



Executive Summary

ES.1 Introduction

This Notice of Project Change to the Comprehensive Wastewater Management Plan and Final Environmental Impact Report and Targeted Watershed Management Plan (CWMP/FEIR/TWMP) Document provides an update to several of the Town's CWMP implementation efforts and pilot projects as called for in the January 10, 2014 Executive Office of Energy and Environmental Affairs (EOEEA) Secretary Certificate.

These pilot projects and other initiatives have been primarily funded by Article 17 of Spring 2011 Town Meeting and a ballot vote in May 2011 and are underway. Their progress to date is summarized in this document.

This update has been prepared by GHD, the Falmouth Water Quality Management Committee (WQMC), and its contractor Science Wares, and has been approved by the Falmouth Board of Selectmen. It is a summary of the efforts and studies to date that support the Compliance Plan Approaches developed for each watershed.

ES.2 Water Quality Monitoring and Data Summary

The University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST) facilitates two water quality monitoring programs in Falmouth's south-facing estuaries. The Pond Watch Monitoring Program has been collecting water quality data every two weeks during the critical impairment months (July and August) in Little, Great, Green, and Bourne Ponds since 1989. In Waquoit Bay, which is shared with the Town of Mashpee, there has been bi-weekly monitoring of the 19 established stations since 2001 during the critical impairment months. Measured parameters for each sampling event include total nitrogen, salinity, and chlorophyll as well as total depth, temperature, Secchi depth, nitrate + nitrite, ammonium, dissolved organic nitrogen, particulate organic nitrogen, phosphate, and dissolved oxygen.

All five of these estuaries remain nitrogen-impaired, as demonstrated by SMAST data. Historical trends from each of the estuaries do not indicate any significant change in the level of impairment in each of the estuaries. These results indicate that the conditions have remained relatively constant in the four Pond Watch estuaries (Little, Great, Green, and Bourne Pond) since 2004 and in Waquoit Bay since 2010.

Overall, the SMAST data show that the total nitrogen levels remain highest in the upper reaches of the estuaries [Station 1] and are lowest near the mouth of the estuary [Station 5]. The total nitrogen concentrations at the sentinel stations are still in excess of their target thresholds (see red line in Figures ES.1 and ES.2). For example, G4 is the sentinel station for Green Pond. Chlorophyll measurements also indicate nutrient enrichment in these estuaries.



Green Pond Total Nitrogen Averages by Station

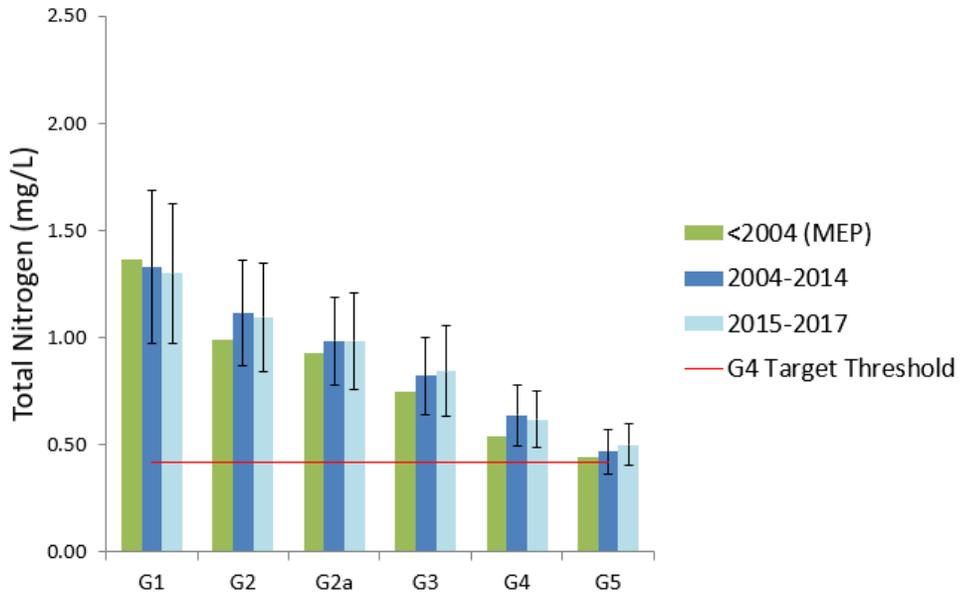


Figure ES.1 Example of the General Trend of Average Annual Total Nitrogen Concentration by Monitoring Period in the South-Facing Estuaries

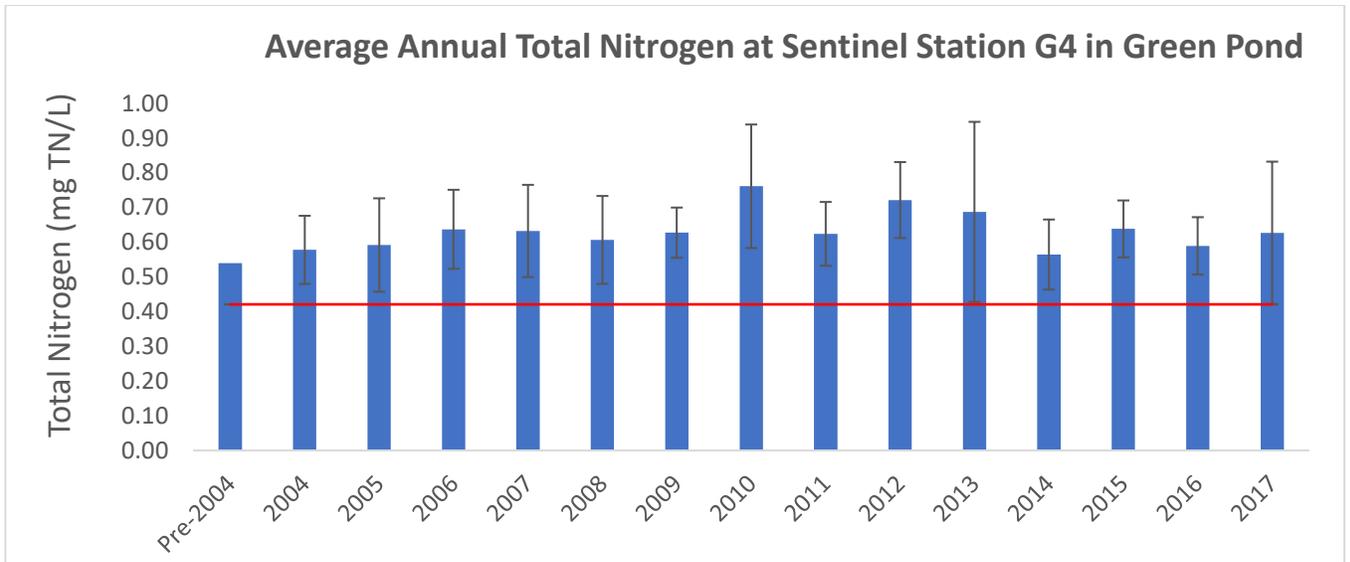


Figure ES.2 Example of the General Trend of Average Annual Total Nitrogen Concentration for the Sentinel Stations in the South-Facing Estuaries

The SMAST data for total nitrogen for Green Pond between 2004 and 2017 present a fairly constant level of impairment. Data from the other south-coast estuaries including Waquoit Bay show a similar pattern. Falmouth and Mashpee will continue to contract with SMAST to monitor these estuaries during July and August each year.



