

The regulations are generally enforced by local health departments. The local BOH, due to specific problems or concerns, can and may impose more stringent requirements. Individuals and/or communities can receive a variance from the regulations; however, it must be in accordance with 310 CMR 15.00.

B. Privately Owned Sewage Treatment Facilities and Publicly Owned Treatment Works.

Privately owned sewage treatment facilities (PSTFs) are the private version of the publicly owned treatment works (POTWs). POTWs are defined in 314 CMR 12.02 as “any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial waste of a liquid nature which is owned by a public entity. A POTW includes any sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.” In Massachusetts, there are detailed requirements at the State level, which apply stringent requirements on the location and operation of PSTFs.

Current MADEP regulations require the use of a PSTF or POTW for any residential or commercial discharge greater than 10,000 gallons per day (gpd). MADEP reviews the performance of these facilities under its Groundwater Discharge Permit (GWDP) Program (314 CMR 5.00). The Town of Mashpee has eight (8) small treatment facilities in operation that are permitted to discharge over 10,000 gpd. These facilities are located at Mashpee Commons, Mashpee High School, New Seabury, Willowbend, Southport, Windchime Point, South Cape Village, and Stratford Ponds. There is one additional WWTF with a 10,000 gpd GWDP at the Forestdale School in Sandwich, located in the Popponesset Bay estuary.

C. Effluent Discharge at an Ocean Outfall. The Massachusetts Ocean Sanctuaries Act (M.G.L. c132A) regulations establish state environmental policy to be enforced in the five Massachusetts Ocean Sanctuary areas, consisting of the Cape Cod Ocean Sanctuary, the Cape Cod Bay Ocean Sanctuary, the Cape and Islands Ocean Sanctuary, the North Shore Ocean Sanctuary, and the South Essex Ocean Sanctuary. These areas are special resources and the goal of the Act is to protect them from any “exploitation, development, or activity that would seriously alter or otherwise endanger

their ecology or appearance”.

The PPA is located in the Cape and Islands Ocean Sanctuary. Municipal wastewater discharges into ocean sanctuaries are specifically precluded under these regulations, unless the discharge was approved and licensed prior to December 1971. A variance from these policies would require State approval and possible legislation stating that a special variance was needed to protect the public health due to a limited number of feasible effluent recharge (to groundwater) alternatives.

D. Groundwater Quality Standards. The Groundwater Quality Standards of 314 CMR 6.00 define three groundwater classes and their designated uses, and they specify the minimum groundwater quality criteria for each class. Class I groundwater is fresh groundwater designated as a potential source of potable water. Class II groundwater is saline water and is designated as a potential source of potable mineral waters. Class III groundwater is fresh or saline water and is designated for uses other than potable water. At a minimum, Class III groundwater can be used as a potential source of non-potable water and is suitable for human contact but not ingestion. The groundwater in the PPA is classified as Class I, and any permitted discharges to the groundwater must meet specific discharge requirements, including a Nitrate-Nitrogen limit of 10 mg/L.

Discharges to groundwater of 10,000 gpd or greater must meet requirements of the Groundwater Quality Standards, as well as the GWDP Program described below.

E. Groundwater Discharge Permitting. The Massachusetts GWDP Program is contained in 314 CMR 5.00, which is the regulation governing wastewater discharges of 10,000 gpd or greater. Facilities designed or constructed prior to March 1995 were allowed to discharge up to 15,000 gpd without a discharge permit.

The groundwater discharge regulations cover several types of discharge to groundwater, including discharges through infiltration beds, percolation fields, lagoons, or injection wells. Permitted discharges must meet the requirements for the groundwater class. These requirements are quite

strict and cannot be met with a typical on-site septic system. Advanced wastewater treatment plants are used to meet the requirements. Application for a discharge permit requires a hydrogeologic evaluation, as well as an engineered design for the treatment and discharge facility. Most discharge permits include a nitrogen limit of 10 mg/L.

F. Reclaimed Water Use. The use of reclaimed water must meet interim guidelines developed by MADEP (January 2000) in addition to the requirements of the GWDP Program. Reclaimed water uses include use of treated wastewater for irrigation at golf courses and landscaping nurseries, discharges into approved Zone II areas, and toilet flushing in commercial buildings.

Higher levels of treatment are required for reclaimed water uses. These guidelines are also currently being reviewed by MADEP and new issues may be released in 2007.

G. Surface Water Quality Standards. In addition to the limitations on ocean disposal of wastewater imposed by the Ocean Sanctuary regulations, the Massachusetts Surface Water Quality Standards define the activities that are prohibited in various class-designated surface water bodies. The water in Waquoit Bay and its tributaries are designated SA, Outstanding Resource Water. This is the top salt-water ranking and means that the water is suitable for all types of water recreation. The water in Popponesset Bay, Nantucket Sound, and Vineyard Sound are designated SA, High Quality Waters. Any actions that would prevent swimming, fishing, or other recreational activities in these waters are strictly prohibited.

In addition to the designations identified above, Flat Pond, Jehu Pond, Jim Pond, Little Flat Pond, Sedge Lot Pond, and Witch Pond are designated as Class B Warm Water Outstanding Resource waters according to 314 CMR 4.00, which regulates surface water quality. Dissolved oxygen, temperature, pH, fecal coliform, solids, color, turbidity, oil, grease, taste, and odor are all regulated and cannot exceed levels set by 314 CMR 4.05 (3b and 4a) that degrade these waters. Any other ponds in the PPA are classified as Class B, High Quality Waters.

An additional summary of water quality is provided in the Integrated List of Waters, also known as the 303(d) list. The classification of water within the PPA is discussed in section 3.6(A) of this chapter.

H. Surface Water Discharge Permitting. The Massachusetts Surface Water Discharge Permit Program described in 314 CMR 3.00 regulates all discharges of pollutants to surface waters located in Massachusetts. These include point sources for public and privately owned treatment works and stormwater discharges.

Discharge of treated wastewater to surface waters in Mashpee would not be allowed due to the Ocean Sanctuaries Act and because of the Outstanding Resource Water designation of the majority of the water in the PPA.

I. Wetlands Protection. The Wetlands Protection Act (WPA) (M.G.L. ch. 131, s. 40) and parallel State regulations (310 CMR 10.00) were enacted to safeguard wetlands, associated resource areas, and floodplains from overdevelopment.

The WPA covers any wet area where the groundwater level is at or near the surface of the ground for a long enough period during the year to support a community of wetland-type vegetation. Wet areas include any salt or fresh-water marsh, meadow, swamp, or bog.

Areas subject to protection under the WPA include banks, dunes, beaches, and flats. All of these protected areas are referred to as resource areas. Resource areas are protected by a surrounding 100-foot buffer zone in which landscape alterations are regulated. The WPA also covers construction on land subject to flooding as well as land subject to coastal storms. Generally, the regulations apply to two types of floodplain: those lands bordering directly on bodies of water, and those lands subject to flooding (called "Isolated Land Subject to Flooding") which do not border bodies of water.

The state regulates activities that involve filling, dredging, or excavating in or near a wetland or

water body. The regulations govern additional construction activities, including site preparation, the removal of trees or bushes, vista pruning, and the changing of land contours.

A Notice of Intent (NOI) must be filed for work in any resource area. The NOI requires a detailed description of the planned activity, and the applicant must show that if the resource area will be altered, the benefits will outweigh the damage. For work outside the resource areas but within a 100-foot buffer zone around a bordering vegetated wetland, bank, dune, or beach, the owner has the option of filing a "Request for Determination" in order to show that the work will not alter a resource area. If the Conservation Commission agrees, it will issue a "Negative Determination", permitting the work as presented. If the Conservation Commission decides that the work will alter a resource area, it will issue a "Positive Determination" and require a full hearing and the filing of a NOI.

J. Massachusetts Rivers Protection Act. This law is an amendment to the WPA and establishes a Riverfront Area, which is included in the resource areas protected by the WPA. The law authorizes conservation commissioners to regulate activities that occur within the Riverfront Area and establishes protection of the natural integrity of rivers as a State priority. For the WNMP PPA, the Riverfront Area is a 200 foot-wide area, extending from the mean high water level of a river.

Permits for work in Riverfront Areas will be denied if a significant adverse impact would result or if there is a "practicable and substantially equivalent economic alternative" that will have less impact on the resource area. Certain activities are exempt from the Rivers Protection Act, including renovation of abandoned cranberry bogs and activities associated with wastewater treatment plants and their related structures, conveyance systems, and facilities.

K. Governor Kings Executive Order No. 181 on Barrier Beach Areas. This Executive Order defines barrier beach areas and sets several State policies to restrict and discourage development in these areas. One policy states that no State funds and Federal grants for construction projects shall be used to encourage growth and development in hazard-prone barrier beach areas. This policy has

been used by the State to restrict government-funded projects in hazard-prone areas, such as Velocity Zones.

Discussions with members of the Massachusetts Office of Coastal Zone Management (CZM) indicate that the State will discourage development in a Velocity Zone and withhold State funding for such a project. This development would include the construction of a treatment facility or collection system in a Velocity Zone. This policy could affect the PPA if a sewer is proposed to collect wastewater along the southern coast where Velocity Zones are located.

L. Regulations for the Land Application of Sludge and Septage. The land application of sludge and septage, as well as the distribution of compost material made from Wastewater Treatment Facility (WWTF) sludge, are regulated by MADEP in 310 CMR 32 and the July 2005 federal standards contained in 40 CFR Part 503. The State regulations are currently more stringent.

Under the MADEP regulations, sludge, septage, and compost (collectively called “material”) are classified as Type I, II, or III, depending upon chemical, pathogen, and organic content, and sludge stabilization processes used. The sludge classification determines how the material is ultimately used or disposed of. Type I material can be used on any site and requires no further MADEP regulations, while Type II and III materials require additional regulation on the ultimate use, the application site, and allowable application rates. Compost must be classified as Type I to be sold or otherwise distributed to the public.

M. Water Resources, Treatment and Supply of Potable Water. The Safe Drinking Water Act (SDWA) of 1974 is federal legislation that dictates the regulation of potable water in the United States. Major amendments were made to the SDWA in 1986 and mandate that 25 additional contaminants come under regulation every three years. This legislation is incorporated into the regulations of 40 CFR 141, 142, and 143, which are maintained and enforced by USEPA.

Massachusetts is a primacy state for the regulation of potable water, which means that MADEP is

the primary agency for maintaining and enforcing the drinking water regulations. Massachusetts' regulations contained in 310 CMR 27.00 closely parallel the federal regulations and establish the maximum contaminant level (MCL) of the regulated contaminants in drinking water. The groundwater quality standards discussed in a previous section and contained in 314 CMR 6.00 have been determined by the drinking water MCLs. Included in the list of MCLs is the Total Nitrate-Nitrogen maximum concentration of 10 mg/L.

The SDWA provides guidelines on the establishment of wellhead protection programs, which Massachusetts has established in Section 310 CMR 22.21. The program delineates three zones around each public water supply. The Zone I delineation is the area immediately around the well or wellfield which must be owned by, or in the control of, the water purveyor. The Zone I for a well producing 100,000 gpd or greater has a minimum diameter of 800 feet. The Zone II delineation is the area of an aquifer that contributes water to a well under the "most severe pumping and recharge conditions that can be realistically anticipated." The regulations define these conditions as 180 days of pumping at safe yield with no recharge from precipitation. Zone II areas are typically determined by a hydrogeological study involving particle-transport computer modeling. The Zone II is bounded by the groundwater divide and by the contact of the aquifer with less permeable material. The Zone III delineation is the area beyond the Zone II from which surface water and groundwater drain into Zone II.

The allowed land use within each zone is regulated by the wellhead protection program. Land use activities within Zone I areas must be related to the water supply or have no significant adverse impact on water quality. The following land uses are prohibited from being sited in a Zone II area:

- Landfills or open dumps.
- Landfilling of sludge or septage.
- Automobile graveyards and junkyards.
- Stockpiling of contaminated snow or ice.
- Petroleum, fuel oil, and heating oil bulk stations and terminals.

