaries, while producing measurable improvements in water quality in near-field waters. The projects have also suggested that the accumulation of oyster waste products on nearby sediments can lead to increased rates of denitrification in these sediments.

In the past three years the Town of Falmouth has utilized the WQMC, the Department of Marine and Environmental Services (MES), and other resources to develop and implement a contractor pilot program in Eel River in Waquoit Bay. The program contracts growers who are able to sell shellfish commercially, with the idea that this revenue can potentially more than cover the cost of seed, labor, and materials required in using the shellfish to remove nitrogen from these impaired estuaries.

MES plans to expand its municipal propagation efforts with revenues received from the Aquaculture Contractor Pilot Program and expects to continue growing oysters in Little Pond, while also using it as an aquaculture training site. The municipal shellfish efforts in Little Pond and other areas of Falmouth also support significant community engagement through countless volunteers, providing hands-on learning opportunities for students, and providing skills development opportunities for local inmates.

## 3.3 Permeable Reactive Barriers (PRBs)

The Town of Falmouth, in partnership with the Woods Hole Oceanographic Institution, was awarded a grant in 2019 to install a pilot injection PRB in the Great Pond watershed. This alternative utilizes a liquid carbon source injected into the groundwater flow path to stimulate the bacterial conversion of nitrate to inert nitrogen gas.

The major goal of the project is to provide the data necessary to refine the long-term operational cost of an injection based PRB by more accurately determining the actual design life of the emulsified vegetable oil (EVO) in a field setting. Monitoring of the pilot PRB project terminated in May 2022 and a complete finding of the project is anticipated in December 2022.

## 3.4 Eco-toilets

In 2018, Falmouth completed a pilot project to evaluate the nitrogen-removal, costs, and public acceptance aspects of eco-toilets, which can be either composting or urine-diverting fixtures or combinations thereof. To encourage participation in this voluntary project, three different incentive programs over a three-year period were provided. Public participation in the Eco-Toilet Pilot Project was low in Falmouth, despite significant financial incentives and ongoing promotion to encourage participation.

Based on the poor response to the Eco-Toilet Program, eco-toilets are not included as a separate non-traditional technology for watershed planning purposes in Falmouth. They continue to be listed as an I/A septic system option. In watersheds where I/A septic systems are the recommended solution for TMDL-compliance, property owners will also be able to select eco-toilets that achieve the same level of nitrogen removal as is required for I/A septic systems. Currently, Falmouth does not have plans to pursue additional eco-toilet initiatives.

### **3.5 Stormwater Management**

The Town of Falmouth's Department of Public Works engineering staff have worked to identify several candidate locations to implement stormwater Best Management Practices (BMP) for nitrogen removal. Based on subsequent field investigations of the several identified catchment areas and the necessary steps to implement the BMP, the Town has decided to further review the effectiveness of emerging technologies to carrying out any specific stormwater management projects.

As part of the stormwater and runoff management public outreach efforts, the Town distributes seasonal flyers on fertilizer use, grass clipping management, and leaf litter removal, and distributes informational flyers encouraging the proper management of pet waste with all pet registration/renewal applications.

### **3.6 Fertilizer Management**

Since the adoption of the Nitrogen Control Bylaw for Fertilizer in 2012, the Town has continued its efforts on public education and enforcement of the conditions set forth in the bylaw. The efforts include an annual mailing by the Department of Marine and Environmental Services to the owners of approximately 2,700 properties within 100 feet of all coastal estuaries as well as, in 2022, an insert in the water bill sent to all 22,000 Town water accounts. Adherence to the Nitrogen Control Bylaw is now also a Standard Condition included in all Order of Conditions issued by the Town of Falmouth Conservation Commission.

### **3.7 Potential Watershed Modifications for Increased Nitrogen Attenuation**

As part of the Town of Falmouth's examining of strategies to meet the TMDL in its watersheds, the Town has begun to evaluate the effectiveness of modifications to upstream environments to reduce nitrogen inputs in downstream estuaries. This Report includes updates on projects associated with the Mill Pond Restoration Project and the Coonamesett River Restoration Project.

### **3.8 Measuring the Impacts of Sewering on Little Pond Water Quality**

Concurrent with the implementation of the Little Pond sewerage project, the Town partnered with both the United States Geological Survey (USGS) and Marine Biological Laboratory (MBL) to establish baseline groundwater-quality data for the area. They have been conducting separate studies measuring the nitrogen in groundwater entering Little Pond before and after sewerage to provide a true test case of the environmental benefits of sewers.