ES.3 Summary of Pilot Projects

At the 2011 Falmouth Spring Town Meeting, Town Meeting Members voiced their strong support for finding ways, in addition to sewerage, to control nitrogen and improve the health of the estuaries. To fund the effort, a \$2.77 million bond issue was voted and subsequently approved by the voters in a town-wide ballot. Since then, the WQMC and various Town departments have initiated a wide range of pilot/demonstration projects to provide a comprehensive analysis of non-traditional options for nutrient management in the impaired watersheds. Completed projects include a demonstration project on eco-toilets and a nitrogen control bylaw for fertilizer. The Town continues to actively conduct project initiatives on shellfish aquaculture, innovative and alternative septic systems (I/As), permeable reactive barriers (PRBs), stormwater management, and inlet widening.

ES.3.1 Eco-Toilets

The first of the Town's demonstration projects to have been completed focused on eco-toilets. The Town initiated an Eco-Toilet Incentive Program to encourage homeowners to install either composting or urine-diverting fixtures in their homes to gauge the effectiveness of the eco-toilets and general public response. To encourage participation, the Town offered three different financial incentives. Numerous outreach efforts were made to increase public awareness of the program, including a mailing to every household in town; about 170 homeowners responded.

Of the 170 homeowners, only 50 had site visits conducted. At the final stage of the program, only nine fixtures were installed. The performance of these systems was monitored by the Barnstable County Department of Health and Environment. Of those homeowners who initially showed interest in the program and chose not to participate, the reasons given were concerns over resale value of their home and the commitment to the ongoing operation and maintenance required for the systems.

The monitoring data results from the installed fixtures indicated a 48% to 86% nitrogen removal depending on the system. However, while the performance of the fixtures was effective in nitrogen reduction, the general findings from the program indicated that a large-scale initiative in Falmouth would likely not be embraced by the community. At present, the Town has no plans to pursue any further eco-toilet initiatives.

ES.3.2 Town Bylaw for Fertilizer

The second of the Town's demonstration projects to be completed was an effort to regulate fertilizer use in the immediate vicinity of the coastal estuaries and within the entire Town. The Town adopted a Nitrogen Control Bylaw that restricts fertilizer application timing, location, and application rate, and bans its application entirely within 100 feet of coastal estuaries. In efforts to regularly educate the public and encourage adherence to the bylaw, there is an annual mailing to all homeowners of properties within 100-feet of coastal estuaries. The bylaw and outreach efforts are expected to result in a 25% reduction in the attenuated fertilizer load to the estuaries.

ES.3.3 Shellfish Aquaculture

The Town initiated a significant oyster aquaculture project in Little Pond beginning in 2013. This demonstration project was funded by the Town, the Cape Cod Economic Development Council, and the Cape Cod Water Protection Collaborative. It was a three-year project to verify nitrogen uptake by



oysters and to culture enough oysters to yield a detectable change in water quality at the site. SMAST was contracted for the three-year monitoring effort for the project. Results from SMAST show that the deployment of oysters in Little Pond produced small-scale, localized water quality improvements including total nitrogen concentration. The primary mechanism for these water quality improvements appears to be the uptake of phytoplankton.

During the course of the three-year program in Little Pond several overwintering techniques were evaluated. The project saw the highest survival when first-year oysters were removed from the water and placed in insulated cold-storage containers, resulting in < 1% mortality.

Based on the success of the pilot project, municipal aquaculture efforts are still ongoing in Little Pond. In 2017 the municipal propagation program assessed the comparative growth rates of different oyster seed stock and began exploring methods for optimizing propagation in impaired estuaries for shellfish other than oysters, such as quahogs and scallops (Figure ES.3).



Figure ES.3 2017 Little Pond Farm <2 Acre Deployment

Additional shellfish aquaculture pilot programs have occurred in West Falmouth Harbor, Waquoit Bay, and Bourne Pond. In West Falmouth Harbor, the project established an oyster reef and studied its ability to self-sustain. In Bourne Pond and Waquoit Bay, the projects examined the effects of various culture techniques on oyster growth rates, nitrogen sequestration by these oysters, and the potential for denitrification rates of oysters grown in the high-density floating bag system similar to those used in Little Pond (Figure ES.3).

Using the findings from the shellfish aquaculture demonstration projects in Little Pond, Waquoit Bay, and Bourne Pond, the Town has been able to progressively optimize its oyster growing strategies for nitrogen removal. The Town now has the experience and ability to grow large numbers of oysters in a high-density floating bag system and successfully overwinter the animals with minimal mortality. In addition, the Town used quantitative analyses to estimate the amount of nitrogen sequestered by oysters in the high-density floating gear using initial season weights and harvest weights for the total area occupied by gear and analyzing a subset of about 25 oysters for the percent nitrogen content in the shell and the tissue. Using these measures, the Town is able to accurately determine the total



nitrogen removal on a kilogram per acre basis and produce measurable improvements in the surrounding water quality.

In 2017 the Town developed a plan that would promote increased aquaculture activities as a nitrogen removal strategy in impaired estuaries. The plan identified areas suitable for shellfish aquaculture activities based on a number of parameters (e.g. presence of eelgrass and/or harvestable shellfish, navigation channels, mooring fields, anadromous fish runs, etc.). The plan recommended involving commercial growers in the municipal efforts. As such, the Town is currently pursuing a pilot program in Eel River to contract with commercial growers to grow on Town-owned aquaculture sites following Town growing protocols including a target nitrogen removal condition (Figure ES.4). A request for proposals for the Eel River sites has been distributed and applicants have been evaluated.