- Treatment or disposal works for wastewater other than sanitary sewage.
- Facilities that generate, treat, store, or dispose of hazardous materials.
- Floor drainage systems in hazardous waste and hazardous material processing or storage facilities.

There are exceptions to the prohibition of wastewater treatment plants listed as the sixth bullet above. These exceptions are reviewed by MADEP on a case-by-case basis.

N. Toxic/Incompatible Discharges to Wastewater Collection Systems. In the early 1980s, the USEPA established nation wide industrial pretreatment standards contained in 40 CFR 403, General Pretreatment Regulations, to regulate the discharge of industrial pollutants to POTWs. The general goals of this program are to limit those toxic/incompatible discharges, which could:

- Pass through a plant inadequately treated.
- Harm a plant's treatment processes, thereby preventing the plant from complying with its permit.
- Accumulate in the plant's sludge in concentrations that would limit sludge disposal options.
- Cause a risk to the health and safety of treatment plant workers or the general public.

When these regulations were established, all communities with POTW flows greater than 5 mgd were required to establish local industrial pretreatment programs. Because there were no facilities in Mashpee with flows greater than 5 mgd, no pretreatment programs were required at that time.

Massachusetts's pretreatment regulations (314 CMR 12.00) parallel the federal regulations. Paragraph 12.09.2 of the Massachusetts regulation states that the Director of the MADEP may require a POTW with a design flow of 5 mgd or less to establish a pretreatment program in order to meet the goals listed above.

O. MEPA Environmental Review. The WNMP Study includes an environmental review process that is governed by MEPA and Cape Cod Commission's DRI review process.

The MEPA process, as described in 301 CMR 11.00, establishes thresholds, procedures, and timetables for a multi-level review process. If a project exceeds review thresholds or if state funding is requested for a project, the project proponent begins the review process by preparing and filing an Environmental Notification Form (ENF) with the Secretary of Environmental Affairs (Secretary). A 30-day review period follows, during which the Secretary receives agency and public comments and holds a site visit and consultation session. At the close of the ENF review period, the Secretary determines whether an Environmental Impact Report (EIR) is necessary, and issues a MEPA certificate. This certificate and the MEPA comments that were received during the review of the ENF and DRI forms are contained in Appendix A. If an EIR is required, it is prepared by the proponent and submitted to the Secretary. The EIR is reviewed at both draft and final stages, by agencies and the public. After completion of the Secretary's review, state agencies may act on the project.

The Town of Mashpee has entered the MEPA process as part of the WNMP Study because state funding was requested for the Project. This state funding is a zero-interest rate loan provided by the MADEP State Revolving Fund (SRF) loan program. An ENF was filed on September 27, 2001, and a certificate dated November 9, 2001 (contained in Appendix A) was issued stating that an EIR is required. The Scope of the WNMP Study will be used as the scope of the EIR.

MEPA requires the filing of a Notice of Project Change (NPC) if more than three years have elapsed between the time of the public notification of a project in the Environmental Monitor and the time of availability of the EIR. More than three years have elapsed since the notification of the ENF in the Environmental Monitor and the EIR is still not ready, due to the lapse in time while waiting for determination of the Total Maximum Daily Loads. Therefore, a NPC is required for this project. It is anticipated that the NPC will be filed after the Final Needs Assessment Report and draft Technology Screening Report are completed.

3.4 REGIONAL REGULATORY ISSUES

A. **Development of Regional Impact (DRI) Review Process.** In accordance with the Cape Cod Commission Act, Chapter 716, the CCC has the authority to review and regulate DRIs. This review is carried out by the Commissioners and the CCC staff, in accordance with Administrative and Enabling regulations.

As stated earlier, the Town of Mashpee's WNMP Study includes an environmental review process that is governed by MEPA and the Commission's DRI procedures. This review process is a joint review process as identified by the Certificate of the Secretary of Environmental Affairs. The Secretary's Certificate and the MEPA comments that were received during the review of the ENF and DRI form are contained in Appendix A.

B. **Cape Cod Commission Regional Policy Plan.** The original Regional Policy Plan (RPP) was adopted by the CCC and approved by the Barnstable County Assembly of Delegates on July 31, 1991, and the Barnstable County Commissioners on August 7, 1991. The Cape Cod Commission Act for the RPP states that this plan must be revised every 5 years, and a new RPP was published in late 2002 (the RPP is currently undergoing another 5-year review). This policy plan sets forth goals and policies, as well as minimum performance standards to be applied to growth and development.

The minimum performance standards and other development review policies of the RPP are intended to be used by both the CCC and local regulatory authorities once they have adopted a Local Comprehensive Plan (LCP) and it has been certified by the CCC. The reader is directed to the RPP document for additional detail.

The following is a brief list of selected goals and minimum performance standards for water resources and coastal resources that pertain to wastewater treatment and disposal in Mashpee. The reader is directed to the 2002 RPP document for additional detail.

1. **Water Resources.** The goal of the Water Resources Minimum Performance Standards is to preserve the high quality of the groundwater (the source of Cape Cod's drinking water) as well as the marine and fresh surface waters. The minimum performance standards include the following:

- Maximum nitrogen loads of 5 parts per million (ppm) apply to development and redevelopment unless no adverse impacts on resources will result. More stringent maximum loads (such as no net nitrogen) may be imposed where necessary, such as in public water supply areas or to meet critical nitrogen loads for marine ecosystems.
- In order to limit phosphorus inputs, no subsurface disposal systems shall be permitted within 300 feet of fresh water ponds.
- Private sewage treatment facilities are only permitted if they do not enable growth more dense than local zoning allows; if no public facilities are available within three years; if tertiary treatment with denitrification meets a maximum 5 ppm nitrogen in the groundwater; and if they protect the aquifer's hydrologic balance and preserve sensitive resources.
- Untreated stormwater runoff shall not be discharged into surface waters or wetlands; best management practices shall be used to improve runoff water quality.
- Conversion from seasonal to year-round uses must protect sensitive resources.

2. **Coastal Resources.** The goal of the Coastal Resources Minimum Performance Standards is to preserve the coastal areas by limiting development in sensitive areas and to maintain and improve shellfish and finfish habitats. The minimum performance standards include the following:

- No development or redevelopment shall be permitted within flood zones or on barrier beaches. Development and redevelopment within 100 feet of the top of a coastal bank, dune crest, or beach is limited.
- No new public infrastructure or expansion of existing infrastructure shall be made in flood zones unless an overriding public benefit is provided and new growth and development in flood hazard areas is not promoted.
- New mounded septic systems are prohibited within Federal Emergency Management Agency (FEMA) V-zones except to upgrade existing failed systems that pose a demonstrated threat to public health, water quality or natural resources.
- No new direct, untreated stormwater discharges shall be permitted into any coastal waters or wetlands, including discharges above or below the mean high water level.
- Pump-out facilities and restrooms shall be provided at new marinas or expansion of existing marinas.
- Development shall not have a significant direct or indirect adverse impact on eelgrass beds. Development and redevelopment shall minimize impacts to fish, shellfish, and crustaceans.

C. Town of Mashpee Comprehensive Plan. The Town of Mashpee has a LCP, which has been certified by the Cape Cod Commission. The LCP is structured to comply with and expand upon the guidelines adopted by the Cape Cod Commission; it was approved by Town Meeting in May of 1998 and certified by the Commission in July of 1998. The sections of the Mashpee LCP that are most relevant to this study (Water Resources/Water & Wastewater Facilities, Coastal Resources, and Land Use & Growth Management) are described as follows.

1. **“Water Resources and Water and Wastewater Facilities” April 1998, Mashpee Planning Department.** The following summarizes the Water Resources and Water & Wastewater goals adapted by the community and Town to be considered during future development in the Town of Mashpee:

- To ensure continued safe drinking water for all residents.
- To minimize negative effects of development on wetlands, groundwater, or surface water bodies.
- To provide safe and cost-effective waste treatment that supports development.
- To coordinate private and public wastewater facilities plans smoothly, and to ensure the safety of private wells.

The Town then identified a series of recommended policies to address these issues, and a Five Year Plan to provide immediate action with focus on the following areas:

- Regulatory Actions
- Data/Knowledge
- Wastewater Facilities
- Other Actions

2. **“Land Use & Growth Management” April 1998, Mashpee Planning Board.** This plan summarizes land use issues facing the Town of Mashpee, including the following community and Town goals:

- To maintain Mashpee’s small town rural/resort character.
- To maintain or improve Mashpee’s air and water quality.
- To minimize the impact of growth on property taxes.
- To ensure that the amount of development in Mashpee is consistent with the carrying capacity of its natural environment and the maintenance of its quality of life.

3. **“Coastal Resources” July 1998, Mashpee Planning Department.** This report is an update to the 1990 *Mashpee Coastal Resource Management Plan and Municipal Harbor Plan*, modified to include issues suggested by the Cape Cod Commission for Local Comprehensive Plans and to reflect public opinion. Policies were recommended for managing and preserving Coastal Resources. The policies included the following general subjects:

- Development issues in flood zones
- Management of stormwater and sediments into Mashpee’s waters
- Nutrient loading in estuarine systems
- Management of boat waste disposal
- Protection of the fisheries and shellfish resources
- Provision of public access to coastal waters
- Protection of barrier beaches, dunes, eroding coastal banks, wetlands, and other significant environmental coastal resource features
- Preparedness and quick response to water-related emergencies, which could threaten the integrity of Mashpee’s coastal resources.

D. **Town of Falmouth Comprehensive Plan.** The most recent Falmouth LCP, based on the CCC’s Regional Policy Plan, was initially adopted and approved in 1998. Although the LCP was revised in 2005, the Community Vision was still considered valid and applicable. The Community Vision discusses the town’s goals of protecting and promoting the “distinctive natural, cultural, historic and economic attributes that define Falmouth” and to “preserve and protect the town’s beaches, coastal ponds, scenic views, and valued natural features.” The 2005 LCP addressed the degradation of the town’s coastal ponds, estuaries and embayments. Some of the goals of the LCP are summarized as follows:

- Preserve potable water supplies and to provide high quality drinking water
- Encourage reduced nutrient loading by appropriate use of new, innovative wastewater

technologies

- Maintain and improve coastal water quality
- Preserve, restore, and enhance the quality and quantity of inland and coastal wetlands
- Address issues relating to nutrient loading and other water quality problems including wastewater management

E. **Town of Barnstable Local Comprehensive Plan.** Barnstable’s Local Comprehensive Plan was approved in 1997. There is currently a draft LCP that is awaiting approval.

The Natural Resources section of the Draft LCP includes goals pertaining to water quality and wastewater issues. The goal for wastewater management directs the Town “to provide adequate wastewater treatment facilities to meet the communities needs while maintaining the environmental integrity of the aquifer” and to “maintain the potability of drinking water supplies and the ecological integrity of streams, ponds, and coastal embayments.” The goals also include:

- Maintain and preserve a high quality drinking water supply
- Encourage the use of public and private wastewater treatment facilities in areas where they will provide environmental or other public benefits
- Encourage the use of innovative and alternative wastewater technologies to achieve higher effluent water quality
- Prevent contamination of water resources by application of best management practices for stormwater runoff and lawn and landscape chemicals

F. **Town of Sandwich Local Comprehensive Plan.** The Town of Sandwich adopted a LCP in May of 1996. This was adopted locally, but the Town has not yet developed a LCP for CCC certification. The Sandwich LCP includes the following goals:

- Minimize or eliminate negative impacts of existing and future development on the surrounding environment

- Maintain a sustainable supply of high quality drinking water
- Maintain and improve coastal water quality to protect coastal ecosystems
- Preserve and restore the quality and quantity of inland and coastal wetlands
- Development and redevelopment to maximize the amount of uninterrupted open space

3.5 TOWN OF MASHPEE REGULATIONS AND BYLAWS

The Code of Massachusetts Regulations allows for local authorities to establish stricter interpretations of the Title 5 regulations, with Title 5 being the minimum requirements allowed by the State. The Town of Mashpee and other towns in the PPA have adopted regulations that pertain to treatment and discharge of sanitary wastewater; some of the Mashpee regulations that govern design, construction, and operation of septic systems are summarized below.

