



Watershed Nitrogen Management Plan

Mashpee is the fastest growing town on Cape Cod. At the same time, it is located almost entirely within the watersheds of two shallow nitrogen-sensitive embayments, Popponesset Bay and Waquoit Bay. The estuarine systems of both bays have shown significant signs of degradation attributable to excessive inputs of nitrogen. The town of Mashpee currently has no municipal sewer system.

It does have a Sewer Commission with full authority, given funding to implement such a system. As a community, we treasure Mashpee's beautiful coastal ponds and estuaries, yet we are responsible for their poor water quality. Excess nutrients – nitrogen, in particular – come from septic systems and wastewater treatment plants, surface runoff after rain storms or snow melt, lawn fertilizer, stormwater drainage system discharges, and other sources. Nitrogen is present in the environment naturally; however, in excess, it is considered a pollutant.

In response to long standing concerns regarding nitrogen, in May 1999 Town Meeting voted \$405,000 to develop a Watershed Nitrogen Management Plan (WNMP). The intent was to provide an environmentally and economically sound plan for nitrogen reduction and wastewater treatment. It recommends areas appropriate for treating and discharging wastewater into the ground. The project culminated in a recommended plan to reduce the Town's nitrogen contributions – and those of its neighbors in the Popponesset Bay and Waquoit Bay watersheds – to coastal waters and specified options for restoring these wonderful resources. By proactively addressing nutrient issues on its own, the Town hopes to avoid regulatory enforcement actions by state or country agencies or the courts.

To learn more about the problem with nutrients and how you both contribute to it can be part of the solution, please visit the [Mashpee Water Pollution Problem](#). To learn more about the Plan and how it was developed, continue to review this document.

About the Project

The WNMP was completed in four phases: 1) Needs Assessment, 2) Technology Screening, 3) Alternative Scenarios Analysis and Site Evaluation, and 4) Recommended Plan. The phases are summarized on these pages. Details can be found in the reports for each phase, which can be viewed and downloaded from the [Historical Documents / Document and Resources / Project Documents](#).

Overview – Although present in the environment naturally, too much nitrogen is considered a pollutant. It is a nutrient that feeds aquatic plants, including algae, which consume oxygen as they grow and die off. When this happens, there is no longer enough oxygen in the water for aquatic life, causing fish kills and harming plants such as eelgrass that serve as a nursery for many important species. The decomposition of organic matter creates odors and is unsightly, resulting in growing layers of muck on the bottoms of our water bodies, impacting recreational uses such as swimming and boating, as well as the economic backbone of the Cape economy – tourism and fishing.



About the Project

The Massachusetts Estuaries Project (MEP) has estimated the maximum amount of a pollutant (in this case nitrogen) that each estuary in Mashpee can receive and still meet water quality standards. This is known as the Total Maximum Daily Load (or TMDL). The results of MEP studies have helped guide the Town's planning process.

The WNMP focuses on specific estuaries. The Project Planning Area (PPA) includes the entire town of Mashpee, the Popponesset Bay watershed that extends into the towns of Barnstable and Sandwich, and the Waquoit Bay East watershed that extends into the towns of Falmouth and Sandwich. The Mashpee Sewer Commission hired the engineering firm GHD Inc. (formerly Stearns & Wheeler, LLC) to prepare the WNMP working with the UMass-Dartmouth School of Marine Science and Technology. Each phase was presented at the Sewer Commission meetings for public review and comment. The Recommended Plan will meet the Town's future wastewater treatment needs while protecting the ponds and estuaries Mashpee shares with Barnstable, Falmouth and Sandwich.

- Needs Assessment
- Technology Screening Report
- Alternative Scenarios Analysis & Site Evaluation
- Alternative Screening Analysis Report
- Recommended Plan

Needs Assessment Report

The Needs Assessment Report identifies the wastewater, stormwater and other nitrogen problems within the Project Planning Area (PPA). The report evaluates existing conditions such as wastewater treatment facilities (WWTFs), physical land features and land uses, and regulatory issues affecting wastewater facilities. Future conditions are also assessed, such as population and growth and the potential effects on proposed wastewater collection, treatment and disposal facilities.