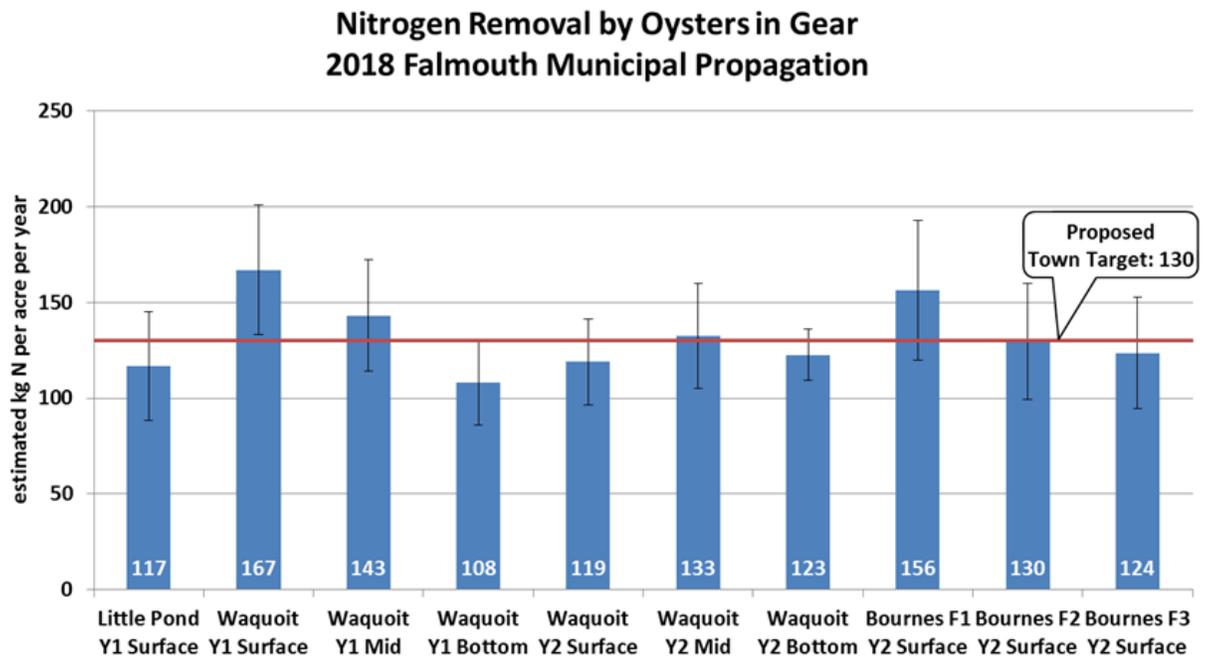


Figure ES.4 Summary of Nitrogen Removal Measurements in 2018

ES.3.4 Innovative and Alternative Septic Systems

In partnership with the Buzzards Bay Coalition, the Town received all equipment for and has completed the first phase of the West Falmouth Harbor Shoreline Septic System Remediation Project (WHFSSSRP) using advanced I/A septic systems. For the first phase of the project, 20 systems were installed and monitored. The range of installation costs for each system varied and were primarily driven by site constraints for installment and the costs to restore the landscaping.

The Town considers the MassDEP standard of 19 mg N/L to be too high to effectively improve the health of the estuary and therefore set a performance goal of 12 mg N/L for each system in this project. The monitoring results showed a wide range of performance from the various installed systems. Through the course of the project it was determined that to be the most effective for achieving Falmouth's Total Maximum Daily Loads (TMDL) goals, there needs to be options for I/A systems that achieve 10 mg N/L, or 75% total nitrogen reduction approved by MassDEP. The



installation and monitoring costs are among the primary concerns in using I/A systems. The conclusion from the pilot project is that for the cost of I/As to be similar to sewers, loans for I/A systems would ideally be available that provide financing comparable to Falmouth's previous betterments.

Phase II of the WFHSSSRP is currently in progress with an additional five systems installed to date and another five systems planned. The groundwater monitoring for all of the systems installed is performed by the Barnstable County Department of Health and Environment. The Coalition for Buzzards Bay published an initial report of the project in 2018 and expects to make a final report at the end of the project.

ES.3.5 Permeable Reactive Barriers

The Town has actively explored and evaluated several potential sites in Great, Green, and Bournes Pond watersheds suitable for the installation of a permeable reactive barrier (PRB). Several potential sites suitable for a PRB were initially identified by a mapping exercise and funds were obtained through the Cape Cod Water Protection Collaborative and the EPA to install monitoring wells to characterize the groundwater hydrology, the soils, and the chemistry of dissolved substances.

Two candidate sites have been identified as a result of these efforts: 0 Shorewood Drive in the Great Pond watershed and Sailfish Drive in the Bournes Pond watershed. Both have a high groundwater velocity rate, high groundwater nitrate concentrations, and shallow depth to the water table. The Town has pursued various funding opportunities to aid in the installation costs to initiate a PRB demonstration project and expects to hear soon from the latest grant application to the Southeastern New England Program for a PRB installation at 0 Shorewood Drive. The US Geological Survey has also assisted in this project by installing a multi-port sampler at an upstream location on Shorewood Drive and sharing the data.

ES.3.6 Stormwater Management

The Town has worked to identify several candidate locations to implement stormwater Best Management Practices (BMP) for nitrogen removal. An initial review of the storm drain system in Great Pond was conducted to determine the nitrogen load from the two most prominent catchment areas in the watershed. Based on subsequent field investigations of the two catchment areas and the necessary steps to implement the BMP, the Town has decided to further review the effectiveness of emerging technologies such as media boxes prior to carrying out any specific stormwater management projects. The Falmouth Department of Public Works continues to employ Best Management Practices in all of its road improvement projects.

ES.3.7 Inlet Widening

In 2016, the Town filed a Notice of Project Change to advance the Bournes Pond Inlet Widening program. The objective of the project is to widen the existing inlet to increase water exchange within Bournes Pond. Historic information indicates the inlet width has naturally varied from 88-feet wide up to 400-feet wide from 1844 to 1984. Its current restrained opening of 50-feet wide occurred in 1985 with the construction of the bridge. The planned widening will open the inlet to approximately 90-feet which is on the lower end of the historical stable inlet widths observed at the Bournes Pond entrance. Modeling scenarios done by SMAST and ACRE indicate that inlet widening to 90-feet



should achieve approximately 50% of the total nitrogen removal requirement in Bournes Pond. To date all of the required permits for the construction phase have been obtained and construction could begin as early as 2020.

ES.4 Little Pond Targeted Watershed Management Plan Update

As part of the approach for meeting the TMDL in Little Pond, the Little Pond Sewer Service Area (LPSSA) was designed to connect approximately 1,350 developed properties to the Town sewer system. Approximately 19% of these properties are within the boundaries of the Great Pond watershed.

The Town has partnered with the USGS and EPA on a project to monitor the groundwater beneath the Maravista Peninsula through a series of 18 monitoring wells. The objectives of the study are to assess groundwater levels and water quality beneath a densely developed coastal neighborhood undergoing a conversion from septic systems and cesspools to municipal sewers, and develop an understanding of water-quality conditions before and after installation of the sewers. It is estimated that it will take approximately seven years for the existing nitrogen load from the traditional septic systems to move through the groundwater and soils before the full benefit of sewerage the LPSSA can be evaluated.

Construction of the new collection system for the LPSSA began in 2015. Groundwater sampling by the USGS began in June of 2016 and has continued to date. Data from the USGS efforts will show the timing of the impacts of sewerage on the groundwater in Maravista while the continued monitoring data from the Pond Watch Monitoring Program (see Section ES.2) will indicate when the effects of sewerage have reached Little Pond. The USGS groundwater monitoring data are publicly available through the USGS data repository.