In addition, the Town has commissioned a survey of the benthic infaunal communities present in Little Pond that serve as indicators on the health of the system in locations where eelgrass is not present as well as to map present macroalgae and eelgrass assemblages. This survey will provide a baseline for comparison in future years, in order to gauge the impact of sewerage on the pond ecosystem over time.

### **3.9 MassDEP Provisionally Approved Innovative/Alternative Septic Systems**

As part of the investigation into technologies that could reduce nitrogen discharged to the groundwater at or near the source, the Town's WQMC in 2010 decided to pursue in situ testing of several such systems. The Town partnered with the Buzzards Bay Coalition in 2016 on the West Falmouth Harbor Shoreline Septic Remediation Project to install advanced I/A systems as part of the pilot project with the goal to achieve an effluent concentration of 12 mg TN/L for each I/A septic system or 70% removal.

Since 2019, the Town has been involved in several joint efforts with regional partners and representatives from the State on establishing a responsible management entity (RME) either on a regional or municipal level for the management of I/A systems. Additionally, the Town has been involved in independent discussions with the MassDEP on how to accelerate General Use approval for the several highly promising technologies able to achieve  $\leq 10$  mg TN/L which include NitROE, Nitrex, and the layer cake design.

## **4. Great Pond Traditional Wastewater Management Alternatives**

### **4.1 Introduction**

The largest source of controllable nitrogen in Great Pond is wastewater from on-site septic systems. Due to the very large nitrogen load reduction required to meet the Great Pond TMDL and because of the density of development adjacent to the pond, centralized sewerage, treatment, and effluent discharge is an essential part of the Great Pond TWMP Preferred Compliance Approach.

### **4.2 Collection System**

A portion of the Great Pond watershed was sewerage in 2017 as part of the Little Pond Sewer Area (LPSA) project. The nitrogen load removal from Great Pond through sewerage these parcels is estimated to be 1,000 kg/yr.

The Town's Great Pond TMDL Compliance Preferred Approach involves expanding the existing sewer collection system to include the TASA, shown in Figure ES-2 (see Attachments). Collection system construction will occur in two phases, first the Teaticket area, then the Acapesket area (areas are labelled 1 and 2 on Figure ES-2). Approximately 1,300 of the identified TASA parcels are in the Great Pond watershed (Figure ES-4 – see Attachments); the remainder are in Green Pond's watershed. Sewerage of TASA is projected to remove 6,188 kg/yr of nitrogen from the Great Pond watershed. The conceptual collection system and wastewater flow estimates include an allocation for future growth, which will be taken into account in sizing of treated effluent discharge.

### **4.3 Wastewater Treatment**

The Falmouth Wastewater Treatment Facility (WWTF) will be upgraded to treat the proposed flow from the TASA and the ESRA – Planning Flow 1. In April 2022, Town Meeting approved a \$24,000,000 appropriation to implement recommended WWTF improvements associated with meeting Planning Flow 1 needs. The project is currently being designed and is expected to go out to bid in the spring of 2023. Construction is expected to take up to two years to complete.

Additional future upgrades will be required to treat Planning Flow 2 and 3 at the Town of Falmouth WWTF.

### **4.4 Effluent Discharge**

The Town of Falmouth WWTF currently has 15 effluent disposal open sand beds. The 2021 groundwater discharge permit for the WWTF established effluent flow limits for these beds by watershed. The permitted capacity of the existing Open Sand Beds 1-15 is allocated to current and future flows from areas currently sewerage.

An effluent discharge evaluation was conducted as part of this project to compare treated effluent discharge sites for Planning Flow 1, with consideration for other planning horizons (Planning Flows 2 and 3). The following potential sites were included in the evaluation (the location of each site is outlined in Figure ES-5 – see Attachments):

- Increasing the capacity of Open Sand Beds 14 & 15 through an increase in the design hydraulic loading rate to the existing beds and a bed area expansion in the undeveloped area to the west and/or north of the existing beds.
- Development of new open sand beds and subsurface leaching fields at the Augusta Parcel.
- Development of new open sand beds at the Allen Parcel.
- Development of a new ocean outfall in Vineyard Sound or Buzzards Bay.

For each site, field investigations were performed, groundwater modeling was conducted, environmental impacts were evaluated, and construction cost was estimated. A Discharge Alternatives Evaluation Matrix was prepared comparing the results of these evaluations for each site, and was presented during Water Quality Management Committee on November 8, 2021 and November 22, 2021. At the November 22, 2021 meeting, the WQMC voted to:

1. Designate existing Open Sand Beds 14 & 15 as the preferred treated effluent discharge site for the projected ESRA/TASA flows in the short-term contingent on a follow-up evaluation of nearby Herring Brook (which the Town anticipates receiving in 2023).
2. Consider ocean outfall options in Buzzards Bay and Vineyard Sound, along with land-based options at the Allen and Augusta parcels, for projected mid-term and long-term wastewater flows.