Wastewater Flows and Nitrogen Loading – Wastewater flows and nitrogen loading (or the amount of nitrogen present in the water) were developed based on MEP reports for the PPA and updated with revised build-out information. Total existing flow for the PPA, including areas in other communities, are 1.6 million gallons per day (MGD). Total future flows are estimated at 2.7 MGD. Residential properties will contribute almost 90 percent of wastewater flows, and wastewater will contribute as much as 80 percent of controllable nitrogen in the future.

Priority Areas – The Needs Assessment then evaluated the PPA based on previously established planning zones in Mashpee (developed by the Town) and some broader areas for the adjacent towns. Each of these were then grouped into larger geographic areas and compared to various criteria to begin the steps of prioritizing nitrogen removal needs.



Needs Assessment Report

The assessment looked at the following criteria:

- Was a nitrogen removal percentage assigned by MEP?
- Was the area identified as having high nitrogen loading per acre?
- Was the area identified as being year-round or seasonal (which will come into play for implementation purposes)?
- Were there other non-nitrogen considerations (i.e. Santuit Pond phosphorus, etc.)?
- Was the area located within a Zone II (a water supply protection area established by the state)?

Areas with MEP removal rates, high nitrogen loading and a greater number of year-round residents were weighted the highest for this analysis. "Primary Priority Areas" included the first three criteria, and possibly others as well. "Secondary Priority Areas" had either one or two of the higher weighted criteria.

"Tertiary Priority Areas" typically only include one of the top three criteria and at most only two of the five criteria identified above (with the exception of Barnstable's portion of Shoestring Bay). The majority met the year round and / or Zone II criteria only; therefore, they are more likely to be dealt with in later phases of a recommended plan. These areas also often included one or more of the following types of characteristics:

- Low nitrogen loading per acre
- Upstream location in the watershed to take advantage of attenuation (or natural nitrogen reduction)
- Large areas of open space
- Highly seasonal populations
- Located near existing WWTFs
- Outside of sensitive watersheds

The full Needs Assessment Report can be reviewed in the Historical Document / Documents and Resources / Project Documents page.

Technology Screening Report

The purpose of Technology Screening is to identify and screen alternatives for wastewater collection, treatment and disposal technologies for further evaluation. The Town's consultants looked at technologies for decentralized and centralized facilities.

- Decentralized technologies include individual innovative and alternative (I/A) septic systems and cluster systems serving flows of less than 10,000 gallons per day (GPD) or small wastewater treatment plants requiring a ground water discharge permit.



Technology Screening Report

- Centralized facilities which serve large areas of town, are often municipally run and treat flows of greater than 150,000 GPD.

Collection systems, disinfection technologies, effluent disposal, and water reuse technologies were also evaluated.

The screening report also looked at other methods for reducing nitrogen through stormwater control, fertilizer management, oyster propagation, and groundwater treatment. These methods would reduce nitrogen to varying degrees, but they are difficult to rely on for consistent, widespread performance. Many are not currently recognized by regulatory agencies for nitrogen removal.

Screening criteria were developed to weigh the relative advantages and disadvantages of each technology. Criteria included 1) suitability for local conditions; 2) implementability or ability to construct, operate, monitor and manage; 3) performance; 4) long-term maintenance; 5) efficiency of land use; 6) aesthetics including visual impact and potential odors; 7) public acceptance and political feasibility; 8) institutional concerns such as permitting issues and state approval; and 9) relative cost when compared to other technologies.

Report recommendations – the consultants recommended 13 of 20 decentralized technologies be further considered based on cost, performance, and other considerations (i.e. aesthetics, land use and long-term maintenance). Three types of small wastewater treatment facilities, or package plants, were advanced due to their flexibility in treating relatively small flows and the level of current use in Mashpee.

The Town evaluated 10 centralized treatment technologies and recommended 4 for further consideration. Nine technologies for water reuse technologies were considered to provide enhanced nitrogen removal downstream of the treatment plant prior to reusing the treated effluent; for instance, in irrigating a golf course. Disinfection processes (chlorination, ozonation and ultraviolet) were evaluated because it's likely any treatment facility constructed in the PPA will be required to provide disinfection.

The study also evaluated 5 collection system technologies. The report recommended gravity and low pressure systems. Effluent discharge technologies need to be specific as to the discharge site to minimize impacts to surface and groundwater. Eight alternatives were evaluated and four were recommended for further study. These include wetland restoration, sand beds, subsurface infiltration and spray / drip irrigation.