To date, over 95% of the properties in the LPSSA have connected to the sewer system, and it is anticipated that the remaining properties will be connected by the fall of 2019. It is estimated that the sewerage of the LPSSA will accomplish a minimum of an 83% reduction of the total nitrogen removal required to meet the TMDL goal.

The Town anticipates that the fertilizer bylaw and stormwater management practices will receive the State-approved nitrogen reduction credit of 25% reduction of the total attenuated load from these sources. Additionally, there are municipal aquaculture efforts in Little Pond that will further aid in meeting the TMDL goal.

Falmouth has taken significant steps to reduce the nitrogen load into Little Pond. As part of the adaptive management approach adopted by the Town, monitoring of the LPSSA will continue to assess the impacts from sewerage. If the current efforts have not fully met the nitrogen removal requirements, use of I/A systems in the upper watershed or the expansion of the LPSSA northward would be the “back-up plan” to achieve TMDL compliance in the Little Pond watershed.

ES.5 West Falmouth Harbor Targeted Management Plan Update

The largest source of controllable nitrogen in the West Falmouth Harbor watershed is the effluent plume from the original lagoon wastewater treatment facility (WWTF) constructed in the 1980s. Since the plant came on line in 1986, significant upgrades to the plant have reduced nutrient



concentrations in the effluent discharged into the West Falmouth Harbor watershed. In 2005, the WWTF was upgraded to a tertiary treatment facility. As a result of an evaluation on nitrogen removal optimization done as part of the design process for the LPSSA (see Section ES.4), several recommendations for additional upgrades to the WWTF were made and completed by 2016. In 2019, a new evaluation was conducted to assess additional requirements for the WWTF to process additional load from the proposed Teaticket/Acapesket Study Area (see Section ES.6). This evaluation recommended adding a third sequencing batch reactor (SBR) to the plant and constructing additional effluent discharge capacity outside of the West Falmouth Harbor watershed. The Town has requested capital funds to complete the recommended upgrades to accommodate additional flow and load from future sewer extensions.

Currently the plant is operating under the most recent Modified Groundwater Discharge Permit (December 2015); this permit limits discharge to 450,000 gpd within the West Falmouth Harbor watershed and to 260,000 gpd outside the watershed.

One of the requirements of the current discharge permit is quarterly groundwater monitoring for nitrogen and phosphorus. There is an existing network of monitoring wells upgradient and downgradient of the various recharge beds within and outside of the West Falmouth Harbor watershed. Monitoring wells downgradient from Recharge Beds 1 – 13 in the West Falmouth Harbor watershed have shown a significant decrease in groundwater total nitrogen concentration since the WWTF upgrade to a tertiary treatment plant was completed in 2005. All the monitoring wells except one, the furthest downgradient from the WWTF, have contained total nitrogen concentrations less than 2 mg/L for more than a year. The monitoring well most distant from the plant still contains a total nitrogen concentration greater than 4 mg/L, though that is expected to drop over time as well as the plume from the original lagoon WWTF washes out. Data from wells downgradient of Recharge Beds 1 - 13 also indicate that there has been no increase in phosphorus concentration in groundwater over the background levels, despite over 30 years of WWTF discharge.

In 2016, SMAST conducted additional modeling scenarios for West Falmouth Harbor to meet TMDL compliance. Using build-out scenarios and the current discharge permit restrictions, the modeling results indicated that if the plant effluent averages an annual concentration at or below 3 mg TN/L the system should meet the West Falmouth Harbor TMDL once the plume from the original lagoon WWTF has flushed out. As shown in Figure ES.5, effluent total nitrogen concentration from the original lagoon WWTF averaged 23.3 mg/L from 1994 to 2005; upgrades completed in 2005 resulted in effluent total nitrogen concentrations averaging 4.7 mg/L from 2006 to May 2016, and additional upgrades completed in 2016 resulted in effluent total nitrogen concentrations averaging 2.7 mg/L from June 2016 to December 2018. The WWTF did have a mechanical problem resulting in reduced performance in 2019. However, the performance from 2016 through 2018 demonstrates the capacity of the WWTF to average 3 mg/L over extended periods. Additional WWTF upgrades including the third SBR and upgrades to the WWTFs sludge processing system are envisioned as part of the next phase of wastewater system expansion to accommodate additional flow from additional service areas and to further improve the consistency of WWTF performance.

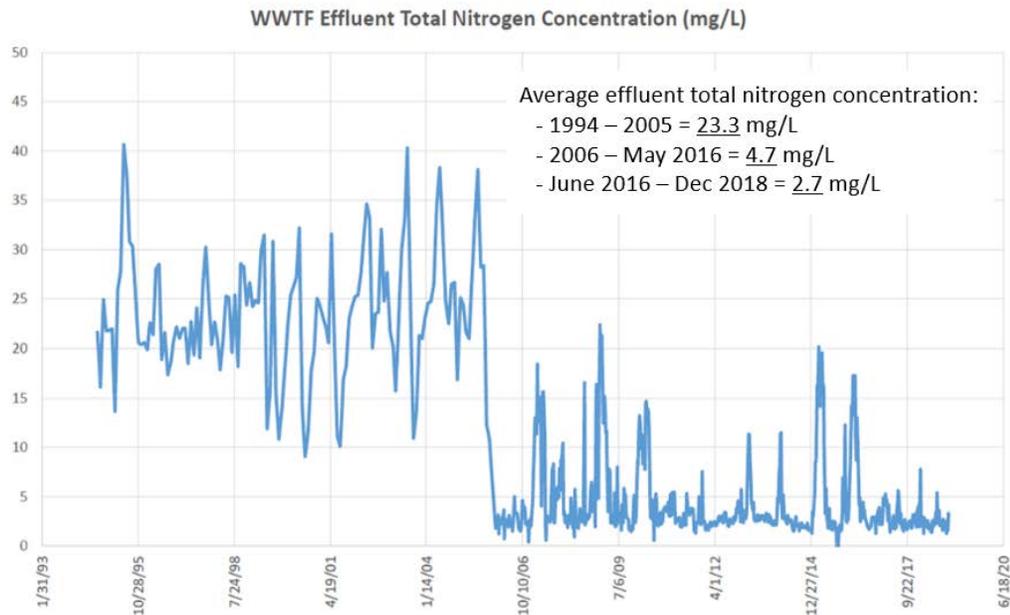


Figure ES.5 Historical Wastewater Treatment Facility Effluent Total Nitrogen Concentrations

To provide a suitable discharge site for treated effluent from the LPSSA, the Town built Recharge Beds 14 and 15 north of the WWTF and outside of the West Falmouth Harbor watershed. Data from the monitoring network for these beds show that total nitrogen has increased slightly in some downgradient wells since discharge began in 2016. It is noted that the upgradient background monitoring well contains slightly elevated total nitrogen concentrations, as well, indicating the potential influence of upgradient sources. Total phosphorus concentrations in the monitoring wells have not increased in any monitoring wells except for the two wells located only 20 feet horizontally from the recharge beds. These two adjacent wells, one screened at the top of the groundwater table and the other screened just below the first, were installed in this manner within 20 feet of the recharge beds in order to confirm phosphorus attenuation in aquifer soils over a short distance, as indeed demonstrated to date.