Full versions of these regulations can be obtained from the Mashpee Board of Health (BOH) and online at http://www.ci.mashpee.ma.us/Pages/MashpeeMA_Health/2006updatedregulations.pdf.

A. **Commercial Septic Systems, December 28, 1981.** This regulation sets forth requirements for the leaching area for multi-unit buildings and industrial or commercial buildings.

B. **Commercial Septic System Nitrogen Loading, March 9, 1984.** This regulation required that effluent to the aquifer be of drinking quality if the sewage effluent exceeded certain flow or nitrogen loading conditions.

C. **Leaching Distance Requirements, February 8, 1985.** This regulation details the minimum distance requirements for disposal facilities that are located in the vicinity of wells, water supplies, swimming pools, drains, or other components which may affect human health.

D. **Septic System Failure Policy, March 6, 1989.** This policy provides specific regulations regarding septic systems, including the following issues:

- Conditions of Failure for septic tanks, pumps, distribution boxes, leaching facilities, and pipes.
- Responsibilities of the property owner, installer, and the BOH.
- Conditions for Variance.

E. **Depth to Groundwater Regulation, September 13, 1990.** This regulation set minimum separation distances between the groundwater and the bottom of leaching facilities.

F. **Septage Disposal Regulation, September 20, 1993.** The policy mandated that septage pumpers doing business in Mashpee dispose of their loads at the Town of Barnstable's wastewater treatment plant, unless permission is requested in writing and granted by the BOH.

G. **Black/Grey Water Septic Systems, August 10, 1995.** This policy regulates the following issues with regard to alternative/innovative septic systems which collect and treat black or grey water:

- Definitions of Black Water and Gray Water.
- Approved discharge systems and conditions.

H. **Water Quality Protection, July 1, 1999.** This regulation applies to systems with design flows in excess of 600 gpd. The purpose of this policy is to decrease the amount of nitrogen contribution to watersheds by regulating the following:

- Limiting effluent conditions for new on-site septic systems to 10 milligrams per liter (mg/L) (thereby requiring on-site denitrification systems).
- Required effluent conditions for existing on-site septic systems.

I. **Innovative/Alternative On-site Septic Systems, Nov. 16, 2000.** The purpose of this regulation is to ensure the proper maintenance, operation and performance tracking that is necessary to evaluate the efficacy of alternative septic systems. The following summarizes some of these requirements:

- All systems failing to meet a 75 foot setback from surface waters, freshwater or coastal wetlands, bordering vegetated wetlands, salt marshes, inland and coastal banks, or other resource areas shall specify the installation of a disinfection unit for the effluent prior to discharge to the leaching facility. Disinfection shall achieve a reduction of fecal coliform to less than 200 fecal coliform per 100 milliliter sample.
- All alternative septic systems shall be monitored for Total Nitrogen on a quarterly basis, and all disinfection units should be monitored quarterly for fecal coliform for a period of two years after installation.
- Humus/Composting Toilets are certified for non-remedial use subject to the conditions set forth at 310 CMR 15.289(3)(a), where a system in full compliance with 31- CMR 15.000 and Mashpee Board of Health regulations could otherwise be installed on the site.

The Town of Mashpee has adopted the following zoning bylaws that pertain to the scope of this study:

1. **Article VI (Section 174- 27.2 – Stormwater Management).** This section outlines the requirements for stormwater management and precipitation recharge. The bylaw outlines the circumstances and project sizes that trigger compliance, along with describing general types of stormwater controls that can be used and submission requirements for approval purposes.

2. **Article VI (Section 174-27 – Water Quality Report).** This section details the types of residential, commercial, or industrial uses permitted in various parcels of the town. A Table of Use Regulations is presented which details exactly what types of construction or land use are permitted

in the various land use classifications. Section 174-27 requires a groundwater quality report for certain proposed subdivisions and non-residential project and outlines the types of analyses to be performed and the calculations to be done.

3. **Article XI - Floodplain Zone Provisions (Section 174-58 through 174-68).** This article outlines the restrictions and permits that are applicable for new construction or substantial improvement within flood zones.

4. **Article XII - Mashpee River and Quashnet River Protective Districts (Section 174-69 through 174-75).** This article describes the extents of the Protective Districts, prohibited uses in the Protective Districts, and applicability of the prohibitions to existing uses. The Protective Districts were developed to protect both the water resources and the wildlife resources contained in those areas.

5. **Article XIII - Groundwater Protection District (Section 174-76 through 174-83).** This article describes in detail the boundaries of the Groundwater Protection Districts. It also contains an extensive list of prohibited uses of land within the protection districts, including use of a Title 5 septic system that is designed for more than 110 gallons per day per quarter acre. Also discussed are the provisions for certain uses via special permits.

6. **Article XIV Areas of Critical Environmental Concern (ACEC) (Section 174-84 through 174-86).** This article describes the construction and land alteration activities that are regulated within the Waquoit Bay ACEC.

The Conservation Commission developed regulations and bylaws to supplement the State's Wetlands Protection Act. The Town wetlands bylaws are contained in Chapter 172 of the Mashpee Code and are supplemented by regulations adopted by the Conservation Commission. The bylaws and regulations include details about submittal requirements, requirements for restoration of habitat, and definitions of the various resource areas that fall under the jurisdiction of the Conservation

Commission. The regulations detail the pollution prevention goals of the Town, aimed at minimizing the impacts to water supplies and water bodies. In conjunction with those goals, the Town has adopted design specifications for lawns that are intended to minimize the impacts from fertilization. Those specifications are included in the regulations; water quality standards are also provided.

3.6 TOWN OF FALMOUTH REGULATIONS AND BYLAWS

The Town of Falmouth has adopted the following regulations that pertain to treatment and discharge of sanitary wastewater.

A. **Chapter 180 (Falmouth Administrative Legislation: Sewers and Septic Systems).** These regulations identify the use requirements and restrictions of the Town's sewers and septic systems, construction requirements, discharge controls, and other miscellaneous provisions. The major issues are:

- sewer connection provisions
- construction, permits and costs of sewer installation
- prohibited discharges

B. **Falmouth Health Regulations, FHR 15.00: Title 5 Modifications.** These requirements identify several provisions that are stricter than the revised Title 5 (March 31, 1995) and are in effect in Falmouth. They include the following main issues:

- Alternative onsite septic systems
- Pressure dosed systems
- Variances to Title 5
- Septic systems location and construction

C. **Article XXI of the Zoning Regulations: Coastal Pond Overlay District.** These regulations establish and delineate Coastal Pond Overlay Districts and their restrictions. Three (3) different classifications are identified: high quality areas, stabilization areas, and intensive water activity areas. Each area has specific zoning requirements and nitrogen concentration standards. The “Critical” eutrophic levels are:

- 0.32 mg/L total nitrogen for high quality areas
- 0.52 mg/L total nitrogen for stabilization areas
- 0.75 mg/L total nitrogen for intensive water activity areas

3.7 TOWN OF BARNSTABLE REGULATIONS AND BYLAWS

Barnstable has implemented regulations and bylaws that are applicable to the work of the WNMP. Barnstable’s regulations include the following:

- The “330 Rule,” which prohibits individual onsite septic systems with wastewater discharge greater than 330 gpd per acre when the system is within a zone of contribution to a water supply well.
- Groundwater Protection Overlay Districts, which include
 - Aquifer Protection – prohibited uses are governed by the underlying zoning district
 - Groundwater Protection – in addition to uses prohibited by the underlying zoning district, landfills, junk yards, underground storage tanks, sewage treatment plants, etc are prohibited; maximum impervious areas are established
 - Well Protection – in addition to the zoning district and groundwater protection overlay district use prohibitions, parking and/or storage of vehicles for transporting fuel, toxic substances, and hazardous substances are prohibited; maximum impervious areas are established.
- Additional regulations governing siting, design, and construction of wastewater disposal facilities can be seen in Chapters 232 and 360 of the 2004 Code of the Town of Barnstable.

Chapter 184 contains the regulations applying to use of the municipal sewer system.

3.8 TOWN OF SANDWICH REGULATIONS AND BYLAWS

The Sandwich Health Department has regulations that apply to wastewater disposal systems, found in the Regulations, Policies, and Clarification of Policies dated April 11, 2005. The regulations include the following topics:

- Alternative system considerations
- Groundwater elevation regulation
- Sludge and septage control
- Title 5 amendments
- Prohibited septic system additives
- Small wastewater treatment facilities
- Nitrate loading policy

Additionally, there are zoning regulations (Protective Zoning Bylaw May 2005), primarily Articles III – General Regulations and V – Water Resource Protection Districts, that pertain to nitrate loading rates and water protection.

3.9 JOINT REGULATORY EFFORTS

The USEPA and MADEP have been working most recently in two areas applicable to the WNMP process in the PPA. The first of these efforts is regarding the establishment of Total Maximum Daily Loads (TMDLs) for non-point sources to coastal embayments and the second is the National Pollutant Discharge Elimination System (NPDES) permitting program for stormwater. The following is a brief description of each of these regulatory requirements.

A. TMDLs. The Federal Clean Water Act (CWA) requires states to develop a list of impaired

waters, which are waters that are unable to meet state-established water quality standards for their intended use (i.e. drinking water supply, fishing, recreational swimming and boating, or healthy ecosystems for plants and animals). States are then required to develop TMDLs for the impaired waters that are affected by pollutants. A TMDL is a determination of the maximum amount of pollutants that a body of water can withstand.

In 1998, the USEPA required all states to submit strategies for completing TMDLs within 8 to 13 years. Massachusetts submitted a strategy consisting of two stages. The first stage would make use of existing studies and information by working to implement corrective actions where feasible; develop a pilot program to define data collection needs and procedures to be used for TMDL development; and develop and standardize TMDL determination methods for pollutants that did not have well established protocols. The second stage will focus on developing the TMDLs, beginning with the TMDLs for pollutants with well-established determination methods.

Once TMDLs are determined, MADEP develops a draft TMDL Report, followed by a public review and comment period. After addressing public comments, MADEP submits the TMDL Report to USEPA for formal approval. The TMDL development process requires that communities develop plans to restore the health of water bodies and then make progress toward implementation of the plans. MADEP monitors the progress of communities in achieving TMDLs. Restoration of water bodies is an extended process, so MADEP looks for reasonable progress. If no reasonable progress is being made, MADEP can take enforcement action.

The CWA requires states to monitor the quality of their water resources to determine if the water meets the standards for intended uses. This information is reported to the USEPA in the Integrated List of Waters. Category 5 of the Integrated List itemizes water bodies that are “impaired or threatened for one or more uses and requiring a TMDL.” Therefore, this list becomes the basis for determining the water bodies for which TMDLs will be established.

The water bodies within the PPA that are listed in the Integrated List as Category 5 – Waters

Requiring a TMDL include Bournes Pond, Great River, Hamblin Pond, Jehu Pond, Little River, Mashpee River, Popponesset Bay, Popponesset Creek, Quashnet River, Santuit Pond, Shoestring Bay, and Waquoit Bay. The pollutant requiring TMDLs for these water bodies is primarily nutrients, but some of the water bodies require pathogen TMDLs as well. Additional water bodies within the PPA appear in Category 4b – Waters Expected to Attain All Designated Uses through Pollution Control Measures other than TMDL's. They include Ashumet Pond, Johns Pond, Mashpee Pond, Peters Pond, Snake Pond, and Wakeby Pond. The pollutant of concern for these waters is metals. The TMDL development process for the Popponesset Bay and Waquoit Bay East watersheds is discussed in detail in Chapter 4.

B. Stormwater and Wastewater Discharges. Discharges to surface waters are regulated by the USEPA through the NPDES permit program, authorized by the CWA. The NPDES program is intended to control water pollution by requiring discharge permits for any point source (i.e. stormwater systems, wastewater system) that discharges pollutants to waters of the United States. In Massachusetts, application is made to both the USEPA and the MADEP. USEPA issues the permit after the MADEP certifies that the discharge meets water quality standards. All four towns within the PPA were required to obtain a NPDES permit under Phase II of the NPDES Stormwater Program. Annual reports for all four of the towns (describing progress on established goals to improve water quality) have been submitted on a regular basis. The annual reports submitted by each town can be reviewed at <http://cfpub.epa.gov/npdes/stormwater/swphases.cfm#phase2>.