Please see the Technology Screening Report document for details on the evaluation process and recommendations.



Alternative Scenarios Analysis & Site Evaluation

Based on the Technology Screening Report, the Mashpee Sewer Commission identified five different wastewater management scenarios for further evaluation. They include leaving existing facilities in place and developing new facilities for unsewered areas, expanding existing facilities, assuming each Town in the watershed develops its own facilities using a standard percent nitrogen reduction for each community (called fair share), and centralized treatment. The analysis of the fifth scenario using NITREX™ technology in individual and cluster systems was prepared by Lombardo Associates.

Proposed sites discussed in this report are outlined below:

Scenario 1: Existing Facilities and New Facilities: Continues operation of existing private WWTFs and constructs additional facilities to achieve nitrogen reduction. New WWTFs are located at Sites 2, 4, 6 and 11 and new recharge locations are at Sites 1, 2, 4, 7 and 11. The scenario assumes approximately 380 properties would be on new I/A systems.

Scenario 2: Upgrade and Expand Existing Facilities: Expands existing WWTFs to the extent feasible to address adjacent areas and enhance nitrogen removal. The WWTFs sites are the same as Scenario 1. The recharge sites are the same, except that Site 1 is eliminated. The scenario assumes approximately 50 properties on new I/A systems.

Scenario 3: NITREX™: The scenario proposed cluster systems and individual I/A systems using NITREX™ technology.

Scenario 4: Fair Share: An overall percent reduction of nitrogen for the Popponesset and Waquoit East watersheds is determined for each community to remove. New WWTF sites are located at Sites 4, 6 and 11 and new recharge sites are at 4, 7 and 11. The scenario assumes approximately 130 properties would be on new I/A systems. Each town would develop its own facilities rather than sharing facilities as in the other four scenarios.

Scenario 5: Centralized Treatment: Wastewater treatment takes place at a centralized (municipal) treatment plant. A plant at Site 4 (in the Popponesset Bay watershed) would treat flows from both watersheds and recharge at multiple sites with the two watersheds. Each of the existing private WWTFs (except New Seabury) would become a pumping station. New Seabury would continue treating wastewater. The Forestdale School would serve as a pumping station for flow sent to another new WWTF located on Site 11 in Sandwich. The new WWTFs are located at Sites 4 and 11 and new recharge sites are 1, 4, 5, 7 and 11. The scenario includes approximately 120 properties in new I/A systems.



Alternative Scenarios Analysis & Site Evaluation

A site evaluation was also prepared for use with each of the five scenarios. Thirteen sites were evaluated for treatment facilities and treated wastewater recharge. Some were considered for recharge only; others were considered for both. The evaluation included criteria such as ownership, land use, proximity to sensitive receptors such as schools. None sites were carries forward for further development. The sites and the potential uses are listed below.

- Site 1 – Heritage Park Ball Fields – drip irrigation and subsurface infiltration
- Site 2 – Ashumet Road – open sand beds; wastewater treatment
- Site 4 – Transfer Station – open sand beds and subsurface infiltration; wastewater treatment
- Site 5 – High School Ball Fields – drip irrigation and subsurface infiltration
- Site 6 – Keeter Property – open sand beds; wastewater treatment
- Site 7 – New Seabury Country Club – drip irrigation and subsurface infiltration; wastewater treatment
- Site 11 – 168 Route 130 (Sandwich) – open sand beds; wastewater treatment
- Site 12 – Bartlett Property – open sand beds
- Site 13 – Adjacent to High School Parcel – open sand beds and subsurface infiltration

Alternatives Screening Analysis Report

Building upon the work performed as part of the Technology Screening Report work and the Alternative Scenarios Analysis & Site Evaluation and the MEP Model Run Description for Options 1A, 1B and 1C, this report summarizes those efforts and outlines the next steps in developing a Recommended Plan for the Project Planning Area.