Crocker Pond lies generally downstream from Recharge Beds 14 and 15 and has been monitored in July, August, and September since 2016. The current data is considered baseline data and will be compared to future data to assess potential nutrient impacts to the pond from discharge to Beds 14 and 15.

The Town has made several additional efforts to augment the nitrogen removal in the West Falmouth Harbor watershed. The Town expects that the fertilizer bylaw and stormwater management practices will receive the State-approved nitrogen reduction credit of 25% reduction of the total attenuated load from these sources. Additionally, the West Falmouth Harbor Shoreline Septic System Remediation Project with the Buzzards Bay Coalition (See Section ES.3) has



removed a small portion of the nitrogen load through the installation of approximately 25 I/A systems to date; five more I/A systems are in the planning stage.

Based on the SMAST modeling, the Town expects to be able to meet the nitrogen TMDL goal for West Falmouth Harbor with the WWTF improvements alone. However, the Town will also continue with the other nutrient mitigation strategies (fertilizer management, I/A system demonstrations, etc.) in order to provide the greatest flexibility to manage nitrogen within the watershed.

ES.6 Great Pond Watershed Planning Scenario

The largest source of controllable nitrogen in Great Pond is wastewater from on-site septic systems. Due to the large nitrogen reduction requirements (about 12,000 kg/yr) and density of development adjacent to the pond, sewerage is being considered in order to meet the nitrogen TMDL goal for Great Pond.

The Town contracted GHD to develop a conceptual sewer plan and to provide an evaluation of the nitrogen load per parcel in the Great Pond watershed. GHD's conceptual design is for a phased sewerage project in the Teaticket/Acapesket Study Area. In total this project proposes to sewer approximately 1,791 developed properties, 1,289 of which are located in the Great Pond watershed and 502 in the Green Pond watershed (Figure ES.6). The first phase of the project would be on the Teaticket Peninsula and contains approximately 811 dwelling units including 210 condominiums in Falmouthport. The mid-point of construction for the first phase of the sewerage project is anticipated to be in 2026. It is estimated that the sewerage of the Teaticket/Acapesket Study Area combined with the sewerage parcels from the LPSSA (see Section ES.4) in Great Pond will remove a minimum of 59% of the nitrogen needed to meet the TMDL goal for Great Pond.

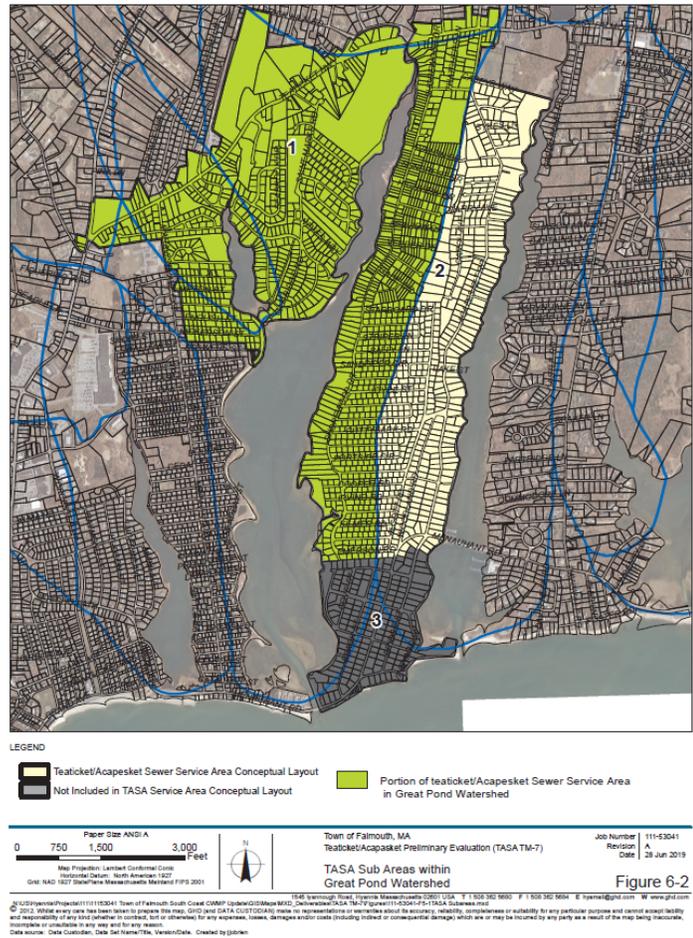


Figure ES.6 Teaticket/Acapesket Study Area Collection System Conceptual Layout of Parcels within the Great and Green Pond Watersheds

Part of GHD's evaluation of the Teaticket/Acapesket Study Area includes an assessment of effluent recharge technologies and disposal sites available to Falmouth. The flow from future development in existing sewerage areas in Falmouth is also a consideration. The discharge options considered include: several sites for open sand beds or sub-surface leaching facilities in Falmouth or at Joint Base Cape Cod; and an ocean outfall into Buzzards Bay or Vineyard Sound and evaluations for capacity, community support, and cost.

Another main source of controllable nitrogen comes from the Coonamessett River which discharges into the head of Great Pond. It is estimated that 50% of the unattenuated nitrogen load entering Great Pond enters via the Coonamessett River. In 2014, the Falmouth Conservation Commission along with nearly two dozen project partners began to plan the conversion of 45 acres of retired cranberry bogs along the river into wetlands. To monitor the effects of the restoration efforts, the Town contracted the Woods Hole Research Center to quantify the nitrogen dynamics and physical characteristics of the river for a period of three years (2018 – 2020). Physical restoration of Lower Bog was completed only recently in 2018, and so the monitoring data has yet to show the anticipated nitrogen reduction impacts. Physical restoration of Middle and Reservoir Bogs is in design and permitting stages and will likely take place in 2020.



To meet the remaining nitrogen removal requirements to achieve the TMDL, the Town's plan expects that the fertilizer bylaw and stormwater management practices will receive the State-approved nitrogen reduction credit of 25% reduction of the total attenuated load from these sources. Additionally, the Town is currently evaluating potential acreage for significant shellfish aquaculture activities in Great Pond. At the head of the estuary, the Town is actively pursuing funding opportunities to install a 300-foot PRB at the Shorewood Drive parcel. It is estimated that the nitrogen reduction from the sewerage, State-approved credits, shellfish aquaculture, and PRB will meet the TMDL. However, if these efforts do not fully meet the nitrogen removal requirements, the Town can consider I/A systems, sewer extensions north of Route 28, and exploring sites for an additional PRB north of Route 28 to achieve TMDL compliance in the Great Pond watershed.