Chapter 4

Massachusetts Estuaries Project Evaluations and Findings

CHAPTER 4

MASSACHUSETTS ESTUARIES PROJECT EVALUATIONS AND FINDINGS

4.1 INTRODUCTION

The Massachusetts Estuaries Project (MEP) was established to “provide water quality, nutrient loading, and hydrodynamic information for 89 estuaries in Southeastern Massachusetts” (MEP, 2003). The project has created a linked watershed/estuary model that is used to predict the water quality changes in an estuary using nitrogen loading inputs from the embayment’s watershed. The purpose of the project is to evaluate each of the 89 estuaries identified, and establish nitrogen loading thresholds that can be used as management goals in the respective watersheds. These thresholds become the basis for generating Total Daily Maximum Loads (TMDLs) that can be used for watershed permitting. As generally defined in the Clean Water Act, TMDLs establish the threshold value for a particular pollutant in a water body, and this threshold is to be consistent with State water quality standards (WQS). The TMDLs developed by the Massachusetts Department of Environmental Protection (MADEP) serve as a guide for implementation activities aimed at reducing nitrogen loadings. In the case of Waquoit Bay, Popponesset Bay, and other coastal embayment watersheds, the pollutant of interest is most often nitrogen. Due to the non-point source nature of nitrogen loadings, it is appropriate to base the TMDL on annual average loadings instead of on daily average loadings.

As part of the MEP, the health of the estuarine habitat is also evaluated and this information is used to establish the water-quality threshold to maintain or improve the habitat. Threshold nitrogen levels are defined by MEP as “the average water column concentration of nitrogen that will support the habitat quality being sought.”

The MEP is a collaborative effort by two state agencies, the Executive Office of Environmental Affairs (EOEA) (through the MADEP) and the University of Massachusetts Dartmouth’s School

of Marine Science and Technology (SMAST), with contributions from the United States Geological Survey (USGS), Cape Cod Commission (CCC), and Applied Coastal Research and Engineering, Inc (ACRE).

The following reports relating to the Waquoit Bay East and Popponesset Bay watersheds were produced:

- “Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Popponesset Bay, Mashpee and Barnstable, Massachusetts” Final Report – September 2004.
- “Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Quashnet River, Hamblin Pond, and Jehu Pond, in the Waquoit Bay System of the Towns of Mashpee and Falmouth, MA” Final Report – January 2005.
- “FINAL: Popponesset Bay total Maximum Daily Loads for Total Nitrogen” April 10, 2006.
- “FINAL DRAFT: Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen” October 14, 2005.

4.2 SUMMARY OF MEP APPROACH FOR ESTUARIES IN THE PROJECT AREA

The nitrogen thresholds for each embayment system were developed to restore or maintain SA water quality or to support high habitat quality with the following basis:

- 310 CMR 4.05 defines SA waters as “suitable for shellfish harvesting without depuration; an excellent habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation,” and having “excellent aesthetic value.”
- MEP defines high habitat quality as “supportive of eelgrass and infaunal communities.”

Watershed specific information was obtained to determine the nitrogen loads resulting from the various nitrogen sources within the watersheds – wastewater, fertilizers, runoff from impervious surfaces, and atmospheric deposition. Natural attenuation and nitrogen recycling estimates were obtained from previous regional studies and from measurements within each watershed. Existing and future nitrogen loadings were established for each subwatershed and, through the use of the “Linked Watershed-Embayment Model,” reductions in nitrogen loadings were evaluated to see if the nitrogen thresholds could be met.

The analysis of parcels located in Mashpee was done with land use information from 2001. Water data (for properties with public water supply) from 1997 through 1999 was used to estimate water flows throughout the watersheds. For properties with water use data, the average water use over the three year period was used. However, not all of the properties in Mashpee use the public water supply. As a result, assumptions had to be made by MEP for water use on the properties that did not have water use information. The following assumptions were used based on average water use for similar land use categories:

- Average water use – residential: 154 gallons per day (gpd)
- Average water use – commercial/industrial: 81.5gpd/1000 ft² of building

Some of the parcels within the watersheds are connected to private wastewater treatment facilities (WWTFs). Wastewater flow and effluent quality for the WWTFs was obtained, and the properties that are connected to the WWTFs were included in the actual measurements, rather than estimating flows. Determination of the nitrogen loads within the watersheds was done using the estimated and actual water flows. The following assumptions were used in the nitrogen loading analysis for the properties not connected to WWTFs:

- Wastewater generation = 90% of water consumption
- Wastewater nitrogen concentration \approx 35 mg/L (with approximately 25% nitrogen reduction within the septic tank and soil adsorption system)

A build-out analysis was performed to estimate the future wastewater nitrogen loading. For this analysis, assumptions similar to the existing use analysis were used, including average water use for residential and commercial properties. Building areas for determination of wastewater generation in commercial and industrial areas were provided by the Mashpee Planning Department.

The following assumptions were made for other nitrogen sources:

- Nitrogen concentration in road runoff = 1.5 mg/L
- Nitrogen concentration in roof runoff = 0.75 mg/L

Septic system nitrogen is the largest source of controllable nitrogen; therefore, the focus of reductions concentrated on this source.

4.3 SUMMARY OF FINDINGS FOR POPPONESSET BAY

The final MEP report for Popponesset Bay was released in September 2004, and the Final TMDL report was released in April 2006. The results of the evaluation are summarized in the following sections.

A. MEP STUDY RESULTS

Nitrogen loading estimates were developed for each subwatershed within Popponesset Bay. Nitrogen inputs from wastewater, stormwater runoff, fertilizer, and natural sources were estimated as described in previous sections. These estimated values are shown as “Present Load” in the following table. The “Build-out Load” is the nitrogen load based on the same inputs, but at the potential future conditions. In order to compare these nitrogen loads to naturally occurring nitrogen levels, estimates were made of what the nitrogen loads would be if there were no human sources. This analysis assumed only atmospheric deposition, with natural

forests occupying the watershed area. The “No Load” column summarizes these loads for each subwatershed.

TABLE 4-1
POPPONESSET BAY NITROGEN LOADS

	Present Load (kg/day)	Build-out Load (kg/day)	Build-out (% Change)	No Load (kg/day)	No Load (% Change)
Sub-Embayment					
Popponesset Bay	1.82	1.98	8.9%	0.08	-95.6%
Popponesset Creek	4.94	5.35	8.4%	0.1	-97.9%
Pinquisset Cove	0.76	0.98	28.7%	0.11	-85.7%
Ockway Bay	3.15	4.25	35.0%	0.24	-76.0%
Mashpee River	12.11	17.57	45.1%	0.62	-79.4%
Shoestring Bay	9.21	11.47	24.5%	0.34	-75.5%
Surface Water Sources					
Mashpee River	15.56	37.15	138.7%	4.68	-69.9%
Santuit River (Shoestring Bay)	15.58	21.46	37.7%	1.27	-91.8%
Quaker Run River (Shoestring Bay)	5.98	6.62	10.6%	0.24	-96.0%
Source: Table VI-4 of MEP's <i>Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Popponesset Bay, Mashpee and Barnstable, Massachusetts</i> , September 2004					

The analyses described above aid in estimating the impact of future growth and human activity on the nitrogen load entering each subwatershed. Based on these analyses, the MEP determined that much of the watershed was already moderately to significantly impaired. In addition, the MEP developed a “target nitrogen concentration,” a concentration at one point in the system (a “sentinel station”) that would aid in restoration of eelgrass to the system. The target concentration for the sentinel station was determined to be 0.38 milligrams of Total Nitrogen per liter. Table 4-2 presents one nitrogen reduction scenario presented by MEP that could achieve the target nitrogen concentration. As stated by MEP, this scenario is only one of many possible ways to achieve the target concentration. This analysis provides a general guideline for nitrogen management. It should be noted that these nitrogen loads are *only* the septic nitrogen loads.

TABLE 4-2
POPPONESSET BAY THRESHOLD SEPTIC LOADS ⁽¹⁾

	Present Septic Load (kg/day)	Threshold Septic Load (kg/day)	Threshold Septic Load % Change
Sub-Embayment			
Popponesset Bay	1.58	1.58	0%
Popponesset Creek	4.00	0.00	-100%
Pinquickset Cove	0.58	0.58	0%
Ockway Bay	2.39	0.00	-100%
Mashpee River	9.61	0.00	-100%
Shoestring Bay	6.94	0.00	-100%
Surface Water Sources			
Mashpee River	16.85	8.63	-48.8%
Santuit River (Shoestring Bay)	11.69	7.58	-35.2%
Quaker Run River (Shoestring Bay)	4.37	4.37	0%
Source: Table VIII-1 of MEP's <i>Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for Popponesset Bay, Mashpee and Barnstable, Massachusetts</i> , September 2004			
(1) MEP reports use the term "septic load" to include septic system and wastewater treatment facility loads.			

The percent change as shown in Table 4-2 represents the percent of the nitrogen contributed to the watershed by wastewater that needs to be removed in order to achieve the stated threshold. For example "-100%" indicates that 100 percent (or all) of the nitrogen currently being contributed by septic systems and wastewater treatment facilities needs to be removed from the watershed to achieve the stated threshold.

B. TMDL DEVELOPMENT

TMDLs were developed for Popponesset Bay as part of the federal Clean Water Act (CWA). Compliance with section 303(d) of the CWA results in the identification of water bodies that do not meet the water quality standards for the designated uses, therefore requiring a TMDL.

Popponesset Bay, Shoestring Bay, and the Mashpee River were identified as requiring nutrient TMDLs.

The MEP work assessed the water quality and determined the loading capacity of the water body (described above). The loading capacities were developed by setting water quality conditions that would:

- restore the natural distribution of eelgrass because it provides valuable habitat for shellfish and finfish;
- prevent algal blooms;
- protect benthic communities from impairment or loss; and
- maintain dissolved oxygen concentrations that are protective of the estuarine communities.

Although the conditions listed above are the objectives of the TMDLs, these conditions will not be observed in all subembayments by achieving the TMDL. For example, benthic infauna will be the only restored condition in certain subembayments.

Achieving the target concentration at the sentinel station can be accomplished in a variety of ways. The MEP report and the TMDL report both present one scenario that will achieve that goal. The following table summarizes the loading capacities (Target Threshold Watershed Load) for the various subwatersheds based on the one scenario that was used in the reports. Also listed are the controllable watershed loads, which are a combination of fertilizer, runoff, wastewater treatment plant effluent, and septic system loadings.

TABLE 4-3
POPPONESSET BAY LOADING CAPACITIES

Sub-Embayment	Present Controllable Watershed Load (kg/day)	Target Threshold Watershed Load (kg/day)	Percent Watershed Load Reductions Needed to Achieve Threshold Loads
Mashpee River	34.15	16.17	52.7
Shoestring Bay	31.24	19.72	36.9
Ockway Bay	3.15	0.76	75.9
Pinquisset Cove	0.77	0.76	1.3
Popponeset Bay	6.75	2.77	59.0
<p>Note: This represents the load reductions necessary for <i>one</i> scenario (of many potential scenarios) that will achieve the target nitrogen concentration at the sentinel station.</p> <p>Source: Table 4 of <i>Final Popponeset Bay Total Maximum Daily Loads for Total Nitrogen</i>, April 10, 2006.</p>			

Similar to Table 4-2, this table shows the percent of nitrogen that needs to be removed from each watershed; however, unlike table 4-2, the watershed load shown here includes all nitrogen sources, not just nitrogen from wastewater.

Consideration of the natural background nitrogen levels and the nitrogen loading allocated to point and nonpoint loads led to the development of TMDLs. The background levels were developed as discussed in section 4.3.A. The following table lists the TMDLs for the Popponeset Bay subwatersheds.