Alternative Screening Analysis Report – The report outlines the framework of the Recommended Plan and the three primary mechanisms being considered:

1. Source Control
2. Direct Environmental Mitigation
3. Land Management Strategies

Source control is defined as approaches that primarily address wastewater, stormwater and lawn fertilizers. Things like:

1. Traditional wastewater treatment
2. Improved stormwater treatment
3. Reduction of fertilizers, use of alternative methods



Alternatives Screening Analysis Report

Direct Environmental Mitigation is defined as less traditional approaches to address nitrogen near or at the location being impacted, for example within the bays or at the shoreline or in close proximity to the impacted embayment. Things like:

1. Growing and harvesting shell fish
2. Dredging of widening of bays inlets
3. Use of permeable reactive barriers – an approach where groundwater is intercepted and passed through a media that removes or converts nitrogen before it reaches the saltwater systems.
4. Wetland restoration and cranberry bog restoration projects

Land management strategies are defined as methods the Town can use to manage growth, development, and secure land and facilities in order for them to reduce the amount of “source and direct mitigation” as each Town considers existing and future impacts on their coastal embayment and fresh water ponds. Things like:

1. Growth Neutral / Flow Neutral policies to minimize future impact from the nutrients
2. Open space purchase and land protections
3. Purchase or protection of land for town use in source control and direct environmental mitigation
4. Phasing of implementation of any plan and consideration of seasonal and year round land uses

As the project develops the Recommended Plan, additional evaluation will be performed to select components of the plan and scheduling will be prepared to show how the plan might be implemented and which areas would be prioritized.

Recommended Plan

The Recommended Plan and Final Environmental Impact Report (May 2015), received its certificate from Executive Office of Energy and Environmental Affairs (EOEEA) as part of the Massachusetts Environmental Policy Act (MEPA) and the Massachusetts Department of Environmental Protection (MassDEP) on July 31, 2015. The plan included phasing, implementation and monitoring approaches to allow the Town(s) to focus on areas of the PPA that are currently developed and producing wastewater nitrogen load.

The purpose of the Recommended Plan and Final Environmental Impact Report (RP/FEIR) is to present the recommendations of the planning process to address the nitrogen Total Maximum Daily Loads (TMDLs) established for Popponesset Bay and Waquoit Bay’s eastern basin, and to discuss the mitigation measures and implementation approach for Mashpee (and its neighboring communities



Recommended Plan

within the project planning area) to address these needs as identified in previous documents. These recommendations as they relate to Mashpee will then be managed through the Town of Mashpee.

The Document consists of 10 Chapters and several Appendices (See “Documents & Resources Page”).

- Chapter 1 reviews the background and MEP findings
- Chapter 2 summarizes how these efforts are consistent with CCC 208 Planning
- Chapter 3 reviews the public outreach program
- Chapter 4 summarizes the framework and evaluation of the plan
- Chapter 5 summarizes the Draft Recommended Plan
- Chapter 6 presents the final recommended plan
- Chapter 7 summarizes the environmental evaluations
- Chapter 8 presents the Draft Section 61 finds and mitigation measures
- Chapter 9 presents the phasing and implementation approach
- Chapter 10 outlines the adaptive management program

The plan focuses on implementation of Shellfish Aquaculture in Popponesset Bay (including Mashpee River, Ockway Bay, Shoestring Bay) and Hamblin and Jehu Ponds (including Great and Little Rivers) as part of the initial phase of work.

In addition, traditional wastewater collection and treatment infrastructure in areas of the Mashpee River Watershed and Quashnet River Watershed are proposed to address areas where shellfish aquaculture is not anticipated to be able to achieve the nitrogen TMDLs.

The implementation is envisioned in the following three categories:

- Short-Term Initiatives
- Phase 1 Implementation (5 Year): approximately 2017 to 2021
- Long-Term Implementation and Adaptive Management: 2022 to 2041 and beyond

Short Term Initiative and Phase 1

2015 – 2016

- MEPA / DRI approval
- Cape Cod Commission DRI approval
- Shellfish Propagation (Expand Existing Program)



Short Term Initiative and Phase 1

2015 – 2016

- WWTF Ownership Discussions
 - Joint Base Cape Cod
 - Private Facilities
 - New Seabury
 - Willowbend
 - Mashpee Commons
 - Southport
 - Stratford Ponds
- Continued development of Intermunicipal Agreements (IMAs), Regional MOUs (this will also influence long-term implementation of areas with the neighboring communities). An IMA has been signed with Sandwich and Barnstable regarding Popponesset Bay cleanup responsibilities. Initial discussions have begun with Sandwich and Falmouth regarding a Waquoit Bay IMA.
- Fertilizer management / bylaw implementation.
- Continued use of stormwater BMPs.