ES.7 Green Pond Watershed Planning Scenario

The largest source of controllable nitrogen in Green Pond is from wastewater from on-site septic systems. In order to meet the nitrogen removal TMDL goal for Green Pond, the Town is considering various alternative options directly in the estuary and upstream in Mill Pond in addition to sewer extensions (Figure ES.7).



Figure ES.7 Green Pond Watershed

As part of the compliance approach for Great Pond (see Section ES.6) the Town's engineers have prepared a conceptual design for the Teaticket/Acapesket Study Area which proposes to sewer approximately 1,791 developed properties, 502 of which are located in the Green Pond watershed (Figure ES.7). It is estimated that the sewerage of these properties on the Acapesket Peninsula will



remove approximately half of the total requirement for nitrogen removal to meet the TMDL goal in Green Pond.

Another main source of controllable nitrogen comes from Mill Pond which discharges directly into the head of Green Pond. From 2015 to 2017 SMAST conducted an assessment on nutrient cycling in Mill Pond and determined that Mill Pond attenuates approximately 60% of the upstream nitrogen load and that the pond itself is phosphorus(P)-limited, not nitrogen-limited. The final report from SMAST made several recommendations for nutrient management in the pond which the Town has begun to pursue. Among the recommendations, a few were direct modifications to the cranberry agricultural practices upstream including: alternating the type of fertilizers used between 'low P' and 'no P', more strategic release of the dam boards to minimize water velocities into Mill Pond, and reducing the board height when damming during harvest and flood to increase flushing in the pond. According to the SMAST report, the bog owner is agreeable to putting these recommendations into practice.

Two additional recommendations made in the SMAST report are being pursued by the Town: installation of a detention pond and harvesting the macrophytes in Mill Pond. The Town is currently discussing with MassDEP the possibility of an agricultural exemption to install a tailwater recovery system rather than a detention pond. A tailwater recovery system would allow plant matter and fine sediments to settle out prior to discharge into Mill Pond and also allow for some recycling of nutrient runoff from irrigation practices back into the cranberry bog operations. Harvesting the macrophytes below the surface of Mill Pond will remove a significant nitrogen source from the pond that is generated when the plants die off and begin to decay. The macrophyte removal will also facilitate wind-driven vertical mixing in the pond to allow for the increased dissolved oxygen levels necessary for the natural denitrification cycle to occur in the sediments.

To meet the remaining nitrogen removal requirements to achieve the TMDL, the Town's plan expects that the fertilizer bylaw and stormwater management practices will receive the State-approved nitrogen reduction credit of 25% reduction of the total attenuated load from these sources. Additionally, the Town is currently evaluating potential acreage for some shellfish aquaculture activities in Green Pond. It is estimated that the nitrogen reduction from the sewerage, State-approved credits, shellfish aquaculture, and nutrient management efforts in Mill Pond will meet the TMDL. However, if these efforts do not fully meet the nitrogen removal requirements, the Town can consider I/A systems or sewer extensions on the Davisville Peninsula, and explore sites for PRBs within the watershed to achieve TMDL compliance in the Green Pond watershed.

ES.8 Bournes Pond Watershed Planning Scenario

The largest source of controllable nitrogen in Bournes Pond is from wastewater from on-site septic systems. The Town believes that it can achieve TMDL compliance in Bournes Pond by using alternative options for nitrogen removal rather than by sewerage.

As a result of the additional modeling done for the inlet widening demonstration project (see Section ES.3), the Town opted to pursue inlet widening for Bournes Pond. This project will expand the current inlet width from approximately 50-feet to 90-feet (Figure ES.8). This expansion will require the construction of a new two-span bridge and modifications to the surrounding coastal areas and structures including extending the western jetty by 25-feet, reconstructing an existing groin, and dredging the inner and outer channel of the inlet. Modeling results done by SMAST indicate that this



project will achieve almost half of the required nitrogen removal to meet the TMDL goal. The Notice of Project Change (NPC) for the inlet widening project was filed in 2016. Several ecological assessment studies were conducted between 2015 and 2018 by Stantec, AECOM, and Applied Coastal to evaluate flood impacts, eelgrass beds, and shellfish locations in relation to the widened inlet. The project is now in its final design and permitting phase, and to date, all pre-construction permits have been obtained. It is anticipated that construction could begin as early as Fall 2020 with completion anticipated by December of 2022.

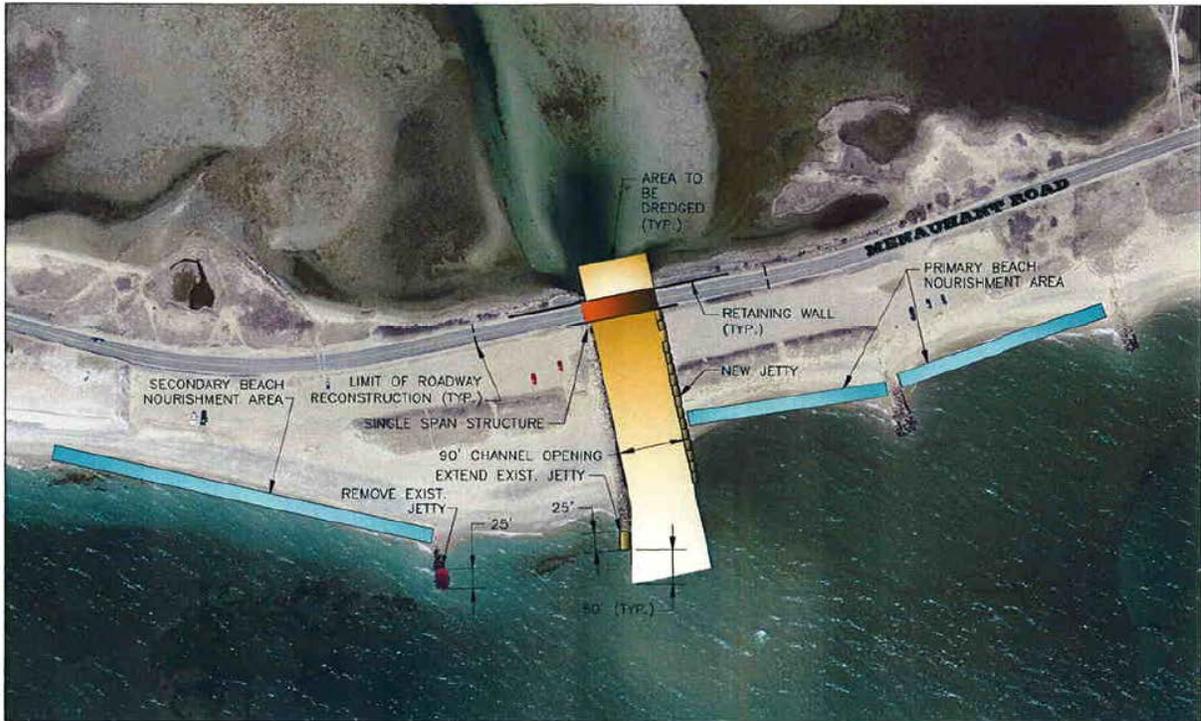


Figure ES.8 Proposed Plan for Widening the Bournes Pond Inlet

In addition to the inlet widening, the Town is currently evaluating suitable potential acreage for significant shellfish aquaculture activities in Bournes Pond which could remove about one-third of the total nitrogen needed to meet the TMDL goal. Additional nitrogen reductions are anticipated from shellfish bio-deposit denitrification.