TABLE 4-4
POPPONESSET BAY TMDLS

Sub-Embayment	TMDL (kg/day)
Mashpee River	26
Shoestring Bay	13
Ockway Bay	3
Pinquickset Cove	1
Popponesset Bay	1
Note: This represents the load reductions necessary for <i>one</i> scenario (of many potential scenarios) that will achieve the target nitrogen concentration at the sentinel station. Source: Table 5 of <i>Final Popponesset Bay Total Maximum Daily Loads for Total Nitrogen</i> , April 10, 2006.	

The TMDL is the sum of the target threshold watershed load, atmospheric deposition load, and benthic flux load. For some subwatersheds, the TMDL is less than the target threshold watershed load. This is due to the negative load contributed by the benthic flux.

4.4 SUMMARY OF FINDINGS FOR WAQUOIT BAY EAST

Waquoit Bay East was the second coastal embayment in the PPA to be evaluated. The eastern portion of the Waquoit Bay watershed, which includes Quashnet River, Hamblin Pond, and Jehu Pond, was prioritized for analysis prior to the remaining portions of the Waquoit Bay watershed in order to assist in Mashpee's nitrogen management planning. Therefore, this section deals only with the reports for that portion of the Waquoit Bay watershed. The final MEP report was released in January 2005, and the Final TMDL report was released in October 2005. It should be noted that the recommendations resulting from this analysis will be revisited and may change when the entire Waquoit Bay system evaluation is completed.

A. MEP STUDY RESULTS

Nitrogen loading estimates were developed for each subwatershed identified above within Waquoit Bay. Nitrogen inputs from wastewater, stormwater runoff, fertilizer, and natural

sources were estimated as described in previous sections. These estimated values are shown as “Present Load” in the table below. The “Build-out Load” is the nitrogen load based on the same inputs, but at the potential future conditions. In order to compare these nitrogen loads to naturally occurring nitrogen levels, estimates were made of what the nitrogen loads would be if there were no human sources. This analysis assumed only atmospheric deposition, with natural forests occupying the watershed area. The “No Load” column summarizes these loads for each subwatershed.

TABLE 4-5
WAQUOIT BAY NITROGEN LOADS

	Present Load (kg/day)	Build-out Load (kg/day)	Build-out (% Change)	No Load (kg/day)	No Load (% Change)
Sub-Embayment					
Hamblin Pond	3.84	4.84	26.1%	0.13	-96.7%
Upper Hamblin Pond	1.54	2.10	36.4%	0.06	-96.3%
Little River	1.11	1.27	14.4%	0.02	-98.1%
Lower Great River	2.95	3.37	14.3%	0.07	-97.8%
Upper Great River	0.68	1.58	132.1%	0.22	-67.1%
Jehu Pond	3.61	4.01	11.1%	0.12	-96.8%
Upper Quashnet River	2.16	3.03	39.9%	0.13	-94.0%
Lower Quashnet River	0.79	0.89	12.5%	0.02	-97.2%
Surface Water Sources					
Red Brook	3.88	7.29	59.9%	0.42	-94.9%
Quashnet River ⁽¹⁾	23.00	46.82	103.6%	4.16	-81.9%
Source: Table VI-5 of MEP's <i>Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Quashnet River, Hamblin Pond, and Jehu Pond in the Waquoit Bay System of the Towns of Mashpee and Falmouth, MA</i> , January 2005. (1) MEP report lists this as Moonakis River. However, based on information provided by the Mashpee Town Planner, Moonakis River is only the lower, brackish portion of this river.					

Based on these analyses, the MEP determined that the eastern subwatersheds are “generally showing impaired habitat quality resulting from nitrogen enrichment.” The overall habitat health assessments ranged from moderate impairment to severe degradation.

As with the Popponesset Bay analysis, the MEP developed a “target nitrogen concentration” that would aid in restoration of habitat quality throughout the system. The target concentration was determined to be 0.38 mg Nitrogen/Liter for Hamblin Pond, 0.446 mg Nitrogen/Liter for Jehu Pond, and 0.50 mg Nitrogen/Liter for the Quashnet River.

As noted previously, the watersheds analyzed for this MEP report are subwatersheds of the main Waquoit Bay system. As a result, the threshold nitrogen concentrations are dependent on the incoming water quality (the water from the main basin of Waquoit Bay). Therefore, the technical report presented two potential scenarios to achieve the target nitrogen concentrations, one (Scenario A) on the assumption that no nitrogen reductions are achieved in the other portions of the watershed (resulting in nitrogen concentration in the incoming water remaining at its existing levels) and one (Scenario B) on the assumption that there are nitrogen reductions throughout the other subwatershed (with a resultant lower nitrogen concentration in the incoming water). The following table summarizes the necessary nitrogen reductions for these two scenarios. Scenario A is the assumption of existing nitrogen concentrations (0.38 mg N/L) and Scenario B is the reduced nitrogen concentration (0.35 mg N/L).



TABLE 4-6
WAQUOIT BAY THRESHOLD SEPTIC LOADS ⁽¹⁾

	Present Septic Load (kg/day)	Scen. A Septic Load (kg/day)	Scen. A Septic Load % Change	Scen. B Septic Load (kg/day)	Scen. B Septic Load % Change
Sub-Embayment					
Hamblin Pond	3.36	0.00	-100%	0.87	-74%
Upper Hamblin Pond	1.26	0.00	-100%	0.33	-74%
Little River	0.92	0.00	-100%	0.24	-74%
Lower Great River	2.35	0.00	-100%	0.00	-100%
Upper Great River	0.36	0.00	-100%	0.00	-100%
Jehu Pond	2.65	0.00	-100%	0.00	-100%
Upper Quashnet River	1.80	0.00	-100%	0.59	-67%
Lower Quashnet River	0.57	0.00	-100%	0.19	-67%
Surface Water Sources					
Red Brook	3.24	0.00	-100%	0.81	-75%
Quashnet River ⁽²⁾	12.59	0.00	-100%	4.16	-67%
<p>Source: Tables VIII-2 and VIII-7 of MEP's <i>Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Quashnet River, Hamblin Pond, and Jehu Pond in the Waquoit Bay System of the Towns of Mashpee and Falmouth, MA</i>, January 2005.</p> <p>(1) MEP reports use the term "septic load" to include septic system and wastewater treatment facility loads.</p> <p>(2) MEP report lists this as Moonakis River. However, based on information provided by the Mashpee Town Planner, Moonakis River is only the lower, brackish portion of this river.</p>					

B. TMDL DEVELOPMENT

Loading capacities and TMDLs were developed as discussed in the TMDL Development section for Popponesset Bay.

The following table summarizes the loading capacities (Target Threshold Watershed Load) for the various subwatersheds. Also listed are the controllable watershed loads, which are a combination of fertilizer, runoff, wastewater treatment plant effluent, and septic system loadings. It should be restated that this represents *one of many* potential scenarios that will achieve the target nitrogen concentration at the sentinel station.

TABLE 4-7
WAQUOIT BAY LOADING CAPACITIES

Sub-Embayment	Present Controllable Watershed Load (kg/day)	Target Threshold Watershed Load (kg/day)	Percent Watershed Load Reductions Needed to Achieve Threshold Loads
Upper Great River	0.68	0.32	52.9
Lower Great River	2.95	0.60	79.7
Upper Hamblin Pond	5.42	2.06	62.0
Hamblin Pond	3.84	1.34	65.1
Jehu Pond	3.61	0.96	73.4
Little River	1.11	0.43	61.3
Upper Quashnet River	25.16	15.51	38.4
Lower Quashnet River	0.79	0.41	48.1
<p>Note: This represents the load reductions necessary for <i>one</i> scenario (of many potential scenarios) that will achieve the target nitrogen concentration at the sentinel station.</p> <p>Source: Table 4 of <i>Final Draft Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen</i>, October 14, 2005.</p>			

The following table lists the TMDLs for the Waquoit Bay subwatersheds.

TABLE 4-8
WAQUOIT BAY TMDLS

Sub-Embayment	TMDL (kg/day)
Great River/Jehu Pond	25
Little River/Hamblin Pond	2
Quashnet River	27
<p>Note: This represents the load reductions necessary for <i>one</i> scenario (of many potential scenarios) that will achieve the target nitrogen concentration at the sentinel station.</p> <p>Source: Table 5 of <i>Final Draft Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen</i>, October 14, 2005.</p>	

The TMDL is the sum of the target threshold watershed load, atmospheric deposition load, and benthic flux load. For some subwatersheds, the TMDL is less than the target threshold watershed load. This is due to the negative load contributed by the benthic flux.

4.5 SUMMARY OF TMDL REQUIREMENTS

The following table summarizes the percent of septic load reductions that will be necessary to achieve the target nitrogen concentration requirements based on the one scenario that was used as the basis of these reports. These percentages represent the reductions necessary if only septic systems loads were removed and all other sources were ignored.

The findings outlined in Table 4-9, representing one scenario, will be the starting point for evaluating the project areas and in the development of alternatives in the next phase of the Project.

TABLE 4-9
EMBAYMENT SEPTIC PERCENT NITROGEN REMOVALS ⁽¹⁾

Embayment System	Embayment	Percent Removal to Meet Threshold ⁽²⁾
Popponesset Bay System	Popponesset Bay	0%
	Popponesset Creek	100%
	Pinquisset Cove	0%
	Ockway Bay	100%
	Mashpee River	100%
	Shoestring Bay	100%
	Mashpee River ⁽³⁾	49%
	Santuit River ⁽³⁾	35%
	Quaker Run River ⁽³⁾	0%
Waquoit Bay System	Hamblin Pond	75%
	Upper Hamblin Pond	75%
	Little River	75%
	Lower Great River	100%
	Upper Great River	100%
	Jehu Pond	100%
	Upper Quashnet River	67%
	Lower Quashnet River	67%
	Red Brook ⁽³⁾	75%
	Quashnet River ^(3, 4)	67%
<p>(1) Source: Table B-1 of <i>Final Popponesset Bay Total Maximum Daily Loads for Total Nitrogen</i>, April 10, 2006 and Table B-1 of <i>Final Draft Quashnet River, Hamblin Pond, Little River, Jehu Pond, and Great River in the Waquoit Bay System Total Maximum Daily Loads for Total Nitrogen</i>, October 14, 2005.</p> <p>(2) Based on <i>one of many</i> potential scenarios to achieve the target concentration.</p> <p>(3) Indicates a surface water source.</p> <p>(4) MEP report lists this as Moonakis River. However, based on information provided by the Mashpee Town Planner, Moonakis River is only the lower, brackish portion of this river.</p>		

Chapter 5

Existing Environmental Resources and Demographics

CHAPTER 5

EXISTING ENVIRONMENTAL RESOURCES AND DEMOGRAPHICS

5.1 INTRODUCTION

This chapter provides a summary of the existing conditions in the project planning area (PPA), environmental resources, land use, zoning, demographics, and existing wastewater treatment facilities. The environmental resources are defined by the topography, geology and soils, groundwater, surface waters, salt waters, flood plains, forests, and protected natural areas. Each of these existing conditions has been identified through review of existing documents and records, interviews, and site evaluations made by the project team.

5.2 NATURAL RESOURCES

A. **Topography.** The town of Mashpee (which makes up the majority of the PPA) is located 66 miles southeast of Boston, in Barnstable County on Cape Cod, Massachusetts. The Town is bordered by Sandwich on the north, Barnstable on the east, Nantucket Sound on the south, and Falmouth on the west. All of the neighboring towns have portions within the PPA. Mashpee is approximately 28.86 square miles, or 18,470 acres (Comprehensive Plan – Land Use & Growth Mgt). Barnstable and Falmouth each have approximately 1,000 acres in the PPA; Sandwich has nearly 5,000 acres in the PPA. Elevations in the PPA range from high areas of over 150 feet above mean sea level in portions of Sandwich to sea level along Nantucket Sound.

B. **Geology/Soils.** The PPA, like most towns on Cape Cod, is comprised mostly of glacial deposits. Most of the PPA is dominated by Mashpee Pitted-Plain deposits, with the Great Neck area (New Seabury and Popponesset) dominated by kame deposits (W&S Facility Plan).

According to the Barnstable County Soil Survey (United States Department of Agriculture – Natural Resource Conservation Service, USDA NRCS, 1993), the most predominant soil types in the PPA include Carver course sand and Carver loamy coarse sand. In addition, there are significant areas of Merrimac sandy loam and Enfield silt loam. The shoreline along the southern coast is considered Hooksan-Beaches-Dune land.