Both recommendations were reviewed and endorsed by the Falmouth Select Board on December 6, 2021.

## **5. Great Pond Recommended Plan**

The Recommended Plan provides a comprehensive strategy for wastewater and nitrogen management in Great Pond and includes a preferred approach and a contingency. Table ES.2 lists the estimated nitrogen load reduction for each compliance component to achieve the TMDL.

The Town has implemented robust monitoring programs and will continue to monitor performance through this adaptive management program. The Town will adjust its TMDL Compliance Approach as needed, based on the findings of the adaptive management program, through a MEPA Notice of Project Change.

**Table ES.2. Nitrogen Budget for Great Pond to Achieve Nitrogen TMDL Compliance**

Compliance Component – Nitrogen Removal Approach	Estimated Nitrogen Loading Reduction (kg-N/year)
	Preferred Alternative
Fertilizer Bylaw (25% of fertilizer load) <sup>1,2</sup>	425
Stormwater Best Management Practices (25% of impervious load) <sup>1,2</sup>	580
Shellfish Aquaculture (uptake) <sup>1,2</sup>	1,300 – 2,100
Shellfish Aquaculture (denitrification) <sup>1,2</sup>	650 – 1,050
Permeable Reactive Barrier at Shorewood Drive (300 feet) <sup>1,2</sup>	1,325
Sewer Extension – Little Pond Sewer Service Area (Great Pond)	1,000
Sewer Extension – Teaticket Acapesket Sewer Service Area Subarea 1	2,890
Sewer Extension – Teaticket Acapesket Sewer Service Area Subarea 2	3,298
Sewer Extensions – Contingency	0
<b>Total Estimated Reduction</b>	<b>11,468 – 12,668</b>
<b>Nitrogen Removal TMDL Goal</b>	<b>12,154</b>
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. Anticipated removal rates provided by the Falmouth WQMC based on the information provided and actions described in Section 5.1.1.</li> <li>2. Advancements in I/A technology will provide supplementary nitrogen removal if not met through primary alternatives.</li> </ol>	

Capital costs for the wastewater management facilities component of the TWMP are summarized in Table ES.3. The implementation schedule for the wastewater management facilities is outlined in Table ES.4.

**Table ES.3. Capital Costs for Recommended Wastewater Facilities**

Infrastructure	Planned Appropriation Date	Capital Costs (Adjusted for Mid-Point of Construction Dollars for Each Project)
TASA Improvements Falmouth WWTF Upgrade	April 2022 - complete	\$24.0 M (2024\$)
TASA Collection System Phase 1 <sup>1</sup>	April 2024	\$39.9 M (2026\$)
Recharge Facilities for TASA / ESRA Flows at Expanded Open Sand Beds 14 & 15	April 2024	\$1.4 M (2026\$)
TASA Collection System Phase 2 <sup>2</sup>	April 2026	\$49.4 M (2026\$)
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. Phase 1 costs based on Alternative Number 2 Subarea 1 outlined in GP TM-1 (see Appendix), which assumes two new lift stations and one sewer easement is obtained for sewershed. This planning number will be refined as the Town finalizes available lift station and sewer easement locations. The cost estimate assumes a single force main system from TASA to the Falmouth WWTF and a grinder pump allowance.</li> <li>2. Phase 2 costs based on Alternative TASA TM7 Subarea 2 outlined in GP TM-1, which assumes four new lift station locations are obtained for the sewershed. This planning number will be refined as the Town finalizes available lift station and sewer easement locations. The cost estimate assumes a single force main system from TASA to the Falmouth WWTF (constructed during Phase 1) and a grinder pump allowance.</li> </ol>		

Table ES.4. Great Pond TWMP Implementation Schedule

Activity	2022	2023	2024	2025	2026	2027	2028
Falmouth WWTF TASA Improvements Project Construction							
Town Meeting – Vote to Establish TASA Betterment Percentage							
TASA Collection System (Phases 1 & 2) and Recharge Facilities Design Appropriation and Ballot Vote							
TASA Collection System and Recharge Facilities Construction Appropriation and Ballot Vote							
TASA Collection System and Recharge Facilities Construction							