To meet the remaining nitrogen removal requirements to achieve the TMDL, the Town's plan expects the fertilizer bylaw and stormwater management practices will receive the State-approved nitrogen reduction credit of 25% reduction of the total attenuated load from these sources. It is estimated that the nitrogen reduction from the inlet widening, State-approved credits, and shellfish aquaculture will be close to meeting the TMDL. Since Falmouth has adopted an adaptive management approach, if these efforts do not fully meet the nitrogen removal requirements, the Town can consider sewer extensions along Route 28, the use of I/A systems, exploring sites for a PRB in the upper watershed, and exploring nitrogen reduction options entering from Bournes Brook to achieve TMDL compliance in the Bournes Pond watershed.



ES.9 Eel Pond/Waquoit Bay Watershed Planning Scenario

The Waquoit Bay watershed is shared by the towns of Falmouth, Mashpee, and Sandwich (Figure ES.9). The entire Eel Pond sub-embayment and the majority of the Childs River sub-embayment fall entirely within Falmouth. The largest source of controllable nitrogen in the Waquoit Bay system is from wastewater from on-site septic systems. The three towns have begun the process of creating an Inter-municipal Agreement (IMA) to determine the allocation of nitrogen that each town is responsible for in order to plan their respective nitrogen reduction efforts. However, prior to determining this allocation, Falmouth has begun to explore options in the Eel Pond and Childs River sub-embayments because the majority of the nutrient reduction efforts for these areas lies within Falmouth. According to the MEP report, the main basin of Waquoit Bay does not require any formal reduction of nitrogen loads and therefore no specific plan has been prepared. S Mast conducted a study examining two potential nitrogen reduction approaches in the Quashnet / Moonakis River sub-embayment, dredging, and aquaculture. The study indicated tidal inlet dredging and shellfish aquaculture could address a portion of the nitrogen load reduction. No further investigation has been done in this region because the watershed is shared, and the IMA process is just beginning.

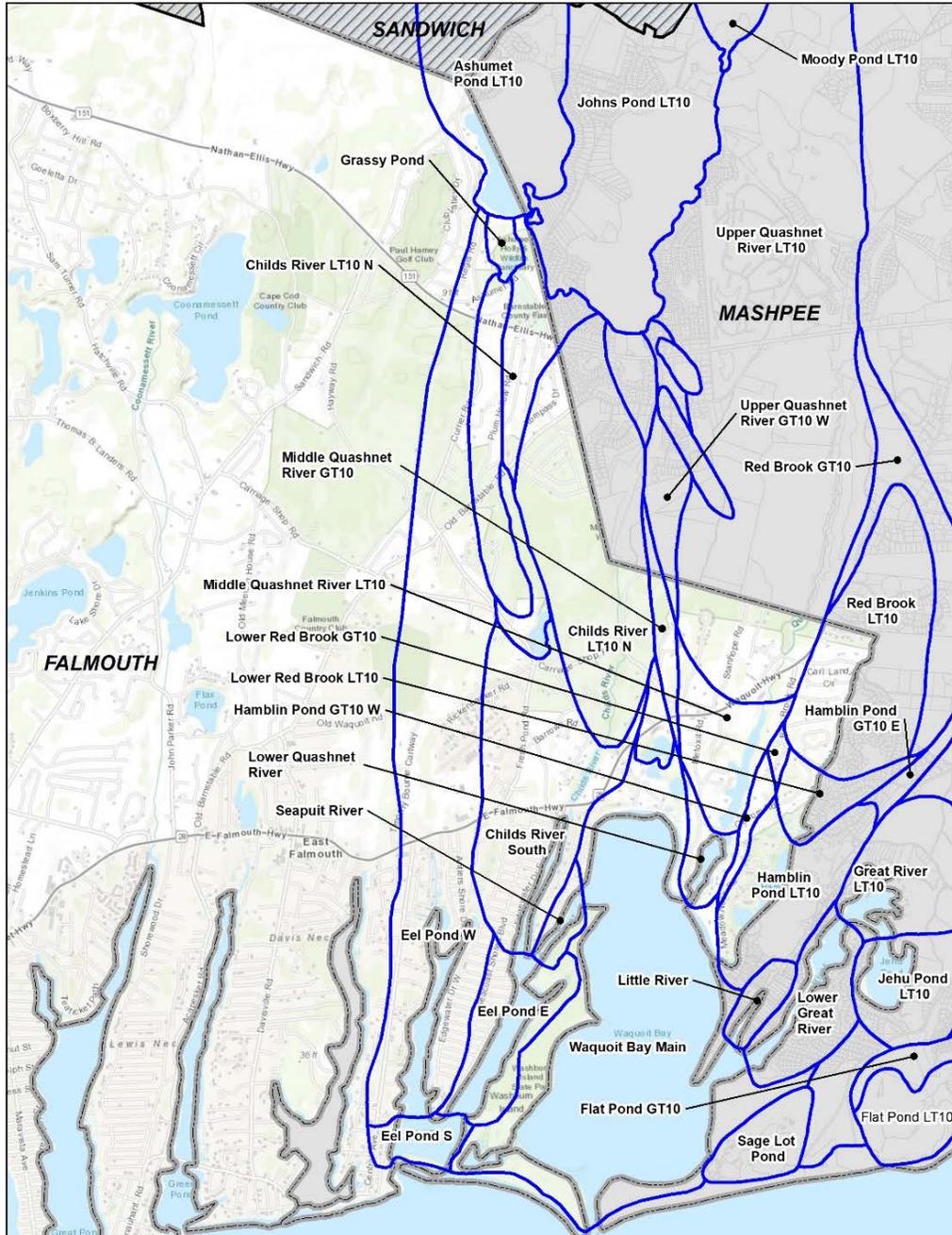


Figure ES.9 Waquoit Bay Sub-Watersheds with Town Lines

As part of the compliance effort for both Eel Pond and Childs River, the Town could consider sewer extensions for the Antler Shores, Seacoast Shores, and Seapit peninsulas. Sewering these three areas would connect an additional 1,300 properties to the sewer system. Due to the complex flow dynamics and exchange of water between the Waquoit Bay sub-watersheds, it is likely that improvements—such as sewerage—made within a specific area like Eel Pond will also have some net benefit to other areas (e.g. Childs River). To accurately predict the secondary benefits to additional watersheds is a challenging task given the present level of information. Therefore, the secondary benefits have not been included in the final projections.