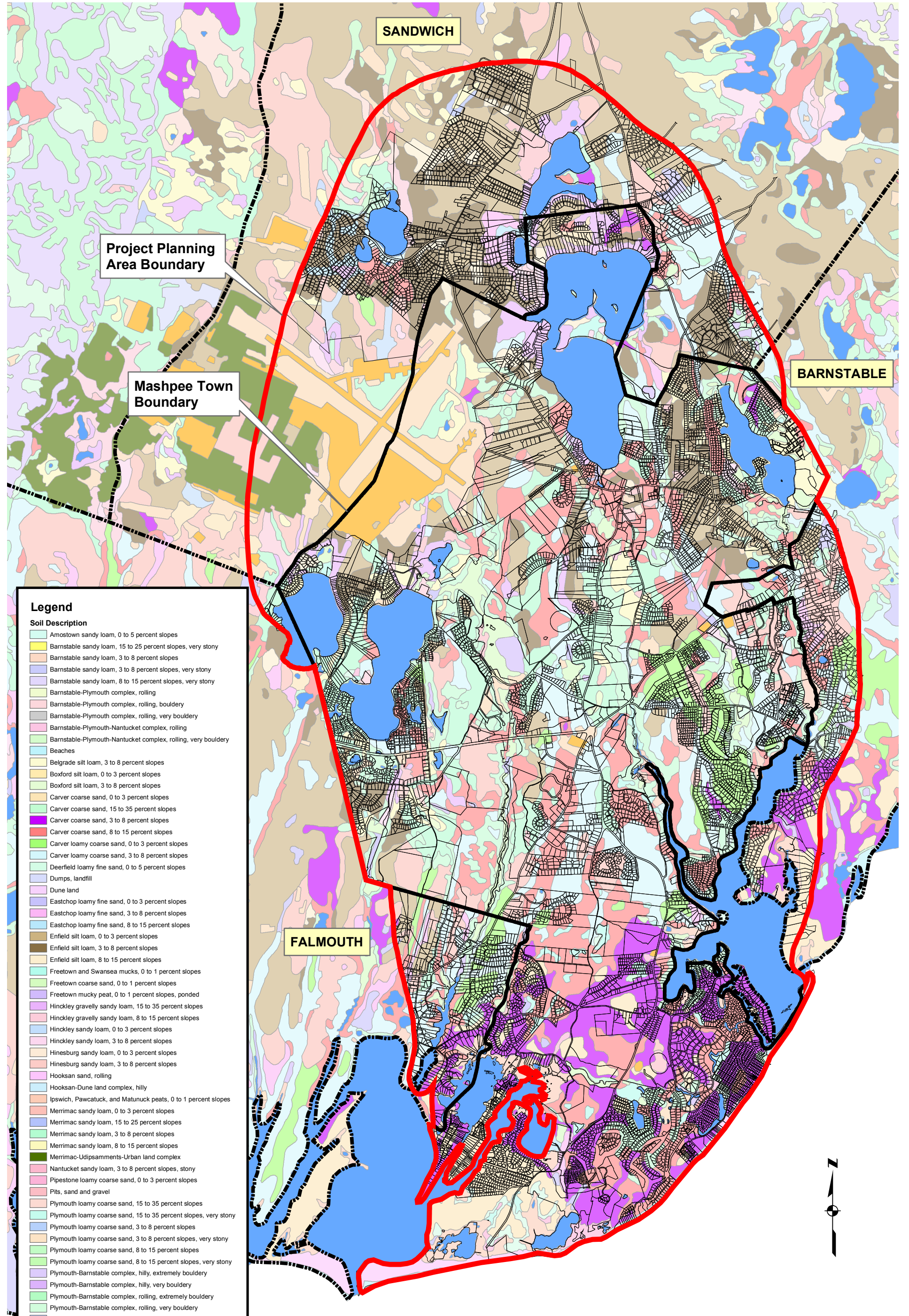
Figure 5-1 depicts the soils of the PPA as developed by the USDA NRCS. In general, the soils have a high permeability, and these high permeability soils are amenable to disposal of wastewater by rapid infiltration.

C. **Groundwater.**

1. **Flow Direction and Elevation.** The Ground Water Model prepared by Earth Tech in 1997 provides an overview of the groundwater contours in the Town of Mashpee. Generally, the groundwater system (Sagamore Lens) is at its highest elevation in the Town of Sandwich. Groundwater flows in a southeasterly direction, and most of the groundwater drains into Nantucket Sound.

2. **Public Water Supplies.** Residents in the PPA receive drinking water from the Sagamore Lens. The towns have multiple public and private water supply wells that draw water from this aquifer. There are currently six public water supply wells in Mashpee: High Wood #2 and #3, Quaker Run, Turner Road, Mashpee Village, and Belcher. High Wood #1, previously used as a summer backup supply, was recently abandoned. There are a limited number of public water supply wells in the other towns in the PPA – Barnstable has one and Sandwich has two.

3. **Protected Areas.** High Wood wells #2 and #3, and Quaker Run (Well T-4) all have 400-ft “Zone I” protective radii within which there can be no development. In addition, each of these wells has an upgradient monitoring well in place to detect contaminants that may be approaching the well. The recharge area of the Quaker Run well (also known as T-4) was modeled by Earth Tech and shown to overlap a contamination plume from the Augat Plant, indicating



Legend

Soil Description

- Amstow sandy loam, 0 to 5 percent slopes
- Barnstable sandy loam, 15 to 25 percent slopes, very stony
- Barnstable sandy loam, 3 to 8 percent slopes
- Barnstable sandy loam, 3 to 8 percent slopes, very stony
- Barnstable sandy loam, 8 to 15 percent slopes, very stony
- Barnstable-Plymouth complex, rolling
- Barnstable-Plymouth complex, rolling, bouldery
- Barnstable-Plymouth complex, rolling, very bouldery
- Barnstable-Plymouth-Nantucket complex, rolling
- Barnstable-Plymouth-Nantucket complex, rolling, very bouldery
- Beaches
- Belgrade silt loam, 3 to 8 percent slopes
- Boxford silt loam, 0 to 3 percent slopes
- Boxford silt loam, 3 to 8 percent slopes
- Carver coarse sand, 0 to 3 percent slopes
- Carver coarse sand, 15 to 35 percent slopes
- Carver coarse sand, 3 to 8 percent slopes
- Carver coarse sand, 8 to 15 percent slopes
- Carver loamy coarse sand, 0 to 3 percent slopes
- Carver loamy coarse sand, 3 to 8 percent slopes
- Deerfield loamy fine sand, 0 to 5 percent slopes
- Dumps, landfill
- Dune land
- Eastchop loamy fine sand, 0 to 3 percent slopes
- Eastchop loamy fine sand, 3 to 8 percent slopes
- Eastchop loamy fine sand, 8 to 15 percent slopes
- Enfield silt loam, 0 to 3 percent slopes
- Enfield silt loam, 3 to 8 percent slopes
- Enfield silt loam, 8 to 15 percent slopes
- Freetown and Swansea mucks, 0 to 1 percent slopes
- Freetown coarse sand, 0 to 1 percent slopes
- Freetown mucky peat, 0 to 1 percent slopes, ponded
- Hinckley gravelly sandy loam, 15 to 35 percent slopes
- Hinckley gravelly sandy loam, 8 to 15 percent slopes
- Hinckley sandy loam, 0 to 3 percent slopes
- Hinckley sandy loam, 3 to 8 percent slopes
- Hinesburg sandy loam, 0 to 3 percent slopes
- Hinesburg sandy loam, 3 to 8 percent slopes
- Hooksan sand, rolling
- Hooksan-Dune land complex, hilly
- Ipswich, Pawcatuck, and Matunuck peats, 0 to 1 percent slopes
- Merrimac sandy loam, 0 to 3 percent slopes
- Merrimac sandy loam, 15 to 25 percent slopes
- Merrimac sandy loam, 3 to 8 percent slopes
- Merrimac sandy loam, 8 to 15 percent slopes
- Merrimac-Udipsamments-Urban land complex
- Nantucket sandy loam, 3 to 8 percent slopes, stony
- Pipestone loamy coarse sand, 0 to 3 percent slopes
- Pits, sand and gravel
- Plymouth loamy coarse sand, 15 to 35 percent slopes
- Plymouth loamy coarse sand, 15 to 35 percent slopes, very stony
- Plymouth loamy coarse sand, 3 to 8 percent slopes
- Plymouth loamy coarse sand, 3 to 8 percent slopes, very stony
- Plymouth loamy coarse sand, 8 to 15 percent slopes
- Plymouth loamy coarse sand, 8 to 15 percent slopes, very stony
- Plymouth-Barnstable complex, hilly, extremely bouldery
- Plymouth-Barnstable complex, hilly, very bouldery
- Plymouth-Barnstable complex, rolling, extremely bouldery
- Plymouth-Barnstable complex, rolling, very bouldery
- Plymouth-Barnstable-Nantucket complex, hilly, very bouldery
- Sudbury fine sandy loam, 0 to 3 percent slopes
- Udipsamments, smoothed
- Urban land
- Water

Data Source: Mass GIS
File Location: J:\GIS\GIS Project Folder\J
ob#00074 Mashpee\2006 WWFP\
Report Figures\00074F05_1Soils.mxd



Stearns & Wheler, LLC
Environmental Engineers and Scientists

HYANNIS, MASSACHUSETTS

phone: (508) 362-6180
web: www.stearnswheler.com

Date: 11/06 Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS
Watershed Nitrogen Management Plan

SOIL MAP

FIGURE 5-1

possible chlorinated Volatile Organic Compound (VOC) contamination of the groundwater (LCP, Water Resources, 1998). Based on statements from the Mashpee Health Agent, it appears that the portion of the plume overlapping the Quaker Run Zone II has been cleaned up as of early 2007.

The groundwater protection districts included in the in the Town of Mashpee zoning bylaw were first delineated in January 1988 to protect aquifers and recharge areas of public and private water supplies. These districts have been updated on a number of occasions to reflect new public wells and new Zone II information. Within these areas and within the Zone II recharge areas of any existing or proposed public water supply well, any land use which could cause possible contamination to groundwater is prohibited. Wastewater treatment facility construction is prohibited in mapped Zone II areas. The other towns in the PPA have similar groundwater protection districts, although they may vary slightly by Town. These groundwater protection districts and Zone II's are presented in Figure 5-2.

D. Surface Waters. The surface waters in the PPA consist of both freshwater bodies and salt water bodies. A brief discussion of the major waters in the PPA follows.

1. Freshwater Bodies

(a) **Lakes and Ponds.** The Town of Mashpee is characterized by four large inland freshwater ponds – Ashumet, Johns, Mashpee-Wakeby, and Santuit – and a variety of smaller ponds, totaling over 1600 acres of area. The four largest ponds, in addition to the smaller Great Flat Pond (which is brackish) and Moody Pond, are considered lacustrine wetlands by the U.S. Fish and Wildlife Service Classifications (Comprehensive Plan - Water Resources, 1998).

In addition to the ponds in Mashpee, there are several ponds in Sandwich, primarily Snake Pond, Pimlico Pond, and Peters Pond. The major ponds in the PPA are summarized in Table 5-1.

TABLE 5-1

FRESHWATER LAKES AND PONDS IN THE PROJECT PLANNING AREA ⁽¹⁾

Pond Name	Surface Area (acres)	Max Depth (ft)
Mashpee & Wakeby Ponds	729	87
Ashumet Pond	203	65
Johns Pond	317	62
Santuit Pond	172	9
Great Flat Pond	37	na ⁽²⁾
Moody Pond	18	14
Peters Pond	127	57
Pimlico Pond	14	25
Snake Pond	83	33
(1) Data provided by Town of Mashpee Local Comprehensive Plan: Water Resources, 1998 and Town of Sandwich Local Comprehensive Plan, 1996.		
(2) No data available.		