2016 – 2020: Phase 1

- File Notices of Project Change and Development of Regional Impact (DRI) modifications to inform (and gain approval from) the environmental review process on the agreements and funding that will allow the next steps to proceed.
- Shellfish Propagation (expanded to related sections of Popponesset Bay, new Jehu Pond, new Hamblin Pond).
- Feasibility Study: Implementing Soft Solutions for Restoring the Quashnet / Moonakis River (sturdy completed – determined no shellfish mitigation possible).
- Feasibility Study: Connection of Quashnet and Combs Schools to Mashpee Commons WWTF, upgrade as required.
- Design and Construction of Site 4 facility (Phase 1) to serve sections of Subarea S (within Mashpee River Watershed) adjacent to Falmouth Road / Route 28. (Approximately 0.1 mgd average annual).
- Design and Construction of related collection system to serve Site 4 WWTF, study of possible connections to Wampanoag and Mashpee Commons (completed).
- Determine additional evaluations of existing wastewater treatment facilities leading into next phase of proposed improvements.
- End of Phase compliance reporting – update MEP Model (landuse and hydrodynamic models) and calibrate with water quality and benthic flux sampling.



Common Terms and Definitions

Attenuation – Reduction in the amount of a substance, in this case nitrogen.

Cluster system – A wastewater treatment system that serves a smaller number of homes and businesses and bridges the gap between individual septic systems and large municipal treatment plants.

Effluent – Outflow or discharge from a system, in this case from a wastewater treatment plant or septic system.

Estuary – Coastal water bodies where fresh ground and surface waters combine with marine waters to form the productive and scenic harbors and bays characteristic of the Cape coastline. Popponeset Bay and Waquot Bay are examples of these.

Gravity sewer – moves sewage from one point to another using the force of gravity in pipes that are typically 8 inches in diameter or greater.

Groundwater – Water located in void spaces of soil beneath the ground surface, often referred to as an “aquifer”.

Groundwater recharge – Returning used water, in this case treated wastewater or stormwater, to the groundwater by injecting it into the soil or other means. The purpose of groundwater recharge is to take advantage to the natural ability of soil and microscopic organisms to absorb nitrogen before it reaches groundwater, and has the added benefit of keeping water local by returning it to the rivers, streams and estuaries that it came from. Appropriate recharge areas will be identified by the Mashpee WNMP project based on soil characteristics and other criteria.

Individual innovative and alternative septic systems – An alternative to a conventional septic system (Title 5) that uses innovative technologies to treat wastewater. Systems must be approved by the state before use. They are sometimes called “I/A systems”.

Low pressure sewer – moves sewage of wastewater by pumping from your home through a small pipe (often 1.5 to 43 inches in diameter).

Nitrogen – An essential nutrient that serves as food for plants. Nitrogen is typically the nutrient that promotes excessive algal growth in marine waters.

Nitrogen loading – Amount of nitrogen present in the water (often presented in lb/day or kg/day).

Nutrients – Essential food for plants (such as nitrogen and phosphorus) that can produce an overabundance of algae when too much is discharged into water bodies.



Common Terms and Definitions

Phosphorus – An essential nutrient that serves as food for plants. It is typically the nutrient that promotes excessive algae growth in fresh waters.

Pump station – Lifts sewage from a low point in an underground gravity sewer up to the high point in the system (typically the wastewater treatment plant).

Total Maximum Daily Load – A regulatory limit developed by state and federal regulators that identifies the maximum amount of a pollutant that a water body can receive and still meet water quality standards (in this case nitrogen).

Water reuse (or recycling) – reusing treated wastewater for beneficial purposes such as irrigating golf courses or recharging groundwater; often referred to as a “purple pipe”.

Watershed – Land area that contributes surface or groundwater to a water body.

Typical Acronyms

I/A septic systems – Individual Innovative and Alternative Septic Systems

MEP – Massachusetts Estuaries Project

PPA – Project Planning Area

TMDL – Total Maximum Daily Load

WNMP – Wastewater Nitrogen Management Plan

WWTF – Wastewater Treatment Facility