Prior to determining the nitrogen removal allocation, the Town has become involved in two projects with the goal of nutrient load reduction. The Town has begun efforts to develop a municipal aquaculture program that contracts commercial growers to remove a targeted amount of nitrogen per acre (see Section ES.3). Three initial sites for this project have been identified in Eel River. The project applicants have been evaluated, and it is anticipated that full-scale growing will begin in 2020. Another project in the Waquoit Bay watershed is a restoration effort that began in 2019 involving collaboration between the local Rod and Gun Club, Falmouth, and the Town of Mashpee to convert 12.4 acres of retired cranberry bogs into wetlands along the Childs River. It is too early in the implementation of this restoration project to determine the full extent of nitrogen removal potential from this effort.

After considering the potential nitrogen reduction from sewerage the Antler Shores, Seacoast Shores, and Seapit Peninsulas to meet the remaining nitrogen removal requirements to achieve the TMDL, the Town is exploring several alternative options for nitrogen reduction. The Town's plan expects that the fertilizer bylaw and stormwater management practices in each sub-embayment will receive the State-approved nitrogen reduction credit of 25% reduction of the total attenuated load from these sources. Additionally, the Town is currently evaluating potentially suitable acreage for some shellfish aquaculture activities in Eel Pond and Childs River. It is estimated that the nitrogen reduction from the State-approved credits, shellfish aquaculture, and proposed sewerage (including Mashpee's sewer contribution in the Childs River watershed) will meet the TMDL for Eel Pond and Childs River. However, if these efforts do not fully achieve TMDL compliance in the Waquoit Bay system, the Town can consider I/A systems or sewer extensions, and exploring sites for PRBs within the watersheds to achieve Falmouth's yet-to-be-designated allocation of the nitrogen removal load.

ES.10 Public Outreach Efforts

The Town continues to engage in public awareness and outreach efforts on Falmouth's water quality issues. Over the past five and a half years almost 80% of the Falmouth Water Quality Management Committee's regular meetings have been recorded and made available on the Falmouth Community Television local cable station and on its website. A journalist from the local newspaper, The Falmouth Enterprise, regularly attends the WQMC meetings. Approximately 129 articles have appeared in this local newspaper on water quality updates or issues raised during the WQMC meetings. On the Upper Cape, approximately 13,000 households have full access subscriptions to The Enterprise in print or online.

In addition to the regular committee meetings, the WQMC has made special outreach efforts for high-impact or localized community issues such as the Little Pond Sewer Service Area project, the initiation of the fertilizer bylaw, hosting a vendor workshop in West Falmouth for interested homeowners to speak with I/A system representatives, and frequent reports at the Falmouth Town Meetings. The Water Quality Management Committee plans to continue to work with the Board of Selectmen and relevant Town departments to inform the public and to provide a forum for open dialogue on water quality issues.



ES.11 CWMP/TWMP Notice of Project Change Summary and Next Steps

The compliance approach for each of the watersheds in this CWMP has been laid out in detail within this report; a synopsis is presented in the Notice of Project Change summary. The Town decided to implement the Comprehensive Watershed Management Plan by moving from west to east along the southern coastline. With the completion of the Little Pond TWMP, the TWMP for Great Pond has been identified as the next watershed to be evaluated. The TWMP for the Great Pond watershed will provide information on several key elements including: the background on the watershed, update and recommended effluent discharge site selection, development of a recommended plan, an update to the environmental impact analysis, and an update to the section 61 findings and mitigation measures.

The Town has prepared Table ES-1, Estimated Costs and Financing Plans, that lists in detail 15 steps that need to be taken and decisions that need to be made at both the local and state levels to achieve a funded plan for the Great Pond watershed. In the process of developing the Great Pond TWMP, Falmouth must make an important decision in choosing a site for discharge of the treated effluent. The financing plan in Table ES-1 is consistent with Falmouth's originally stated policy of funding sewer projects in those years when new debt can replace retiring debt. The next funding window is Fiscal Year 2025, and expectations are that Town Meeting and the voters would approve a bond issue of \$60 million in April/May 2024 to be effective at the start of Fiscal Year 2025 starting on July 1, 2024.

ES.12 Section 61 Findings and Mitigation Measures Update

An update to the Section 61 findings and mitigations measures is a regulatory requirement. The changes to these findings have built upon those in the original CWMP. Mitigation measures are described for general construction sites, sewer construction, wastewater treatment facility, and infiltration sites. The update also includes additional mitigation measures involving adaptive management and climate change.



Table ES.1 Estimated Costs and Financing Plans

Item	Action Item	2019	2020	2021	2022	2023	2024	2025
1	Little Pond Sewer Service Area Completed	X						
2	(A) CWMP Update/NPC; (B) Oyster Pond Draft CWMP Submitted to MEPA/DEP	X						
3	Capital Plan within debt limit: add third Sequencing Batch Reactor; plant upgrade		X	X	X			
4	Receive MEPA Secretary's Certificate for CWMP Update		X					
5	Evaluate Results of Remediation to date; Engineering Contract for Great Pond TWMP		X					
6	Draft TWMP for Great Pond Sewer Service Area; Decision on Discharge Site; Submit to MEPA/DEP		X	X				
7	Sec. Certificate for Draft TWMP; Final TWMP; Sec. Certificate for Final TWMP				X			
8	Town Meeting Sets Betterment Percentage					X		
9	Construction Design Funding; Ballot Vote					X		
10	SRF PEF Application Submittal					X		
11	Obtain Listing on the SRF Intended Use Plan						X	
12	\$60M Town Vote Bond for Construction Contingent on 0% SRF Loan; Ballot Vote						X	
13	SRF Full Application Submitted - all required items must be in place						X	
14	State SRF Commitment; Bid Approval							X
15	SRF-Funded Construction Projects; On-going Adaptive Management							X

Program Funding and Timetable 2025-2040	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Town Construction of \$60M																
Plan Next Construction Projects																
\$40M Town Vote - Spring 2030						X										
Town Construction of \$40M																
\$XX Town Vote - Spring 2035 ⁽¹⁾											X					
Town Construction																

Notes:

CWMP = Comprehensive Wastewater Management Plan

NPC = Notice of Project Change

TWMP = Targeted Watershed Management Plan

PEF = Project Evaluation Form

SRF = State Revolving Fund

1. Due to the unknowns and uncertainties related to funding in the future, the Town has not identified the appropriation goal for 2035.