According to the Cape Cod Commission's 2001 Cape Cod Pond and Lake Atlas, all of the 18 Mashpee ponds sampled for the atlas are impacted by either chlorophyll-a, total nitrogen, or total phosphorus. Santuit Pond, in particular, is described as a "slightly nutrient enriched pond with some water quality concerns." Additionally, the Atlas says that "the ecosystem in Santuit Pond would rapidly respond to any additions of phosphorus." The Atlas recommended that a land use assessment be performed to determine future development (and resultant phosphorus additions) in the area. Ongoing pond monitoring has continued to show degradation in the water quality of Santuit Pond. Algal blooms and high bacteria levels, both likely related to nutrient loading and effluent runoff, have been documented on a regular basis.

In order to meet the requirements of the federal Clean Water Act, MADEP identifies waterbodies that will require TMDLs in order to meet water quality standards. The resultant list is known as the 303(d) List. Santuit Pond was listed under "impaired waters" on the Proposed 2006 303(d) List (for nutrients and organic enrichment/low DO). None of the Sandwich ponds were listed as requiring a TMDL.

(b) **Rivers.** There are five long, narrow river valleys running from north to south through the PPA – the Childs, Quashnet, Mashpee, Quaker Run, and Santuit (W&S Facility Plan, 1988), in addition to the smaller streams of Abigail’s Brook, Dutchman’s Creek, and Red Brook. The following rivers were listed on the Proposed 2006 303(d) List:

- Mashpee River (Nutrients, Pathogens)
- Quashnet River (Nutrients, Organic enrichment/Low DO, Pathogens)

(c) **Wetlands.** Wetlands result from both salt and freshwater and are valuable for flood protection, nutrient uptake and release, wild life habitat and propagation, groundwater recharge, and open space for recreation and scenic beauty. The Wetlands Protection Act (WPA) is administered and enforced by MADEP’s Wetlands Program. The WPA imposes restrictions on the removal, filling, dredging, or alteration of any designated wetland. The wetland delineations within the PPA are shown in Figure 5-3.

(d) **Vernal Pools.** Vernal pools are temporary bodies of freshwater that provide critical habitat for a number of vertebrate and invertebrate wildlife species. More than thirty vernal pools have been identified by the Natural Heritage & Endangered Species Program in the Town of Mashpee and along its borders with neighboring towns (Massachusetts Heritage Atlas, 2006). The vernal pools are located in three general areas: southeast of Johns Pond, in the corridor between Hamblin Pond and Popponesset Bay, and in the northeast portion of the PPA surrounding Santuit Pond. Figure 5-3 shows all of the locations.

2. Salt Water Bodies

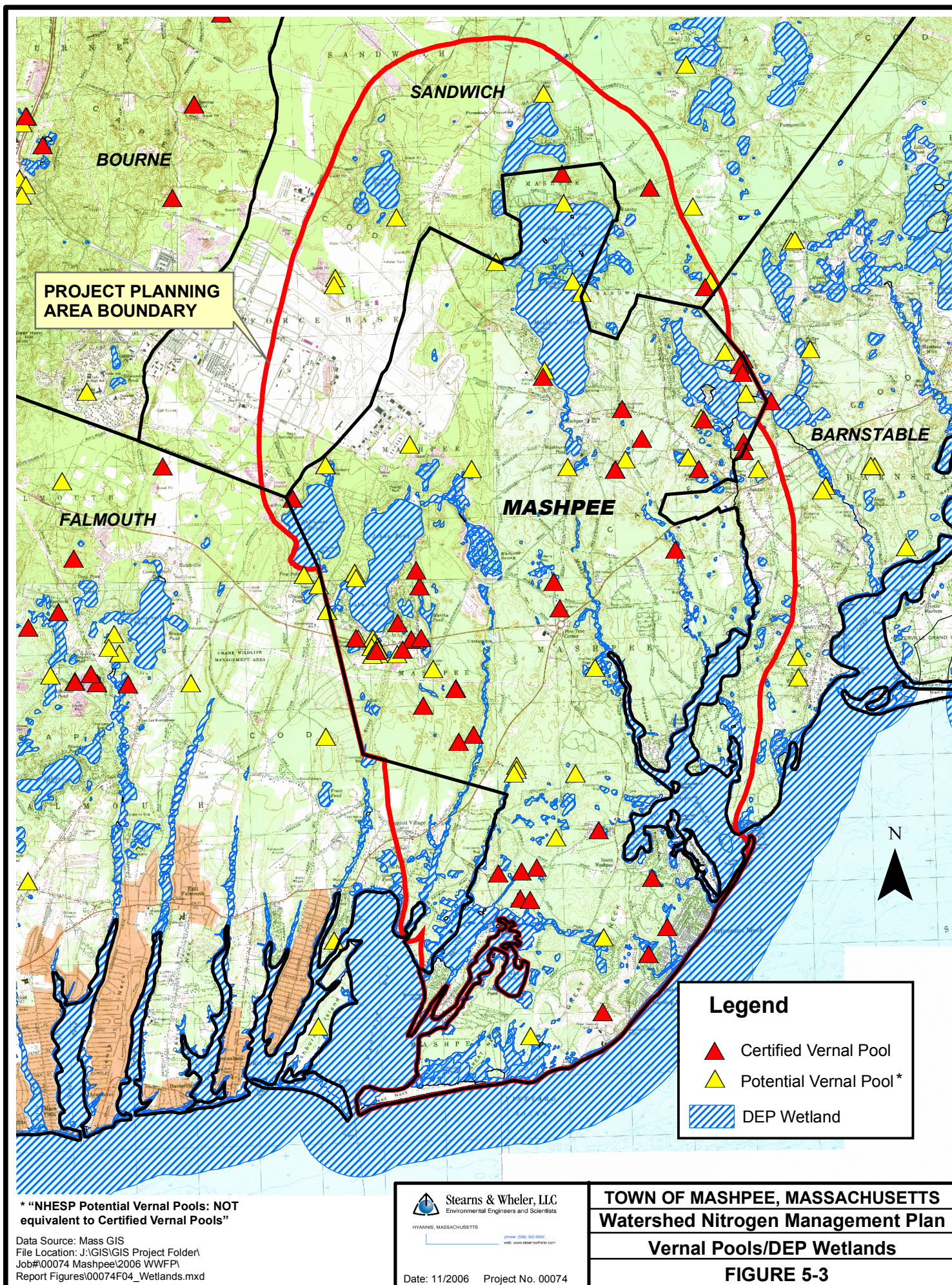
(a) **Coastal Embayments.** The rivers described above feed into the two large estuarine systems in the PPA – Waquoit Bay and Popponesset Bay – which are of particular concern for nitrogen loading sensitivity. Waquoit Bay includes the subembayments of Hamblin Pond, Jehu Pond, Sedge Lot Pond, Little River, Great River, and the brackish waters of

Great Flat Pond. Hamblin Pond was listed as an impaired water on the proposed 2006 303(d) list, requiring nutrient and pathogen TMDLs; Jehu Pond was listed as impaired, requiring a nutrient TMDL; Little River was listed as impaired, requiring nutrient and pathogen TMDLs. The Popponesset Bay estuary subembayments include Shoestring Bay, the lower Mashpee River, Ockway Bay, Popponesset Creek, Spoon-drift Cove, Pinquisset Cove, and Spinnaker Cove. Popponesset Creek was listed as impaired water on the Proposed 2006 303(d) list, requiring a pathogen TMDL.

- **Nitrogen Sensitivity.** Coastal embayments are sensitive to nitrogen inputs because nitrogen is typically the limiting nutrient in these surface water systems. This means that coastal waters have more than enough phosphorus and other nutrients to fertilize marine plants, and the growth of these marine plants is limited by the nitrogen content in the water. Therefore, as more nitrogen is added to the system, more plant material is produced. Water quality can be impacted by the additional plant material that is produced.

Nitrogen enters a coastal embayment through its recharge area (watershed). The nitrogen originates from on-site septic systems; discharges from wastewater treatment plants; fertilization of lawns and agricultural lands; waterfowl; wetlands; atmospheric deposition; benthic flux (the nitrogen release from the degradation of organic material from the sediment in the estuaries); and stormwater runoff from impervious surfaces. Wastewater treatment plants are currently designed to remove nitrogen to less than 10 milligrams per liter (mg/L). Therefore, the discharge of treated wastewater from wastewater treatment plants has lower nitrogen concentration than discharge from individual septic systems. Typical Title 5 approved septic systems provide minimal nitrogen removal and are usually the largest source of nitrogen to coastal embayments. Typical Title 5 approved systems can be upgraded to remove nitrogen, and these systems are often called “Innovative and Alternative (I/A) Systems.” These I/A systems typically have effluent nitrogen concentrations of 19 mg/L.

The assimilative capacity of a coastal embayment is a function of its depth and tidal



* "NHESP Potential Vernal Pools: NOT equivalent to Certified Vernal Pools"

Data Source: Mass GIS
 File Location: J:\GIS\GIS Project Folder\
 Job#\00074 Mashpee\2006 WWFP\
 Report Figures\00074F04_Wetlands.mxd

Stearns & Wheler, LLC
 Environmental Engineers and Scientists
 HYANNIS, MASSACHUSETTS
 phone: (508) 961-5800
 web: www.stearnswheler.com

Date: 11/2006 Project No. 00074

flushing characteristics and is unique to each embayment. Often, coastal embayments are impacted by average embayment nitrogen concentrations as low as 0.35 mg/L. This is considerably lower than the State drinking water standard of 10 mg/L. The assimilative capacities for the Waquoit Bay and Popponesset Bay have been determined through a nitrogen loading assessment by the MEP. The MEP evaluated and identified the critical nitrogen loading limits for each estuary.

- **Shellfish and Finfish Resources.** The PPA's coastal and estuarine water bodies have significant finfish and shellfish resources. Waquoit Bay and Popponesset Bay are both desirable habitat for a variety of shellfish. Commercial and recreational harvesting of quahogs, bay scallops, and soft shell clams occurs in both bays. Ribbed mussels, whelks, razor clams, and crabs are also present in the bays.

Shoestring Bay and the lower Mashpee River have seen shellfish bed closures since the 1980s due to high concentrations of fecal coliform bacteria. The remaining shellfish resources are classified as either approved or conditionally approved. See Figure 5-4 (A, B, and C).

With the goal of addressing the nitrogen loading and eutrophication problems, the Town of Mashpee's Shellfish Department is currently investigating the possibility of using oysters to mitigate existing impacts in the waters of the Mashpee River – one of the most impacted embayments in Mashpee. The ultimate goal is to remove 500 kilograms of nitrogen from the Mashpee River with oyster fisheries. The oysters harvest the algae and nitrogen, thereby improving the quality of the water. Once the oysters are harvested, that nitrogen is removed from the system. More than 100,000 oysters have been harvested each year for the last two years, which is equivalent to an estimated 50 kilograms of nitrogen removed per year. In Fiscal Year 2008, SMAST will be doing a study on the nitrogen removal capabilities of cultured oysters.

(b) **Floodplains and Velocity Zones.** Floodplains are nature's way of buffering land from

excessive storm events because they act to dissipate the wind and wave action generated during these storms. The majority of the floodplains within the PPA are along Mashpee's coasts. Article XI: Floodplain Zone Provisions of the Town of Mashpee Zoning bylaws prohibits new development within areas designated as V (Velocity) Zones on the Flood Insurance Administration Flood Rate Maps and are defined as areas susceptible to 100-year coastal flooding with high velocity wave action. The V-Zones are illustrated in Figure 5-5.

A-Zones are also designated by FEMA and are areas where flooding is predicted to occur once every 100 years. This flooding occurs with minimal associated wave action, and these areas are located landward of the V-Zones, typically in salt marshes and low elevation areas of Mashpee. The surface elevations in these areas typically lie below ten feet mean sea level (MSL). The A-Zones are also illustrated in Figure 5-5.

(c) **Salt Marshes.** Salt marshes cover approximately 250 acres of waterfront in the Town of Mashpee (Comprehensive Plan, Water & Water Resources), and provide critical habitats and nurseries for marine and terrestrial species. The salt marshes in Mashpee are included in the Wetlands Map (Figure 5-3).