## 5.1 Contingency Compliance Approach

The Contingency Compliance Approach provides a conservative estimate of additional centralized wastewater collection and treatment that would be required within the Great Pond watershed if the pilot projects included in the Preferred Compliance Approach did not perform as anticipated (Table ES.5). Removal of an additional 4,966 kg-N/year through sewerage would require the sewerage of approximately 1,232 single-family residential properties sewerage in the Great Pond watershed north of Route 28 (based on an average nitrogen removal of 4.6 kg-N/year unattenuated N load per single-family home). Findings of the adaptive management program will be used to assess whether additional sewerage will need to be incorporated into the Town’s Compliance Approach in the future. Proposed changes will be documented through a MEPA Notice of Project Change, as required.

Table ES.5. Nitrogen Budget for Great Pond to Achieve Nitrogen TMDL Compliance

	Estimated Nitrogen Loading Reduction (kg-N/year) - Contingency Alternative
Fertilizer Bylaw (25% of fertilizer load)	0
Stormwater Best Management Practices (25% of impervious load)	0
Shellfish Aquaculture (uptake) <sup>1</sup>	0
Shellfish Aquaculture (denitrification) <sup>1</sup>	0
Permeable Reactive Barrier at Shorewood Drive (300 feet) <sup>1</sup>	0
Sewer Extension – Little Pond Sewer Service Area (Great Pond)	1,000
Sewer Extension – Teaticket Acapesket Sewer Service Area Subarea 1	2,890
Sewer Extension – Teaticket Acapesket Sewer Service Area Subarea 2	3,298
Sewer Extensions – Contingency	4,966
<b>Total Estimated Reduction</b>	<b>12,154</b>
<b>Nitrogen Removal TMDL Goal</b>	<b>12,154</b>

## **6. Climate Change / Greenhouse Gas Evaluation for Preferred Alternative**

This section outlines the Base Case and Preferred Alternative greenhouse gas (GHG) evaluation that was conducted using the United States Environmental Protection Agency (USEPA) Portfolio Manager and discusses potential opportunities for on-site energy generation as part of future wastewater infrastructure design and construction.

## **7. MEPA Draft Section 61 Findings and Mitigation**

An update to the Section 61 findings and mitigation measures is a regulatory requirement. The changes to these findings have built upon those in the original Comprehensive Wastewater Management Plan (CWMP). Mitigation measures are described to general construction sites, sewer construction, wastewater treatment facility, and effluent discharge sites. The report also includes additional mitigation measures involving adaptive management and climate change.

## **8. Consistency with Cape Cod Commission Section 208**

The 2015 Section 208 Plan outlines the Cape Cod Commission's (CCC) consistency criteria for review of large planning efforts as a replacement to the Development of Regional Impact (DRI) review process, which was its regulatory predecessor. Compliance with these criteria is required for the Town to be eligible for State Revolving Fund (SRF) loan opportunities and is required as part of the MEPA process and watershed permitting process. The report outlines the consistency approach for each CCC consistency criteria for this project.

## **9. Update on Comprehensive Planning Process**

The Town of Falmouth has adopted the general CWMP approach of working west to east (beginning at Little Pond) to develop TWMPs to address nitrogen mitigation needs along its southern coastline. This approach allows for traditional wastewater collection infrastructure to be extended from existing infrastructure, which is primarily located within the Town's downtown areas and the Little Pond Sewer Service Area, a portion of which is currently within the Great Pond watershed. A proposed strategy (or compliance approach) for each watershed is outlined in Section 9 of this report.

Each strategy will continue to be refined as a TWMP for each subsequent watershed is developed and as pilot project/water quality data is collected and analyzed. The Town will continue to monitor Little Pond and West Falmouth Harbor to evaluate whether the significant improvements and management strategies implemented in those watersheds achieve the anticipated results.

One of the conclusions of the nitrogen management planning process has been that it will be extremely challenging to meet the TMDLs for all of the Town’s coastal ponds with land-based treated wastewater discharge. Therefore, the Town of Falmouth has initiated an investigation into the feasibility of an ocean outfall for future treated wastewater discharge. If, through this process, it is found that an outfall is infeasible due to cost or other factors, the Allen and/or Augusta parcel could be employed for land-based discharge for wastewater collected from future sewer service areas.

The proposed schedule for the development of the remaining South Coast Estuary TWMPs is outlined in Table ES.6.

**Table ES.6. Future TWMP Development Schedule**

Action Item	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Ocean Outfall Evaluations													
Green and Bournes Pond TWMP													
Waquoit Bay TWMP													