E. **Forests**

A combination of frequent forest fires and soil depletion resulting from agricultural activities and wind action in exposed areas has resulted in a loss of much of Cape Cod's original forest area. The forests that remain in the PPA are classified primarily as pine-oak climax forests. Various species of oak trees, including scrub oak, white oak, red oak, and pin oak, as well as pitch pines dominate these forests. In addition, there are some white cedar swamplands in the southern portion of the PPA.

MASSACHUSETTS DIVISION OF MARINE FISHERIES - DESIGNATED SHELLFISH GROWING AREA

**Division of
Marine Fisheries**
DIRECTOR PHILIP G. COATES



Produced: December 08, 1999

STATION TYPE

- | | |
|------------------|---------------|
| CLASSIFICATION | SECONDARY PSP |
| POLLUTION SOURCE | TERTIARY PSP |
| AD-HOC | CHEMICAL |
| PRIMARY PSP | MARINA |

BOUNDARY LINES CLASS AREA TYPE, AS OF 07/01/1999

- | | | |
|---------------------|--------------------------|--------------------|
| GROWING AREA | APPROVED | MANAGEMENT CLOSURE |
| CLASSIFICATION AREA | CONDITIONALLY APPROVED | PROHIBITED |
| TOWN | CONDITIONALLY RESTRICTED | |
| | RESTRICTED | |

This product is for planning and educational purposes only. It is not to be used by itself for legal boundary definition or regulatory interpretation.

GROWING AREA CODE: SC17

AREA NAME: MASHPEE SOUTH COASTAL

AREA TOWN(S): FALMOUTH/MASHPEE



Data Source: Mass GIS
File Location: J:\GIS\GIS Project Folder\Job#\n00074 Mashpee\2006 WWFP\Report Figures\00074F05-4a.mxd

Stearns & Wheler, LLC
Environmental Engineers and Scientists
HYANNIS, MASSACHUSETTS
Phone: (508) 362-6800
Web: www.stearnswheler.com

Date: 04/2007 Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS
Watershed Nitrogen Management Plan
Shellfish Growing Map
Area SC17
FIGURE 5-4A

MASSACHUSETTS DIVISION OF MARINE FISHERIES - DESIGNATED SHELLFISH GROWING AREA

**Division of
Marine Fisheries**
DIRECTOR FIELD OFFICES



Produced: November 30, 1999

SCALE 1 inch : 2660 feet

STATION TYPE

- CLASSIFICATION
- POLLUTION SOURCE
- AD-HOC
- PRIMARY PSP

- SECONDARY PSP
- TERTIARY PSP
- CHEMICAL
- MARINA

BOUNDARY LINES CLASS AREA TYPE, AS OF 07/01/99

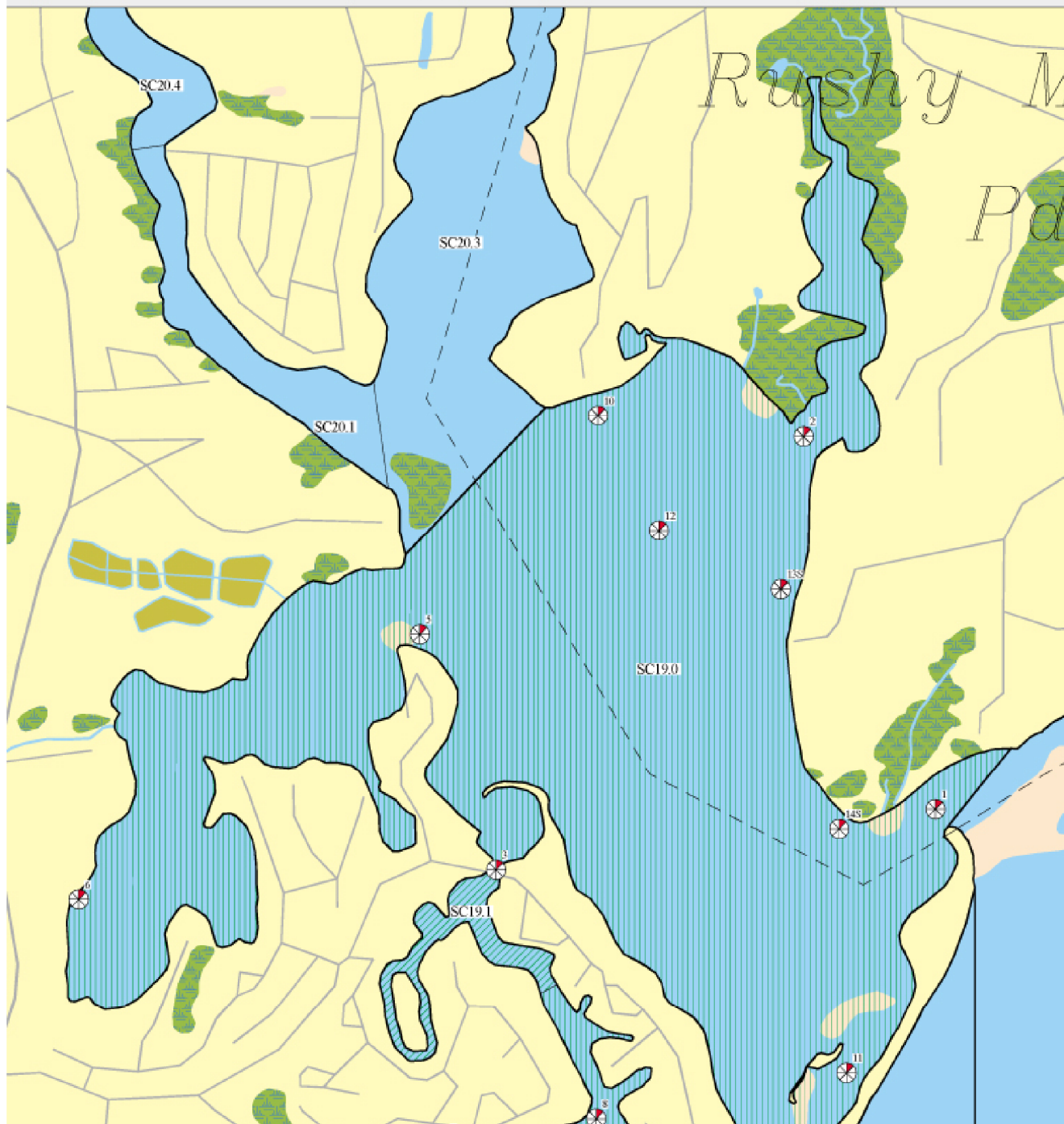
- GROWING AREA
- CLASSIFICATION AREA
- TOWN
- APPROVED
- CONDITIONALLY APPROVED
- CONDITIONALLY RESTRICTED
- RESTRICTED
- MANAGEMENT CLOSE
- PROHIBITED

This product is for planning and educational purposes only. It is not to be used by itself for legal boundary definition or regulatory interpretation.

GROWING AREA CODE: SC19

AREA NAME: POPPONESSET BAY

AREA TOWN(S): BARNSTABLE/MASHPEE



Stearns & Wheler, LLC
Environmental Engineers and Scientists

HYANNIS, MASSACHUSETTS

phone: (508) 362-6800
web: www.stearnswheler.com

Date: 04/2007

Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Shellfish Growing Map

Area SC19

FIGURE 5-4B

Data Source: Mass GIS

File Location: J:\GIS\GIS Project Folder\Job#\n00074 Mashpee\2006 WWFP\Report Figures\00074F05-4a.mxd

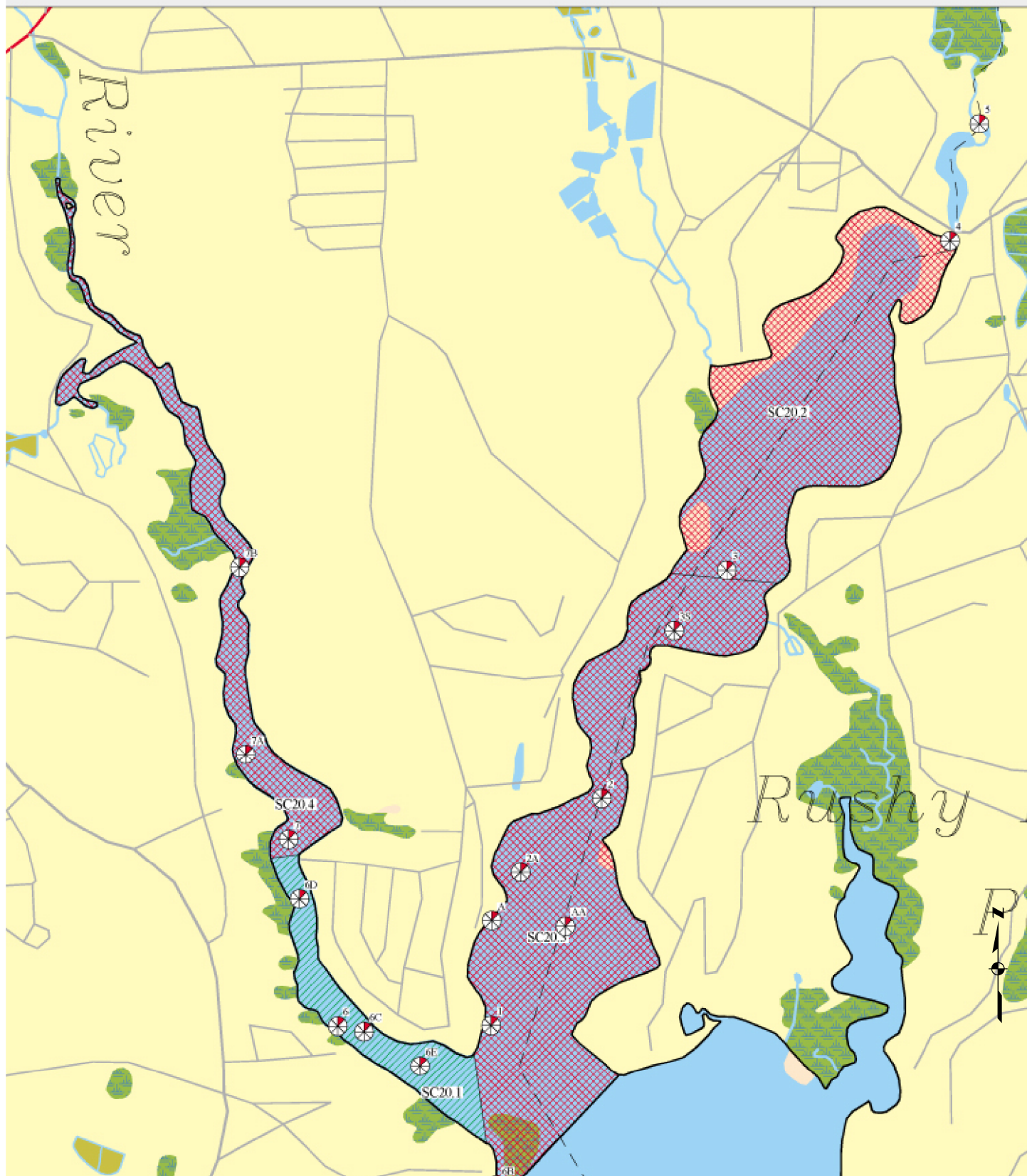
SCALE 1 inch : 3045 feet

GROWING AREA CODE: SC20

AREA NAME: MASHPEE RIVER & SHOESTRING BAY

AREA TOWN(S): BARNSTABLE/MASHPEE

proposed change is not to be used as a basis for legal boundary definition or regulatory interpretation.



*Note: See Figure 54-B for Legend

Data Source: Mass GIS
File Location: J:\GIS\GIS Project Folder\Job#\n00074 Mashpee\2006 WWFP\Report Figures\00074F05-4c.mxd



Stearns & Wheler, LLC
Environmental Engineers and Scientists

HYANNIS, MASSACHUSETTS

phone: (508) 362-6800
web: www.stearnswheler.com

Date: 04/2007 Project No. 00074

TOWN OF MASHPEE, MASSACHUSETTS

Watershed Nitrogen Management Plan

Shellfish Growing Map

Area SC20

FIGURE 5-4C